Montara Operations Environment Plan

MV-90-PLN-I-00001

Rev 10

Facility:	**MV - Montara Venture**
Review Interval:	**12 Months**
Safety Critical:	**Yes**

Approval:				
Rev:	**Date:**	**Owner:**	**Reviewer:**	**Approver:**
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2	02-Apr-19	H. Astill	M. Craig	T. Hoang
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REVISION HISTORY

Revision	Date	Author / Editor	Amendment
0		GS/LM	Rev 0 ready for submission to NOPSEMA
1		MP/KY	Rev 1 in response to NOPSEMA Rev 0 comments ready for submission
2		MP/HA	Rev 2 in response to NOPSEMA Rev 1 assessment findings
3		MP/HA	Minor update for continuous improvement opportunity under the document control procedure. Clarification on inline measurement, supporting lab activities and relationship to EP commitments in PW. No MOC required.
4		MP/HA	Minor update for continuous improvement opportunity under the document control procedure. Clarification on inline measurement, supporting lab activities and relationship to EP commitments in PW. No MOC required.
5		MP	Minor editorial update in response to NOPSEMA Inspection recommendation 2110-4, Section 7.6.3
6		MP	Updates in accordance with Montara EP Annual Review and MOC 152 and NOPSEMA inspection recommendations 2110-7, 2110-8 and 2110-9
7		MP	Updates in accordance with MOC 2020-179A (EPS 25 and EPS 26 added)
8		MP	Updates in accordance with MOC 2021-064 (EPS 20 added)
9		LM	Updates in accordance with 2021 Montara EP Annual Review, MOC-835
10		LM/JVR	Updates in response to NOPSEMA inspection recommendations 2380-C1-R1 and R2 regarding the impact of birds on the facility and proposed management and monitoring measures and produced water monitoring results updates. Updates in response to NOPSEMA inspection conclusions 3591-C01 and 3591-C02 regarding Jadestone's plans for decommissioning obligations and management of GHG emissions. Inclusion of Montara-1,2,3 wellhead monitoring following withdrawal of Montara-1,2,3 Wellhead Abandonment Environment Plan (TM-70-PLN-I-00003) from NOPSEMA assessment.

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Acronyms and Abbreviations

Abbreviation	Description
AFFF	Aqueous Film Forming Foam
AFZ	Australian Fishing Zone
AHV	Anchor handling vehicle
ALARP	as low as reasonably practicable
AMP	Australian Marine Parks
AMSA	Australian Maritime Safety Authority
AQIS	Australian Quarantine and Inspection Service
API	American Petroleum Institute
APPEA	Australian Petroleum Production and Exploration Association
AUV	Autonomous underwater vehicle
BCF	Bioconcentration factor
BIA	Biologically important areas
BOD	Biological oxygen demand
BOP	Blowout preventer
Bq/g	Becquerel per gram
CAA	Civil aviation authority
CCR	Central control room
CCTV	Closed circuit television
CGFU	Compact gas floatation unit
CHARM	Chemical Hazard and Risk Management
CMMS	Computerised Maintenance Management System
COW	Crude oil washing
CP	Cathodic prevention
CPI	Corrugated plate interceptor
DA	Designated Authority
DAH	Dissolved aromatic hydrocarbons
DAWE	Department for Agriculture, Water and Environment (previously DoEE)
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water (previously DAWE)
DEC	Department of Environment and Conservation (now DBCA)
DEWHA	Department of the Environment, Water, Heritage and the Arts (now DCCEEW)
DIIS	Department of Industry, Innovation and Science
DMIRS	Department of Mines, Industry Regulation and Safety (previously Department of Mines and Petroleum, DMP)
DoF	Department of Fisheries (now DPIRD)

Abbreviation	Description
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)
DSD	Department of Sustainable Development
DSMS	Diving safety management system
DSV	Diving support vessel
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (now DAWE)
dwt	Dry weight tonnes
EEZ	Economic Exclusion Zone
EH&S	Environmental Health & Safety
EMBA	Environment that may be affected
ENVID	Environmental hazard identification (process)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EP	Environment Plan
EPA	Environmental Protection Authority
EP Act	Environmental Protection Act 1986
EPO	Environmental performance outcome
EPS	Environmental performance standard
ESD	Emergency Shut-Down system
ESP	Electric Submersible Pump
FPSO	Floating production storage and offtake (facility)
FRC	Fast response craft
GFU	Gas floatation unit
HLO	Helicopter landing officer
HP	High pressure
HPU	Hydraulic power unit
H2S	Hydrogen sulphide
HSE	Health safety and environment
HWU	Hydraulic Workover Unit
HVAC	Heating ventilation air conditioning (system)
ICAO	International civil aviation organisation
ICCS	Interface central control system
ICD	Inflow control devices
IMCRA	Integrated marine and coastal regionalisation of Australia

Abbreviation	Description
IMO	International Maritime Organisation
IMPS	Introduced marine pest species
IMS	Invasive Marine Species
IMR	Integrity, maintenance and repair
ITF	Indonesian Throughflow (current)
IWC	International Whaling Commission
JEE	Jadestone (Eagle) Energy Pty Ltd
KEFs	Key Ecological Features
Kl	Kilolitre
KO	Knock out (drum)
Ksm^3	Thousand Standard Cubic Metres
LC50	Lethal concentration of a compound at which 50% of test species dies within a specified time frame
LAT	Lowest astronomical tide
LMS	Listed migratory species
LP	Low pressure
LSA	Low specific activity
LWI	Light well intervention
MAOP	Maximum Allowable Operating Pressure
MARPOL	Marine pollution (legislation)
MCR	Marine Conservation Reserve
MEG	Methylene glycol
mg/L	Milligrams per litre
MGPS	Marine growth protection system
MMA	Marine Management Area
mmscfd	Million Standard Cubic Feet per Day
MOPU	Mobile offshore production unit
MPRA	Marine Parks Reserves Authority
MSDS	Material safety data sheet
NCB	North Coast Bioregion
NDT	Non-Destructive Testing
NEBA	Net Environmental Benefit Assessment
NES	National Environmental Significance
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NORMs	Naturally Occurring Radioactive Materials

Abbreviation	Description
NSF	Northern Shark Fishery
NWS	North-West Shelf
NWSTF	North-West Slope Trawl Fishery
OCIMF	Oil Companies International Marine Forum
OCNS	Offshore Chemical Notification Scheme
ODS	Ozone Depleting Substances
OGP	Oil and gas producers (association)
OIM	Offshore Installation Manager
OIW	Oil-in-water
OPEP	Oil pollution emergency plan
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006
OPGGS (E) Regs	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OPMF	Onslow Prawn Managed Fishery
OSCP	Oil Spill Contingency Plan
OSMP	Operational and scientific monitoring plan
PAH	Polycyclic aromatic hydrocarbons
PLET	Pipeline end terminal
PLONOR	Pose little or no risk
POB	Persons on board
PPD	Personal protection device
ppm	parts per million
PRS	Production Reporting System
PSZ	Petroleum safety zone
PTS	Permanent Threshold Shift
PW	Produced water
RLWI	Riserless light well intervention
ROV	Remote Operated Vehicle
SBFTF	Southern Bluefin Tuna Fishery
SCM	Subsea control module
SCSSV	Surface controlled subsurface safety valve
SDS	Safety data sheet
SDU	Subsea distribution unit
SIL	Safety integrity level
SIMPOPs	Simultaneous operations
SMP	Scientific monitoring program

Abbreviation	Description
SO2	Sulphur dioxide
SRB	Sulphur Reducing Bacteria
SSS	Side-Scan sonar
SSWI	Ship Specific Work Instructions
STP	Sewage Treatment Plant
STP	Submerged turret production system
SWL	Safe Working Load
TEMPSC	Totally enclosed motor propelled survival craft
TPH	Total petroleum hydrocarbons
TRSV	Tubing retrievable safety valve
TTS	Temporary Threshold Shift
UPS	Universal power supply
UV	Ultraviolet
UWILD	In water survey in lieu of docking
VBSA	Vessel based support activity
VDU	Vacuum distillation unit
VOC	Volatile organic compounds
WA	Western Australia
WAF	Water accommodated fraction
WHCP	Wellhead hydraulic control panel
WHP	Wellhead platform
WSTF	Western Skipjack Tuna Fishery
WTBF	Western Tuna and Billfish Fishery
WOMP	Well Operations Management Plan

1. OVERVIEW OF THE ACTIVITY

1.1 Location

The Montara operations activity is in the production licenses AC/L7 (Montara field) and AC/L8 (Skua, Swift and Swallow fields) in the Timor Sea.

The activity is approximately 690 km east of Darwin in a water depth of approximately 80 m and produces oil from the Montara, Skua, Swift and Swallow fields (**Figure 1-1**).

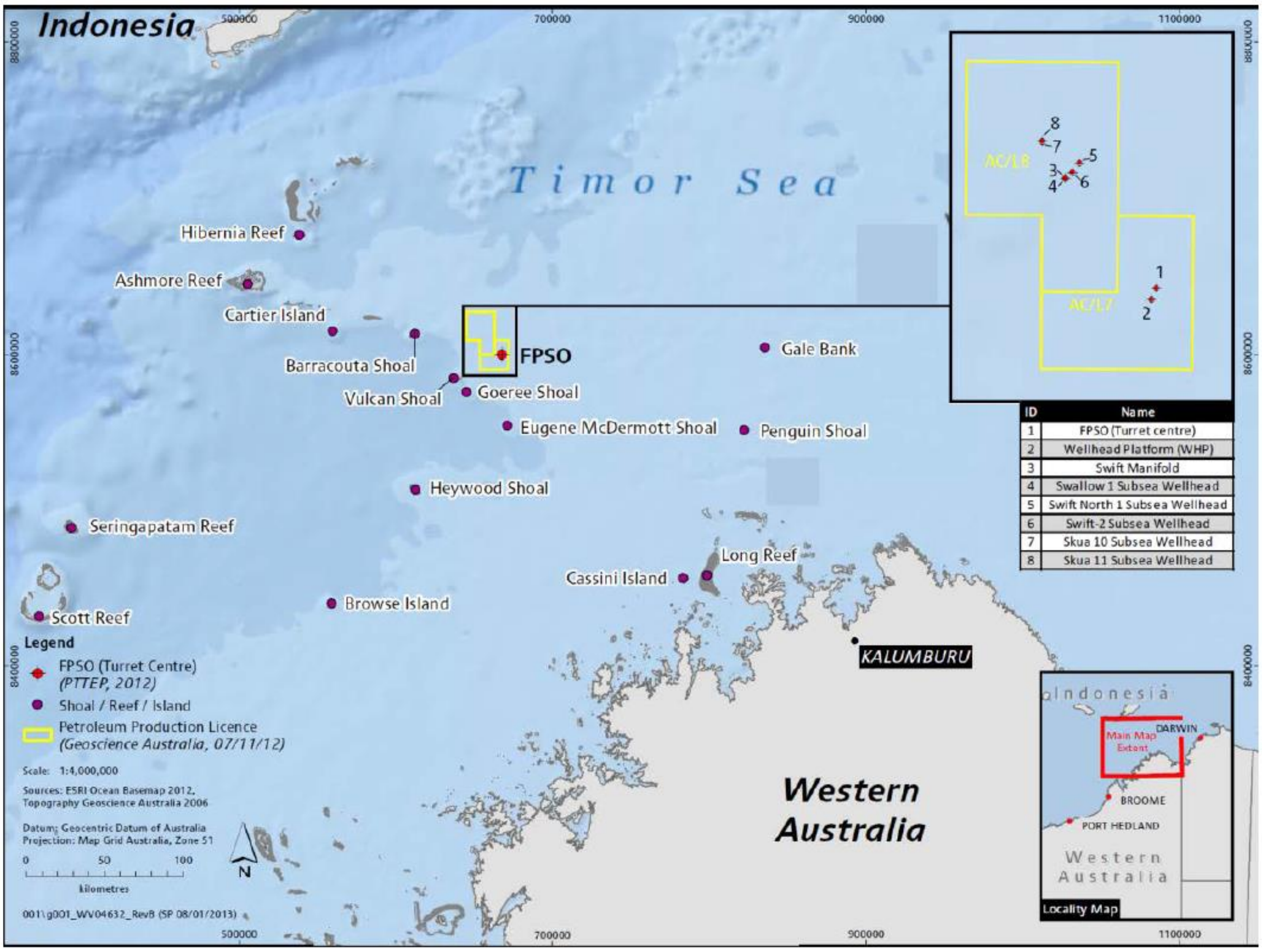

Figure 1-1: Location of the Montara operations activity

The locations of key environmental sensitive receptors in closest proximity to the *Montara Venture* floating production storage and offtake (FPSO) facility are provided in **Table 1-1**.

Table 1-1: Locations of key sensitive receptors in relation to the Montara Venture FPSO

Sensitive receptor	Approx. distance from FPSO (km)
Goeree Shoal	33
Vulcan Shoal	34
Eugene McDermott Shoal	46
Barracouta Shoal	57
Cartier Island	109
Hibernia Reef	150
Ashmore Reef	168
Cassini Island	185
Browse Island	193
Long Reef	193
Mainland Australia	208
Rote Island (Indonesia)	251
West Timor	265
Seringapatam Reef	296
Sandy Islet	337
Scott Reef	340
East Timor	356
Savu Island (Indonesia)	365
Flores Island (Indonesia)	486
Sumba Island (Indonesia)	495

1.2 Structure and Layout

The Montara operations infrastructure includes:

- An unmanned well head platform (WHP) at the Montara field with five ‘dry’ wells, three 14-inch production risers, two 6-inch gas lift risers and one 12-inch J-tube;
- Five subsea wells for development of the Skua, Swift and Swallow fields;
- Production flowline system consisting of two 6 inch, one 10 inch and three 14-inch flowlines and associated tie-in spools;
- Gas lift flowline system consisting of one 6 inch and three 4-inch flowlines and associated tie-in spools;
- Three infield control umbilicals and associated flying leads;
- A subsea manifold in the Swift field for comingling the production fluids and distributing the compressed gas and electro-hydraulic services to the subsea wells;
- A floating production, storage and offtake (FPSO) facility and its associated mooring system located approximately 1.5 km northeast of the WHP. Two 10-inch flexible production risers

and associated riser bases. One 6-inch flexible gas lift riser and associated riser base. Two control umbilicals and associated riser bases. One gas compressor for the gas lift system;

- Support/ supply vessels, work vessels and tug boats supporting third-party offtake tanker movement, facility logistics, maintenance and provisioning; and
- Helicopter support.

The locations of the field infrastructure as listed are provided in **Table 1-2** below and illustrated in **Figure 1-2**.

Table 1-2: Montara Operations Activity Infrastructure Coordinates (GDA 94, Zone 51)

Wells and infrastructure	Latitude (south)	Longitude (east)
Montara Venture FPSO (turret centre)	12° 39’ 35.3”	124° 32’ 41.1”
Wellhead platform	12° 40’ 20.5”	124° 32’ 22.2”
Swallow 1 subsea well	12° 32’ 29.5”	124° 26’ 36.8”
Swift north 1 subsea well	12° 31’ 29.9”	124° 27’ 33.7”
Swift 2 subsea well	12° 32’ 3.6”	124° 27’ 6.0”
Skua 10 subsea well	12° 30’ 4.6”	124° 25’ 5.4”
Skua 11 subsea well	12° 30’ 4.6”	124° 25’ 5.6”
Montara H5 well	12° 40’ 20.5”	124° 32’ 23.3”
Montara H6	12° 40’ 20.5”	124° 32’ 22.2”
Montara H4 well	12° 40’ 20.5”	124° 32’ 22.3”
Montara H3 ST-1 well	12° 40’ 20.5”	124° 32’ 22.2”
Montara H2 well	12° 40’ 20.5”	124° 32’ 22.2”
Montara G2 well	12° 40’ 20.5”	124° 32’ 22.3”

1.3 Cautionary and Safety Zones

Petroleum Safety Zones (PSZ) extend 500 m around the following Montara infrastructure:

- FPSO submerged turret production;
- Well head platform;
- Swallow 1 subsea wellhead and Swift manifold (combined);
- Swift North 1 subsea wellhead;
- Swift 2 subsea wellheads; and
- Skua 10 and Skua 11 subsea wellhead (combined).

Pursuant to Section 616 of the OPGGSA all vessels, other than those under the control of Jadestone or authorised by Jadestone, are prohibited from entering or being present in the area of the PSZ.

A cautionary zone of 2.5 NM radius is maintained around the WHP, FPSO and subsea structures including the pipelines. This information has been notated on Admiralty Charts covering the region (#314), and although vessels are requested to avoid navigating, anchoring and fishing, it is not an exclusion zone.

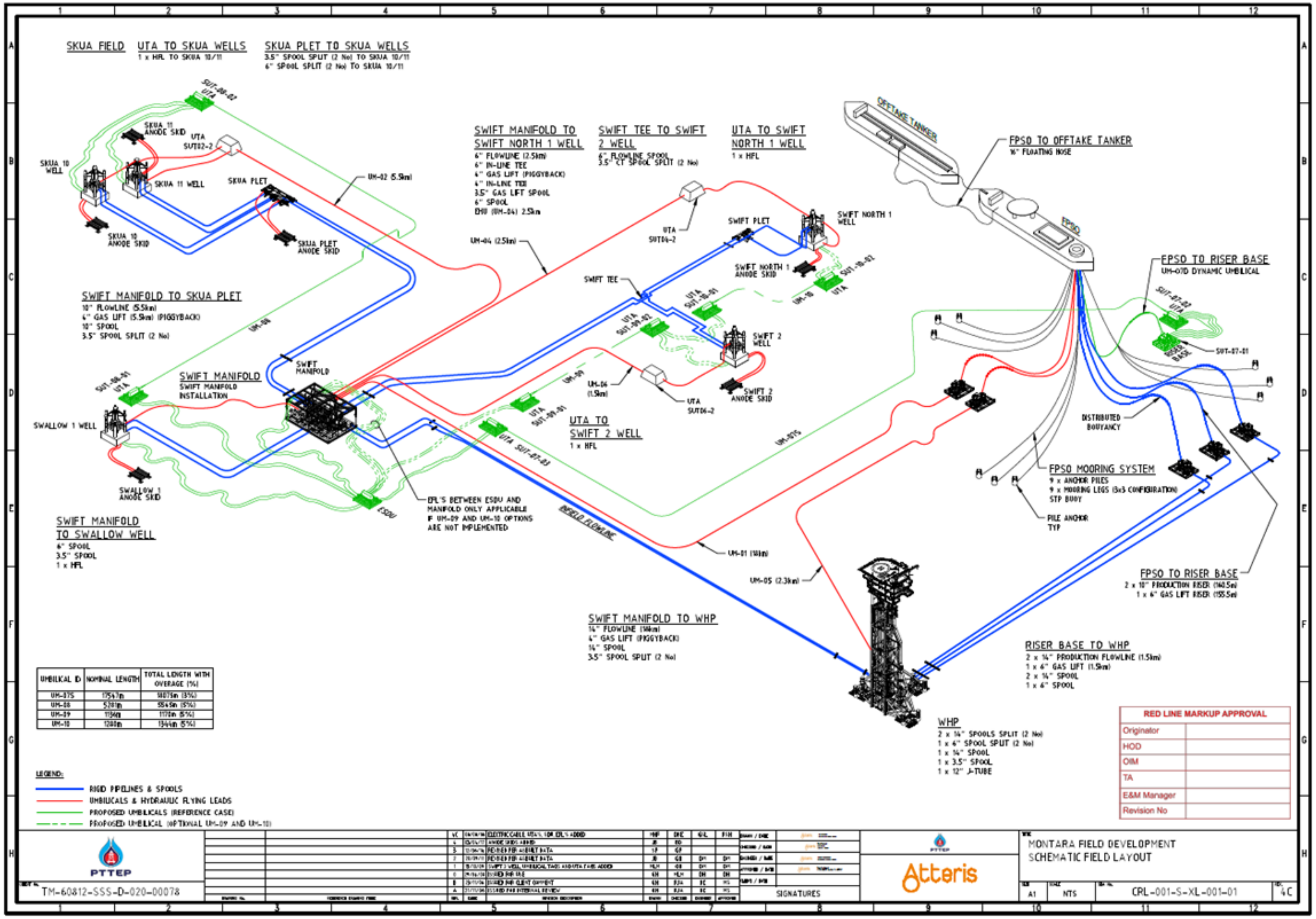

Figure 1-2: Schematic of the Montara operations field layout

1.4 Operator and Titleholder Details

Jadestone Energy (Eagle) Pty Ltd (Jadestone) is the titleholder and operator of the Montara Operations in Production Licenses AC/L7 (Montara Field) and AC/L8 (Skua, Swift and Swallow Fields) in the Timor Sea.

The title and operatorship of the Montara Operations was transferred to Jadestone from the previous operator on 6 August 2019. Prior to 6 August 2019, PTTEP Australasia (Ashmore Cartier) Pty Ltd was the titleholder and operator of the Montara Operations.

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

Jadestone Energy has an experienced management team that prides itself on technical excellence. This robust technical core to the business underpins Jadestone's ability to:

- Operate safely;
- Optimise production from existing assets; and
- Identify, capture and maximise the value of its portfolio of assets.

The company recognises that local presence is essential to create, build and maintain partnerships in the region. To this end, Jadestone Energy established its corporate headquarters in Singapore and principal technical teams in Kuala Lumpur and Perth, with country operational offices in Jakarta and Ho Chi Minh City.

Jadestone Energy 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:

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ACN 613 671 819

Jadestone's contact for the Montara facility is:

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In the event contact details for Jadestone or the liaison contact change within the timeframe of this EP, NOPSEMA will be advised of the updated details.

2. OVERVIEW OF THE ENVIRONMENT PLAN

2.1 Objective

This Environment Plan (EP) has been prepared in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Environment Regulations) under the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act) and as administered by NOPSEMA. **Table 2-1** provides EP section references against the requirements of the OPGGS (E) Regulations.

The objectives of this EP are to ensure that:

- All activities associated with the Montara operations activity are planned and conducted in accordance with Jadestone's Health, Safety and Environmental (HSE) Management Policy (Figure 2-2);
- Potential adverse environmental impacts and risks associated with the proposed activities, during both routine and non-routine operations, are continuously 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 operation of the Montara operations activity. The assessment aims to systematically identify and assess the potential environmental impacts associated with the operational 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 with the required level of assurance that the activities are being managed in an environmentally responsible manner.

This EP meets the requirement to submit a revision of the Montara Operations Environment Plan (MV-HSE-D30-811607) when a new or increased environmental impact or risk is identified (as required by regulation 17(6) of the OPGGS(E) Regulations). The significant change is in relation to an increase in the presence of roosting and nesting birds on the facility. Other minor changes have also been included in this revision relating to decommissioning obligations, greenhouse gas emissions and produced water monitoring results.

This EP is written to allow for the continuation of production at the Montara Facility from the date of its acceptance by NOPSEMA until the five year anniversary of its initial acceptance (unless otherwise agreed with NOPSEMA). NOPSEMA's Guidance Note for Environment Plan Content Requirements (GN1344; September 2020) was referred to in the preparation of this EP.

Table 2-1: Requirements of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009

Reg	Requirement	Section
	Environmental assessment	
13(1)	*Description of the activity* The environment plan must contain a comprehensive description of the activity including the following: a) the location or locations of the activity; b) general details of the construction and layout of any facility; c) an outline of the operational details of the activity (for example, seismic surveys, exploration drilling or production) and proposed timetables;	**3**

Reg	Requirement	Section
	d) any additional information relevant to consideration of environmental impacts and risks of the activity.	
13(2)	*Description of the environment* The environment plan must: 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.	**5**
13(3)	Without limiting paragraph (2)(b), particular relevant values and sensitivities may include any of the following: a) the world heritage values of a declared World Heritage property within the meaning of the EPBC Act; b) the national heritage values of a National Heritage place within the meaning of that Act; c) the ecological character of a declared Ramsar wetland within the meaning of that Act; d) the presence of a listed threatened species or listed threatened ecological community within the meaning of that Act; e) the presence of a listed migratory species within the meaning of that Act; f) any values and sensitivities that exist in, or in relation to, part or all of: (i) a Commonwealth marine area within the meaning of that Act; or (ii) Commonwealth land within the meaning of that Act.	**5**
13(4)	*Requirements* The environment plan must: a) describe the requirements, including legislative requirements, that apply to the activity and are relevant to the environmental management of the activity; and b) demonstrate how those requirements will be met.	**7, 8**
13(5)	*Evaluation of environmental impacts and risks* The environment plan must include: a) details of the environmental impacts and risks for the activity; and b) an evaluation of all impacts and risks, appropriate to the nature and scale of each impact or risk; and c) details of the control measures that will be used to reduce the impacts and risks of the activity to as low as reasonably practicable and an acceptable level.	**2, 7, 8**
13(6)	To avoid doubt, the evaluation mentioned in paragraph (5)(b) must evaluate all the environmental impacts and risks arising directly and indirectly from: a) all operations of the activity; and b) potential emergency conditions, whether resulting from accident or any other reason.	**4, 7, 8**
13(7)	Environmental performance outcomes and standards The environment plan must: a) set environmental performance standards for the control measures identified under paragraph (5)(c); and b) set out the environmental performance outcomes against which the performance of the titleholder in protecting the environment is to be measured; and c) include measurement criteria that the titleholder will use to determine whether each environmental performance outcome and environmental performance standard is being met.	**7, 8**

Reg	Requirement	Section
	Implementation strategy for the environment plan	
14(1)	The environment plan must contain an implementation strategy for the activity in accordance with this regulation.	**9**
14(2)	The implementation strategy must: a) state when the titleholder will report to the Regulator in relation to the titleholder's environmental performance for the activity; and b) provide that the interval between reports will not be more than 1 year.	**9**
14(3)	The implementation strategy must contain a description of the environmental management system for the activity, including specific measures to be used to ensure that, for the duration of the activity: a) the environmental impacts and risks of the activity continue to be identified and reduced to a level that is as low as reasonably practicable; and b) control measures detailed in the environment plan are effective in reducing the environmental impacts and risks of the activity to as low as reasonably practicable and an acceptable level; and c) environmental performance outcomes and standards set out in the environment plan are being met.	**9**
14(4)	The implementation strategy must establish a clear chain of command, setting out the roles and responsibilities of personnel in relation to the implementation, management and review of the environment plan, including during emergencies or potential emergencies.	**9**
14(5)	The implementation strategy must include measures to ensure that each employee or contractor working on, or in connection with, the activity is aware of his or her responsibilities in relation to the environment plan, including during emergencies or potential emergencies, and has the appropriate competencies and training.	**9**
14(6)	The implementation strategy must provide for sufficient monitoring, recording, audit, management of non-conformance and review of the titleholder's environmental performance and the implementation strategy to ensure that the environmental performance outcomes and standards in the environment plan are being met.	**9**
14(7)	The implementation strategy must provide sufficient monitoring of, and maintaining a quantitative record of, emissions and discharges (whether occurring during normal operations or otherwise), such that the record can be used to assess whether the environmental performance outcomes and standards in the environment plan are being met.	**9**
14(8)	The implementation strategy must contain an oil pollution emergency plan and provide for the updating of the plan.	**OPEP**
14(8AA)	The oil pollution emergency plan must include adequate arrangements for responding to and monitoring oil pollution, including the following: a) the control measures necessary for timely response to an emergency that results or may result in oil pollution; b) the arrangements and capability that will be in place, for the duration of the activity, to ensure timely implementation of the control measures, including arrangements for ongoing maintenance of response capability; c) the arrangements and capability that will be in place for monitoring the effectiveness of the control measures and ensuring that the environmental performance standards for the control measures are met; d) the arrangements and capability in place for monitoring oil pollution to inform response activities.	**OPEP**

Reg	Requirement	Section
14(8A)	The implementation strategy must include arrangements for testing the response arrangements in the oil pollution emergency plan that are appropriate to the response arrangements and to the nature and scale of the risk of oil pollution for the activity.	**OPEP**
14(8B)	The arrangements for testing the response arrangements must include: a) a statement of the objectives of testing; and b) a proposed schedule of tests; and c) mechanisms to examine the effectiveness of response arrangements against the objectives of testing; and d) mechanisms to address recommendations arising from tests.	**OPEP**
14(8C)	The proposed schedule of tests must provide for the following: a) testing the response arrangements when they are introduced; b) testing the response arrangements when they are significantly amended; c) testing the response arrangements not later than 12 months after the most recent test; d) if a new location for the activity is added to the environment plan after the response arrangements have been tested, and before the next test is conducted – testing the response arrangements in relation to the new location as soon as practicable after it is added to the plan; e) if a facility becomes operational after the response arrangements have been tested and before the next test is conducted – testing the response arrangements in relation to the facility when it becomes operational.	**OPEP**
14(8D)	The implementation strategy must provide for monitoring of impacts to the environment from oil pollution and response activities that: a) is appropriate to the nature and scale of the risk of environmental impacts for the activity; and b) is sufficient to inform any remediation activities.	**OPEP**
14(8E)	The implementation strategy must include information demonstrating that the response arrangements in the oil pollution emergency plan are consistent with the national system for oil pollution preparedness and response.	**OPEP**
14(9)	The implementation strategy must provide for appropriate consultation with: a) relevant authorities of the Commonwealth, a State or Territory; and b) other relevant interested persons or organisations.	**6**
14(10)	The implementation strategy must comply with the Act, the regulations and any other environmental legislation applying to the activity.	**9**
	Details of titleholder and liaison person	
15(1)	The environment plan must include the following details for the titleholder: a) name; b) business address; c) telephone number (if any); d) fax number (if any); e) email address (if any); f) if the titleholder is a body corporate that has an ACN (within the meaning of the Corporations Act – 2001) – ACN.	**1.4**
15(2)	The environment plan must also include the following details for the titleholder's nominated liaison person:	**1.4**

Reg	Requirement	Section
	a) name; b) business address; c) telephone number (if any); d) fax number (if any); e) email address (if any).	
15(3)	The environment plan must include arrangements for notifying the Regulator of a change in the titleholder, a change in the titleholder's nominated liaison person or a change in the contact details for either the titleholder or the liaison person.	**1.4**
	Other information in the environment plan	
16	The environment plan must contain the following: a) a statement of the titleholder's corporate environmental policy;	**2**
	b) a report on all consultations between the titleholder and any relevant person, for regulation 11A, that contains: (i) a summary of each response made by a relevant person; and (ii) an assessment of the merits of any objection or claim about the adverse impact of each activity to which the environment plan relates; and (iii) a statement of the titleholder's response, or proposed response, if any, to each objection or claim; and (iv) a copy of the full text of any response by a relevant person;	**6**
	c) details of all reportable incidents in relation to the proposed activity.	**9**

2.2 Scope

The scope of this EP covers the following activities associated with the Montara operations activity:

- Routine production;
- Routine inspection, maintenance and repair (IMR) of the FSPO and WHP, wells and associated subsea infrastructure (including use of remotely operated vehicle (ROV) and diving activities);
- Support services including vessel and helicopter support; and
- Non-routine and unplanned activities and incidents associated with the above.

The infrastructure covered by this EP includes the following as located within the defined Operational Area:

- Montara Venture FPSO and associated mooring system;
- Unmanned wellhead platform;
- Subsea infrastructure (including wells, manifold, gas compressor, spools, risers, flowlines, umbilicals and associated flying leads etc.);
- Support/ supply vessels assisting with activities defined above within the defined Operational Area; and
- Helicopter activity within the Operational Area.

This EP applies to activities undertaken within the Operational Area only as defined in the description of the activity (**Section 2.3**).

Activities that are not covered in this EP include nearby shipping activity, third-party offtake tankers, drilling or intervention activities undertaken by a mobile offshore drilling unit (MODU), or decommissioning. Vessels associated with the Montara operations activity when outside the Operational Area adhere to all applicable maritime regulations, and Commonwealth and State environmental management obligations.

Activities proposed within the Operational Area outside the scope of this EP will be the subject of a separate EP or a revision of this EP.

2.3 Operational Area

The Operational Area is defined as a 2 km boundary around all topsides and subsea infrastructure within production licenses AC/L7 and AC/L8 (refer **Figure 2-1**).

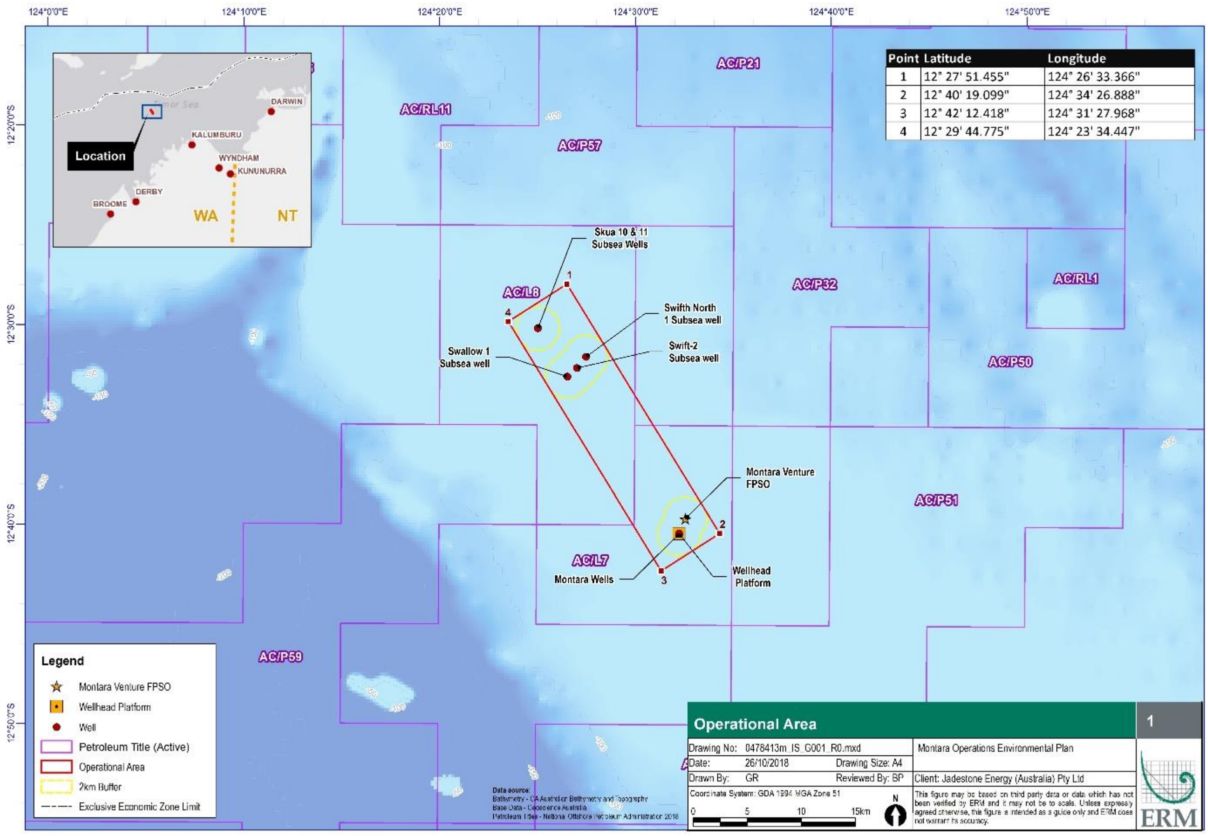


Figure 2-1: Operational area for the Montara operations activity

2.4 HSE Policy

Protecting the environment, valuing cultural heritage and maintaining open stakeholder communication are an integral part of Jadestone's business approach. This is reflected in Jadestone's HSE Policy (**Figure 2-2**) and this EP.

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 2-2: Jadestone Energy (Australia) Pty Ltd HSE Policy (April 2020)

2.5 Legislative Framework

2.5.1 International and Commonwealth Legislation

Australia is signatory to numerous international conventions and agreements that obligate the Commonwealth government to prevent pollution and protect specified habitats, flora and fauna. All activities conducted during the operation of the Montara operations activity will comply with legislative requirements established under international, Commonwealth and state legislation, and in line with applicable best practice guidelines and management procedures. Those which are relevant to the Montara operations activity are detailed in **Table 2.2** and **Table 2-3** below.

2.5.2 EPBC Act Montara Approvals Conditions

The Montara operations activity was granted EPBC Act approval in 2003 by the Commonwealth Environment Minister through the then Department of Environment and Heritage (DEH) subject to certain conditions (EPBC 2002/755) which were varied in December 2012 by the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities (DSEWPaC), now Department of Climate Change, Energy, the Environment and Water (DCCEEW).

More recently, a number of the approval conditions were redacted resulting in a consolidated approval notice that contains a number of conditions relating to the Montara operations activities. A list of the conditions relevant to the operations activities is provided in Table 2-4 while a copy of the consolidated approval notice is provided in Appendix A.

Table 2-2: Summary of Applicable Legislation

Legislation	Description of the legislation	Legislative requirement relevant to environmental management of the activity	Demonstration of how requirements are met
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	This Act came into force in July 2000 replacing five existing Commonwealth Acts (*Environmental Protection (Impact of Proposals) Act 1974*, *World Heritage Properties Conservation Act 1983*, *National Parks and Wildlife Conservation Act 1975*, *Whale Protection Act 1980*; and *Endangered Species Protection Act 1992*). The *Environment Protection and Biodiversity Conservation Act (EPBC)* provides for the protection of the environment, especially those aspects of the environment that are matters of National Environmental Significance (NES); and promotes ecologically sustainable development through the conservation and ecologically sustainable use of natural resources. Under this legislation all activities that will, or have the potential to, affect matters of NES are prohibited except; when undertaken in accordance with approval by the Minister for Environment, or when approved through a Bilateral Agreement with a State or Territory, or when approved through a process accredited by the Minister. Matters of “National Environmental Significance” are: • World Heritage Properties; • National Heritage Places; • Wetlands of International Importance; • Listed Threatened Species and Communities; • Listed Migratory Species;	Since February 2014, NOPSEMA’s environmental management authorisation process has been endorsed by the Federal Minister for the Environment as a Program (the Program) that meets the requirements of Part 10, Section 146, of the *EPBC Act*. Under the Program, the Minister for the Environment has approved a class of actions which, if undertaken in accordance with the endorsed Program, will not require referral, assessment and approval under the *EPBC Act*. Petroleum and greenhouse gas activities undertaken in Commonwealth waters in accordance with the Program are considered to be “approved classes of action”. The Program has objectives, which include ensuring activities undertaken in the offshore area are conducted in a manner consistent with the principles of ecologically sustainable development and will not result in unacceptable impacts to matters of national environmental significance (protected matters) recognised under Part 3 of the *EPBC Act*. Part 8 of the EPBC Regulations 2000 outlines requirements for vessel when interacting with cetaceans. Part 9, 10 and 13 outlines requirements for bird management. Consultation with the department has confirmed that there is no requirement for a Part 13 permit under the EPBC Act for bird management, if an accepted EP is in place.	This EP considers the impacts to protected matters (summarised in Section **5.2, 5.3 and 5.4**). This has included making specific reference in Section 5 to the values of matters protected under Part 3 of the EPBC Act (including protected matters) using references and relevant guidance documents, such as EPBC Act significance guidance documents, relevant policy statements, plans of management established by government, recovery plans and on-line databases (**Table 5-3**). Section **4** of the EP describes the risk assessment undertaken and requires the consideration of the principles of ESD, conservation and management advice and the environmental context (amongst other elements) in determining whether the proposed activities are acceptable. Control measures reflecting the requirements of Part 8 of the EPBC Regulations have been implemented to manage potential interactions with cetaceans. These are provided in: **Section 7.2** Noise Emissions.

Legislation	Description of the legislation	Legislative requirement relevant to environmental management of the activity	Demonstration of how requirements are met
	• Nuclear Actions; • Commonwealth Marine Areas; and • Great Barrier Reef Marine Park.		**Section 7.7** Physical Presence of the EP describes bird management measures. **Section 7.9** Spill response Activities. **Section 8.3** Interaction with Fauna.
North and North West Marine Networks Management Plan for Australian Marine Park (AMP)	In recognition of the importance of the marine environment, it is listed as a matter of national environmental significance under the *EPBC Act*. Under the Act, the Director is responsible for managing marine parks (supported by Parks Australia), and is required to make management plans for marine parks. The objectives of the North and North-west Marine Parks Management Plans 2018 for the AMPs are to provide for: a) the protection and conservation of biodiversity and other natural, cultural and heritage values of marine parks in the North-west Network; and b) ecologically sustainable use and enjoyment of the natural resources within marine parks in the Northwest Network, where this is consistent with objective (a). The values are broadly defined as: • Natural values — habitats, species and ecological communities within marine parks, and the processes that support their connectivity, productivity and function; • Cultural values — living and cultural heritage recognising Indigenous beliefs, practices and	In recognition of the importance of the marine environment, it is listed as a matter of national environmental significance under the EPBC Act. Under the Act, the Director is responsible for managing marine parks (supported by Parks Australia), and is required to make management plans for marine parks. Other parts of the Australian Government must not perform functions or exercise powers in relation to these parks that are inconsistent with management plans. A number of zones (IUCN zones) are implemented in each AMP to ensure appropriate use and conservation of each AMP's relevant values and protected matters. Noting 'Emergency response' is permitted in all AMPs and state marine parks, Section 4.2.9 of the management plan states: *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 without an authorisation issued by the Director, provided that the actions are taken in accordance with an environment plan that has been accepted* *by NOPSEMA, and the Director is notified in the event of oil pollution within a marine park, or where an oil spill response action must be taken within a marine*	The Rules and requirements for the IUCN Zones are described in **Section 5.3 and Table 5-5**. The values of each AMP are described in **Table 5-5 and 5-6** of the EP. The Operational area is outside of any AMP. However, impacts on habitat in marine parks can occur directly or indirectly during a hydrocarbon spill and response (including monitoring). This is assessed in **Section 7.9.2 and 8.7 and 8.8**. The Acceptability assessment also describes consultation with DG of AMPs and references the following text: Jadestone will have regard to the representative values of the reserves and other conservation advice published and endeavour 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 (**Section 5.4 and Table 5-5**)

Legislation	Description of the legislation	Legislative requirement relevant to environmental management of the activity	Demonstration of how requirements are met
	obligations for country, places of cultural significance and cultural heritage sites; • Heritage values — non-Indigenous heritage that has aesthetic, historic, scientific or social significance; and • Socio-economic values — the benefit of marine parks for people, businesses and the economy.	*park, so far as reasonably practicable, prior to response action being taken.* In the event of a spill, appropriate ongoing consultation arrangements are in place with the Director of National Parks in the event of a spill and prior to activities being conducted in an AMP.	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. **Section 6** (**Table 6-6**) Triggered Consultation includes the following commitment in the event of a loss of well control event. Notify AMP Director General of spill response activities within AMP (so far as reasonably practicable prior to response activities within a MP).
Commonwealth marine area	The Commonwealth marine area is any part of the sea, including the waters, seabed, and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not State or Northern Territory waters. Commonwealth marine areas are matters of national environmental significance under the *EPBC Act*. An action is likely to have a significant impact on the environment in a Commonwealth marine area if there is a real chance or possibility that the action will: • Result in a known or potential pest species becoming established in the Commonwealth marine area • Modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that	Refer EPBC Act above.	Control measures implemented to protect the commonwealth marine area are described throughout the EP in Sections **7** and **8**, and through the implementation of the EP as described in Section **9**.

Legislation	Description of the legislation	Legislative requirement relevant to environmental management of the activity	Demonstration of how requirements are met
	an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results • Have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution • Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity; social amenity or human health • Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected, or • Have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.		
Climate Change Act 2022	The Act sets out Australia's greenhouse gas emissions reduction targets. It outlines Australia's greenhouse gas emissions reduction targets of a 43% reduction from 2005 levels by 2030 and net zero by 2050; requires the minister to prepare and table an annual climate change statement; requires the Climate Change Authority to give the minister advice in relation to the annual statement and future greenhouse gas emissions reduction targets;	The Act itself does not impose obligations directly on companies, but its passage into law sets the scene for sector-based reforms to implement the 2030 target and emissions budget, which will impact businesses. The Safeguard Mechanism reforms, which will apply principally to the industrial and resources sectors, is one such measure.	Control measures implemented are provided in: **Section 7.3** Atmospheric Emissions.

Legislation	Description of the legislation	Legislative requirement relevant to environmental management of the activity	Demonstration of how requirements are met
	and provides for periodic reviews of the operation of the Act. The Act operates as 'umbrella' legislation to implement Australia's net-zero commitments and codifies Australia's net 2030 and 2050 GHG emissions reductions targets under the Paris Agreement.		
OPGGS Act and OPGGS (E) Regulations 2009	The OPGGSA 2006 (OPGGSA) came into effect 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 Climate change and Energy is advised by the Commonwealth DCCEEW). Under the OPGGS (E) Regulations an EP is required for proposals under Commonwealth jurisdiction, comprising a description of the environmental	The OPGGS (E) Regulations 2009 require that the petroleum activity is undertaken in an ecologically sustainable manner, and in accordance with an accepted EP.	Throughout this EP and through implementation of the HSE-MS. The principles of ESD are also considered in the acceptability of the potential impacts described in the EP. The EP has been prepared in accordance with these Regulations for acceptance by the designated authority (NOPSEMA). **Section 3** Description of the Activity. **Section 4** Evaluation of Environmental Impacts and Risks. **Section 7** and **Section 8** Assessment of Planned and Unplanned Events. **Section 9** Implementation Strategy.

Legislation	Description of the legislation	Legislative requirement relevant to environmental management of the activity	Demonstration of how requirements are met
	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.		
Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Section 571)	Under section 571(2) of the Offshore Petroleum and Greenhouse Gas Storage Act 2006, titleholders are required to have sufficient financial assurance to meet the costs, expenses and liabilities that may arise in connection with carrying out petroleum activities, particularly in the event of a major oil spill.	Requirement for titleholders to maintain sufficient financial assurance to meet the costs, expenses and liabilities that may arise in connection with carrying out petroleum activities among other things.	Confirmation of financial assurance is a requirement for acceptance of the EP and is submitted to NOPSEMA with the EP.
Navigation Act 2012	The primary legislation that regulates ship and seafarer safety, shipboard aspects of protection of the marine environment, and employment conditions for Australian seafarers.	The *Navigation Act 2012* includes specific requirements for safe navigation, including systems, equipment and practices consistent with the International Convention for the Safety of Life at Sea (SOLAS) and the International Regulations for Preventing Collisions at Sea (COLREGS), as implemented as maritime law in Australia through a series of Marine Orders, including *Marine Orders – Part 21 – Safety of navigation and emergency procedures* and *Marine Orders – Part 30 – Prevention of collisions*. The *Navigation Act 2012*, in conjunction with the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and through legislative Marine Orders, also requires vessels to have pollution prevention certificates (see below).	Control measures implemented to meet the requirements of this act are provided in: **Section 7.1** Light Emissions. **Section 7.7** Physical presence. **Section 8.6** to **8.8** Hydrocarbon Spills.

Legislation	Description of the legislation	Legislative requirement relevant to environmental management of the activity	Demonstration of how requirements are met
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (*POPS Act*)	The *POPS Act* provides for the prevention of pollution from vessels, including pollution by oil, noxious liquid substances, packaged harmful substances, sewage, garbage, and air pollution. In conjunction with Chapter 4 of the *Navigation Act 2012*, the *POPS Act* gives effect to relevant requirements of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL 73/78) in Australia.	The requirements of the *POPS Act* and the *Navigation Act 2012* are implemented as maritime law in Australia through a series of Marine Orders and legislative instruments, made and administered by the Australian Maritime Safety Authority (AMSA). The requirements of each Marine Order made under the *POPS Act* and the *Navigation Act 2012* and their relevance to the activity are outlined separately below.	Control measures implemented to prevent pollution from vessels are provided in: **Section 7.3** Atmospheric emissions. **Section 7.4** Liquid discharges. **Section 7.5** Chemical discharges. **Section 7.6** Produced water discharges. **Section 8.4** and **8.5** Unplanned releases. **Section 8.6** to **8.8** Hydrocarbon Spills.
Marine Orders Part 91 – Marine Pollution Prevention — Oil	Marine Orders Part 91 implements Part II of the *POPS Act*, Chapter 4 of the *Navigation Act 2012,* and Annex I of MARPOL 73/78 (oil pollution). The Marine Orders provide standards for the discharge of certain oily mixtures or oily residues and associated equipment and include duties to manage bunkering and transfers of oil between vessels; to maintain Oil Record Books and Shipboard Oil Pollution Emergency Plans (SOPEPs); and to report oil pollution.	Vessels ≥400 gross tonnes (GT) are required to maintain: - International Oil Pollution Prevention (IOPP) certificates to demonstrate that the vessel or facility and onboard equipment comply with the requirements of Annex I of MARPOL 73/78 (as applicable to vessel size, type and class); - Oil Record Books to record activities, such as fuel/oil bunkering and discharges of oil, oily water, mixtures and residues; and - SOPEPs outlining the procedures to be followed during an oil pollution incident. Discharges must also comply with Annex I of MARPOL 73/78, and oil pollution incidents must also be reported to AMSA. The requirements will apply to vessels (as appropriate to their size, type and class) at all times.	Control measures implemented are provided in: **Section 7.4** Liquid Discharges. **Section 8.6** to **8.8** Hydrocarbon Spills.

Legislation	Description of the legislation	Legislative requirement relevant to environmental management of the activity	Demonstration of how requirements are met
Marine Orders Part 93 – Marine pollution prevention — to noxious liquid substances; and Marine Orders Part 94 – Marine pollution prevention — packaged harmful substances	The requirements of Marine Orders Part 93 and Marine Orders Part 94 and the *POPS Act* relating to noxious liquid substances and packaged harmful substances do not apply to the activity on the basis that: the activity does not involve 'chemical tankers' or 'NLS tankers' that carry a cargo of noxious liquid substances in bulk, as defined by Annex II of MARPOL 73/78. Packaged harmful substances, as defined by Annex III of MARPOL 73/78, are not carried on board the FPSO or vessels.	N/A	Vessels are compliant with Marine Order 93 as detailed in: **Section 8.5** Unplanned release of (non-hydrocarbon) liquids.
Marine Orders Part 96 – Marine pollution prevention — sewage	Marine Orders Part 96 – Marine pollution prevention — sewage implements Part IIIB of the *POPS Act*, Chapter 4 of the *Navigation Act 2012,* and Annex IV of MARPOL 73/78 (sewage). The Marine Orders include requirements for the treatment, storage and discharge of sewage and associated sewage systems, and for an International Sewage Pollution Prevention (ISPP) certificate to be maintained on board.	Vessels ≥400 GT are required to maintain International Sewage Pollution Prevention (ISPP) certificates to demonstrate that vessels and their onboard sewage systems comply with the requirements of Annex IV of MARPOL 73/78. Discharges of sewage must also comply with Annex I of MARPOL 73/78, and oil pollution incidents must also be reported to AMSA. These requirements do not apply to the FPSO once attached to the seabed (as a petroleum facility) and are no longer "vessels engaged on an overseas voyage" as defined by the *POPS Act*.	Control measures implemented are provided in: **Section 7.4** Liquid discharges. **Section 7.9** Spill response activities.

Legislation	Description of the legislation	Legislative requirement relevant to environmental management of the activity	Demonstration of how requirements are met
Marine Orders Part 95 – Marine pollution prevention — garbage	Marine Orders Part 95 – Marine pollution prevention — garbage implements Part IIIC of the *POPS Act*, Chapter 4 of the *Navigation Act 2012,* and Annex V of MARPOL 73/78 (garbage). The Marine Orders provide for the discharge of certain types of garbage at sea, waste storage, waste incineration, and the comminution and discharge of food waste. They also set out requirements for garbage management and recording.	The FPSO and vessels ≥100 GT, or vessels certified to carry 15 persons or more, are required to maintain a Garbage Management Plan. The FPSO and vessels ≥400 GT are required to maintain a Garbage Record Book. The requirements will apply to the FPSO and vessels (as appropriate to their size, type and class) at all times.	Control measures implemented are provided in: **Section 7.4** Liquid discharges. **Section 8.4** Unplanned release of solid waste.
Marine Orders Part 97 – Marine pollution prevention — air pollution	Marine Orders Part 97 – Marine pollution prevention — air pollution implements Part IIID of the *POPS Act*, Chapter 4 of the *Navigation Act 2012,* and Annex VI of MARPOL 73/78 (air pollution). The Marine Orders set requirements for marine diesel engines and associated emissions, waste incineration on board vessels, engine fuel quality, and equipment and systems containing ozone-depleting substances (ODS).	The FPSO and vessels ≥400 GT are required to have International Air Pollution Prevention (IAPP) certificates and Engine International Air Pollution Prevention (EIAPP) certificates to demonstrate that the vessel or facility and onboard marine diesel engines comply with the requirements of Annex VI of MARPOL 73/78. Low-sulfur fuel oil / marine diesel with 3.5% mass-for-mass (m/m) sulfur content is also required to be used in engines before 1 January 2020 (and 0.5% m/m sulfur content on and after 1 January 2020). From 1 March 2020, vessels are prohibited from carrying fuel oil with a sulphur content of more than 0.50 per cent m/m, unless an exhaust gas cleaning system (EGCS) is fitted. In accordance with Annex VI of MARPOL 73/78, the requirements do not apply to the following: - emissions resulting from the incineration of substances that are solely and directly the result of the exploitation and offshore processing of seabed mineral resources (i.e. hydrocarbons), including but not limited	Control measures implemented are provided in: **Section 7.3** Atmospheric Emissions.

Legislation	Description of the legislation	Legislative requirement relevant to environmental management of the activity	Demonstration of how requirements are met
		to flaring during well completion and testing operations and flaring arising from upset conditions; - emissions associated solely and directly with the treatment, handling, or storage of seabed minerals (i.e. hydrocarbons); and - emissions from marine diesel engines that are solely dedicated to the exploration, exploitation and associated offshore processing of seabed mineral resources (i.e. hydrocarbons). Therefore, the requirements do not apply to emissions from the gas export compressor, gas turbine generators and associated backup diesel-powered generators (there is no legislative requirement for these generators to have EIAPP certificates). Vessels ≥400 GT are required to have an IMO-approved waste incinerator, as confirmed by the IAPP certificate. The provisions of the Marine Orders that require vessels ≥400 GT with rechargeable systems containing ODS to maintain an ODS Record Book do not apply to the FPSO and vessels engaged in the activity, as they will remain within the Australian exclusive economic zone (EEZ) for the duration of the petroleum activity included in the scope of this EP, and therefore, will not be “vessels engaged on an overseas voyage" as defined by the *POPS Act*. The provisions of the Marine Orders that require Vessels ≥400 GT to have an International Energy Efficiency (IEE) certificate and a Ship Energy Efficiency Management Plan do not apply to the FPSO or vessels engaged in the activity. The FPSO is connected to the	

Legislation	Description of the legislation	Legislative requirement relevant to environmental management of the activity	Demonstration of how requirements are met
		seabed and is therefore a facility under the OPGGS Act and not "vessels engaged on an overseas voyage" as defined by the POPS Act. Vessels will remain within the Australian EEZ for the duration of the petroleum activity included in the scope of this EP, and therefore, will not be "vessels engaged on an overseas voyage" as defined by the *POPS Act*. From 1 January 2023, engine suppliers and anyone who carries out a major conversion on a marine diesel engine will be required to provide an EIAPP certificate (and supporting Technical File) for each marine diesel engine with a power output above 130kW.	
Biosecurity Act 2015 Biosecurity Regulations 2016	The Act and its supporting legislation are the primary legislative means for managing risk of pests and diseases entering into Australian territory and causing harm to animal, plant and human health, the environment and/or the economy.	*The Biosecurity Act 2015* (Biosecurity Act) came into effect on 16 June 2016 and replaces the *Quarantine Act 1908*. The key legislative change between the two acts is the jurisdictional shift of the Department of Agriculture and Water Resources from 200 nautical miles (nm) to 12 nm (i.e. Australian territory). In the context of the oil and gas industry, this shifts the regulatory compliance responsibility from offshore facilities located outside Australian territory to the domestic conveyances that service/support them. The *Australian Ballast Water Requirements, Version 8* include legislative obligations under this Act with regards to the management of ballast water and ballast tank sediment when operating within Australian seas. *National Biofouling Management Guidance for the Petroleum Production and Exploration Industry* (voluntary to adhere to) and *Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species* provide guidance on	Control measures implemented are provided in: **Section 8.2** Marine Pest Introduction.

Legislation	Description of the legislation	Legislative requirement relevant to environmental management of the activity	Demonstration of how requirements are met
		management of biofouling for vessels, infrastructure and immersible equipment, which is considered to be good oilfield practice to prevent introduction of IMS.	
Biodiversity Conservation Act 2016 (WA) *Animal Welfare Act 2002* (WA)	Biodiversity Conservation Act 2016 replaced the *Wildlife Conservation Act 1950* (WA) and came into effect 1 January 2019. Protection of ecological communities and habitats, flora and fauna. Ensures the humane treatment, protection, housing, release and euthanising of fauna.	Consult with WA DBCA and obtain relevant permit(s) before a wildlife hazing and post-contact wildlife response.	Oiled wildlife response is described in **Section 7.9** Spill response activities. Consultation with WA DBCA would occur in the event of a spill as described in the OPEP. **Table 6-6** of the EP also requires consultation with response agencies.
National Greenhouse and Energy Reporting Act 2007	This Act provides for the National Greenhouse and Energy Reporting (NGER) Scheme to account for and manage (via the safeguard mechanism) greenhouse gas emissions and energy consumption and production.	Report project greenhouse gas emissions, energy consumption and energy production data, as well as emissions performance compared to the facility emissions baseline, to the Clean Energy Regulator annually, following the commencement of production.	Since commissioning, the total annual flaring volumes (MMscf) as listed in **Table 7-2** have been reported within the NGERS Annual Reports and continue to be reported.
National Environment Protection (National Pollutant Inventory) Measure 1998	The National Pollutant Inventory NEPM Goals are 1. To collect a broad base of information on emissions and transfers of substances on the reporting list, and 2. To disseminate the information collected to all sectors of the community in a useful, accessible and understandable form.	The NEPM does not require reporting of greenhouse gas emissions as this is covered by the NGER Act, other emissions are reported if a facility exceeds certain levels of pollutants.	http://www.npi.gov.au/reporting
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.	Planned activities will not impact on shipwrecks, and it is unlikely that a large hydrocarbon spill would impact on shipwrecks.	**Section 5.4.10** Cultural Heritage notes the shipwrecks that are known to be present in the EMBA.

Table 2-3: Summary of Applicable Industry Standards, Guidelines and Policy Documents

Guideline	Description
Australian and New Zealand guidelines for fresh and marine water quality (ANZECC/ARMCANZ 2018)	These guidelines provide a framework for water resource management and state specific water quality guidelines for environmental values, and the context within which they should be applied.
International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL 73/78)	This convention is designed to reduce pollution of the seas, including dumping, oil and exhaust pollution. MARPOL 73/78 currently includes six technical annexes. Special areas with strict controls on operational discharges are included in most annexes.
International Convention on the Control of Harmful Anti-fouling Systems	This convention prohibits the use of harmful organotins in anti-fouling paints used on ships and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.
International Convention for the Safety of Life at Sea (SOLAS) 1974	In the event of an offshore emergency event that endangers the life of personnel, the International Convention for the Safety of Life at Sea (SOLAS) 1974 may take precedence over environmental management.
Bonn Agreement for Cooperation in Dealing with Pollution of the North Sea by Oil and other harmful substances (Bonn Agreement)	The Bonn Agreement is the mechanism by which the North Sea states, and the European Union (the Contracting Parties), work together to help each other in combating pollution in the North Sea area from maritime disasters and chronic pollution from ships and offshore installations; and to carry out surveillance as an aid to detecting and combating pollution at sea. The Bonn Agreement Oil Appearance Code (BAOAC) may be used during spill response activities.
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.
Convention Concerning the Protection of the World Cultural and Natural Heritage (1972)	The Convention links together in a single document the concepts of nature conservation and the preservation of cultural properties. The Convention recognizes the way in which people interact with nature, and the fundamental need to preserve the balance between the two.
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

Guideline	Description
	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.
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.
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.
The Australian Petroleum Production and Exploration Association (APPEA) Code of Environmental Practice (APPEA 2008)	In Australia, the petroleum exploration and production industry operate within an industry code of practice developed by the Australian Petroleum Production and Exploration Association (APPEA); the APPEA Code of Environmental Practice (2008). This code provides guidelines for activities that are not formally regulated and have evolved from the collective knowledge and experience of the oil and gas industry, both nationally and internationally. The APPEA Code of Practice covers general environmental objectives for the industry, including planning and design, assessment of environmental risks, emergency response planning, training and inductions, auditing and consultation and communication. The 'offshore development and production' section of the Code is of particular relevance to the Montara operations. As an APPEA member, Jadestone adheres to this Code of Environmental Practice when undertaking offshore exploration and production activities.
Australian Ballast Water Requirements, Version 8	Australian Ballast Water Management Requirements outline the mandatory ballast water management requirements to reduce the risk of introducing harmful aquatic organisms into Australia's marine environment through ballast water from international vessels. These requirements are enforceable under the Biosecurity Act 2015.
International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention) 2004. BWM	The IMO has been addressing the problem of IMS in ship's ballast water since the 1980s. Ballast water and sediments guidelines were adopted in 1991 and the ballast water convention was adopted in 2004. Recent accession by Finland has triggered the final entry into force of these international requirements. As a result, the International Convention for the Control and Management of Ships Ballast Water and Sediment will enter into force on 8th September 2017 (IMO Briefing 22 2016). It aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments. Ballast Water Management systems must be approved by the Administration in accordance with this IMO Guidelines.

Guideline	Description
National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia 2009).	A voluntary biofouling management guidance document developed under the National System for the Prevention and management of Marine Pest Incursions. Its purpose is to provide tools to operators to minimise the amount of biofouling accumulating on their vessels, infrastructure and submersible equipment and thereby to minimise the risk of spreading marine pests.
International Convention on the Control of Harmful Anti-fouling Systems	This convention prohibits the use of harmful organotins in anti-fouling paints used on ships and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.
Plans of management for: - World Heritage properties, - Commonwealth/National Heritage places	Sites accepted to the World Heritage listing are only inscribed if considered to represent the best examples of the world's cultural and natural heritage. There are no World Heritage properties that intersect with the EMBA. The Commonwealth Heritage List is a list of natural, Indigenous and historic heritage places owned or controlled by the Australian Government. There are five Commonwealth Heritage places that intersect with the EMBA; Ashmore Reef National Nature Reserve, Christmas Island Natural Areas, Mermaid Reef – Rowley Shoals, North Keeling Island and Scott Reef and Surrounds – Commonwealth Area. The National Heritage list is Australia's list of natural, historic and Indigenous places of outstanding significance to the nation. There are no National Heritage properties that intersect with the EMBA.
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. 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).
EPBC Act-related guidelines	Relevant guidelines/policies are considered in the management of impacts and risks (e.g. EPBC Act Policy Statement 2.1 - Interaction between offshore seismic exploration and whales: Industry guidelines).
NOPSEMA OPGGS Act-related guidelines	NOPSEMA guidelines applicable to Montara operations include: NOPSEMA Guidance: Responding to public comment on environment plans N-04750-GN1847 July 2022 NOPSEMA Guidance: Making submissions to NOPSEMA (N-04000-GLO225 July 2022) NOPSEMA Guidance: Notification and reporting of accidents and dangerous occurrences (N-03000-GN0099 March 2022)NOPSEMA Guidance: Consultation with Commonwealth agencies with responsibilities in the marine area (N-06800- GL887 March 2022) NOPSEMA Guidance: Ageing assets and life extension (N-04300-GN1975 A783718, July 2021) NOPSEMA Guidance: Petroleum Activity (N-04750-GN1343 A336223, March 2021) NOPSEMA Guidance: NOPSEMA Guidance: Environment plan content requirements (N04750-GN1344, September 2020); NOPSEMA Guidance: Responding to public comment on environment plans (N-04750-GN1847, September 2020); NOPSEMA Guidance: Oil pollution risk management (N-04750-GN1488, July 2021);

Guideline	Description
	NOPSEMA Guidance: Notification and Reporting of Environmental Incidents (N-03000-GN0926 June 2020); NOPSEMA Guidance: ALARP (N04300-GN0166, June 2020); NOPSEMA Guidance: Offshore project proposal content requirements (N-04750-GN1663, August 2020); NOPSEMA Guidance: Petroleum Activity (N-04750-GN1343, March 2021); NOPSEMA Guideline: When to submit a proposed revision of an EP (N-04750-GL1705, September 2020); NOPSEMA Guidance: Change to titleholder with operational control of activities (N-04000-GN1746, May 2020); NOPSEMA Guidance: Petroleum activities and Australian Marine Parks (N-04750-GN1785, June 2020); NOPSEMA Guidance: Activities within Commonwealth Marine Reserves (N-04750-GN 1565 Rev 0, 26 November 2015); NOPSEMA Guideline: Environment Plan Decision Making (N-04750-GL1721, June 2021 NOPSEMA Guideline: Financial assurance for petroleum titles (N-04730-GN1381, July 2020); NOPSEMA Information Paper: Source control planning and procedures (N-04750-IP1979, June 2021); NOPSEMA Information Paper: Operational and Scientific Monitoring Programs (N-04750-IP1349, October 2020); National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia, 2009); Australian Ballast Water Management Requirements (Version 8, Department of Agriculture, Water and the Environment 2020); Australian and New Zealand guidelines for fresh and marine water quality (ANZECC/ARMCANZ 2018); and The Australian Petroleum Production and Exploration Association (APPEA) Code of Environmental Practice (APPEA 2008). APPEA Joint Industry Operational and Scientific Monitoring Plan Framework (APPEA 2021). Relevant guidelines/ policies are considered in the management of impacts and risks.
Ramsar wetland ecological character descriptions	There are no Ramsar wetlands that have coastal boundaries intersecting with the EMBA.
Marine Bioregional Plan	Marine bioregional plans are identified and considered in Section 5. Key Ecological Features (KEF) are elements of the Commonwealth marine environment that are considered to be of regional importance for either a region's biodiversity or its ecosystem function and integrity. 14 KEFs intersect with the EMBA: Ashmore Reef and Cartier Island and Surrounding Commonwealth Waters; Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex; Continental Slope Demersal Fish Communities; Carbonate bank and terrace system of the Van Diemen Rise; Gulf of Carpenteria Basin; Pinnacles of the Bonaparte Basin; Shelf break and slope of the Arafura Shelf; Tributary Canyons of the Arafura Depression; Exmouth Plateau; Glomar Shoals; Mermaid Reef and Commonwealth waters Surrounding Rowley Shoals; Ancient Coastline at 125 m Depth Contour; Canyons linking the Argo Abyssal Plain with the Scott Plateau; and Carbonate Bank and Terrace System of the Sahul Shelf.

Guideline	Description
The Conservation Values Atlas (DoEE 2018a)	The Conservation Values Atlas has been developed by the Commonwealth Government. This is used for the identification of Biologically Important Areas (BIA), KEFs etc. which have been presented in the Section 5 and considered in the assessment of impacts and risks in Sections 7 and 8. BIA's are identified by the Commonwealth government, are spatially defined areas where aggregations of individuals of a species are known to display biologically important behaviour, such as breeding, foraging, resting or migration.
Species Profile and Threats Database (DoEE 2018b)	This database has been used in Section 5 as a source of information on the receptors. Information accessed has included species details such as habitat, movements, feeding, reproduction and taxonomic comments. Noting that profiles are not available for all species and ecological communities.

Table 2-4: EPBC approval conditions from consolidated approval notice relating to Montara operation activities (EPBC 2002/755, 12 June 2018)

#	Condition	How this condition is met within the EP
1	The person taking the action must submit for the Minister's approval, an Oil Spill Contingency Plan (OSCP) that demonstrates the response preparedness of the person taking the action for any spills, including hydrocarbons from offshore wells and infrastructure, pipelines, construction and operation vessels. This must include the capacity to respond to a spill and mitigate the environmental impacts on the Commonwealth marine area and species listed as threatened or migratory under the EPBC Act. The OSCP must include, but is not limited to:	An Oil Pollution Emergency Plan (OPEP) is submitted to NOPSEMA with this EP for acceptance. As per Condition 13, a NOPSEMA accepted EP is taken to also be approved by the Minister.
a)	identification of sensitive areas, species or habitats that may be impacted by a potential spill, as determined by site-specific modelling of worst-case scenario spills;	The receptors and locations that may be impacted by the potential spill scenarios identified are described in Section 5. Modelling has been undertaken and is described further in Section 8.6.
b)	specific response measures for those sensitive areas, species or habitats and prioritisation of those areas during a spill response, including a net environmental benefit analysis of the response options;	Response measures and a preliminary NEBA are described in the Montara Operations OPEP.
c)	a description of resources available for use in containing and minimising impacts in the event of a spill and arrangements for accessing them;	Response measures and a preliminary NEBA are described in the Montara Operations OPEP.
d)	a demonstrated capacity to respond to a spill at the site and measures that can feasibly be applied within the first 48 hours of a spill occurring;	First strike response measures applied within the first 48 hours are described in the Montara Operations OPEP.
e)	training of staff in spill response measures and identifying roles and responsibilities of personnel during a spill response;	Training and competency of personnel involved in spill response and roles and responsibilities are described in the Montara Operations OPEP.
f)	procedures for reporting spill incidents within 48 hours of a spill occurring; and	Spill reporting arrangements are provided in described in the Montara Operations OPEP.
g)	a demonstrated procedure or a plan for testing, maintenance and review of the OSCP.	Testing and maintenance of the OPEP is described in the Montara Operations OPEP.
	The OSCP must be submitted and approved by the Minister prior to the recommencement of operations, or as otherwise agreed to in writing by the Minister. The person taking the action must not recommence the operations unless the Minister has approved the OSCP. The approved OSCP must be implemented.	A NOPSEMA accepted OPEP is taken to also be approved by the Minister and meets the requirements of an OSCP as referred to in this condition.

#	Condition	How this condition is met within the EP
3	The person taking the action must monitor produced formation water in accordance with a NOPSEMA accepted Environment Plan for the activity, including aspects of quality, quantity and effects on the receiving environment.	The monitoring regime for produced formation water is described in detail in Section 7.6.
7	The person taking the action must submit for the Minister's approval, an Operational and Scientific Monitoring Program (OSMP) that will be implemented in the event of a spill to determine the potential extent and ecosystem consequences of such a spill, including, but not limited to:	As per Condition 13, a NOPSEMA accepted OSMP is taken to also be approved by the Minister.
a)	triggers for the initiation and termination of the OSMP, including, but not limited to, spill volume, composition, extent, duration and detection of impacts;	Jadestone's OSMP details triggers for initiation and termination of SMPs.
b)	a description of the studies that will be undertaken to determine the operational response, potential extent of impacts, ecosystem consequences and potential environmental reparations required as a result of the spill;	Jadestone's OSMP details studies to be undertaken.
c)	inclusion of sufficient baseline information on the biota and the environment that may be impacted by a potential spill, to enable an assessment of the impacts of such a spill;	Jadestone's OSMP details arrangements for baseline information to be referenced in evaluation of impacts and recovery in sensitive receptors impacted by a spill.
d)	a strategy to implement the scientific monitoring plan, including timelines for delivery of results and mechanisms for the timely peer review of studies; and	Jadestone's third party service provider for scientific monitoring provides a plan that details implementation arrangements.
e)	provision for periodic review of the program.	Jadestone's OSMP specifies periodic review requirements.
	The OSMP must be submitted and approved by the Minister within three (3) months following the recommencement of operations, or as otherwise agreed to in writing by the Minister. The approved OSMP must be implemented.	A NOPSEMA accepted OSMP is taken to also be approved by the Minister.
10	The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement the management plans/ monitoring programs required by this approval, and make them available upon request to the Department. Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the Department's website. The results of audits may also be publicised through the general media.	Section 9 provides detail on the monitoring, recording and reporting requirements associated with the Montara operations activity.
11	Upon the direction of the Minister, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister	Jadestone will respond to the Minister's directions with regard to independent audits as and when required.

#	Condition	How this condition is met within the EP
13	A plan, program or strategy required by condition 1, 2 or 7 is automatically deemed to have been submitted to, and approved by, the Minister if the measures (as specified in the relevant condition) are included in an environment plan (or environment plans) relating to the taking of the action that:	
a)	was submitted to NOPSEMA after 27 February 2014; and	This EP is submitted after 27th February 2014
b)	either: i) is in force under the OPGGS Environment Regulations; or ii) has ended in accordance with regulation 25A of the OPGGS Environment Regulations.	This EP, once accepted, will be in force under the OPGGS(E) Regulations.
13A	Where a plan, program or strategy required by condition 1 or 7 has been approved by the Minister and the measures (as specified in the relevant condition) are included in an environment plan (or environment plans) that:	
a)	was submitted to NOPSEMA after 27 February 2014; and	This EP is submitted after 27th February 2014
b)	either: i) is in force under the OPGGS Environment Regulations; or ii) has ended in accordance with regulation 25A of the OPGGS Environment Regulations, the plan, program or strategy approved by the Minister no longer needs to be implemented.	This EP, once accepted, will be in force under the OPGGS(E) Regulations.
13B	Where an environment plan, which includes measures specified in the conditions referred to in conditions 13 and 13A above, is in force under the OPGGS Environment Regulations that relates to the taking of the action, the person taking the action must comply with those measures as specified in that environment plan.	Compliance with this EP is reported annually to NOPSEMA as required under the OPGGS(E)R and further detailed in Section 9.

3. DESCRIPTION OF THE ACTIVITY

3.1 Overview

Production at the Montara field commenced in Quarter 2 2013. The Montara operations activity is expected to have a life of approximately 12 years and to be fully operational within this period. The activity commenced with an indicative production rate of 30,000 bbl/d crude oil, and current production rate is approximately 16,000 bbl/d which is expected to decline over the life of the activity as is typical for oil field developments.

This EP is written to allow for the continuation of production at the Montara Facility for a period of five (5) years from the date of its acceptance by NOPSEMA, which is within the expected operational life of the Montara activity.

Oil is extracted from production wells in each of the Montara, Skua, Swift and Swallow fields and is transported in flow lines to the Montara Venture FPSO facility via the Montara WHP.

3.2 Field Infrastructure

3.2.1 Wellhead platform

The WHP is an unmanned operation platform. No hydrocarbon processing is performed on the WHP. Hydrocarbon production fluids from the Swift, Swallow and Skua subsea wells are co-mingled subsea and arrive at the WHP to then be co-mingled with the Montara production fluids, or Montara can be segregated via one of the export flowlines. The co-mingled fluids are then exported to the FPSO via the two export flowlines.

The WHP is designed to:

- Act as a support structure for Montara wellheads and risers, including future allowances;
- Collect and co-mingle the output from the individual wells and facilitate well flow rate and control;
- Provide for gas re-injection and gas lift;
- Provide for remote control from the FPSO; and
- Provide for well testing with control from, and data to, the FPSO and the ability to backflow re-injection gas through flowlines.

The WHP is a normally unmanned platform which will be visited as required for maintenance and operations purposes. When visiting the WHP, a minimum of two personnel visit the WHP, based on the buddy system principle. Safety equipment onboard the facility provides for up to 10 personnel, the maximum POB that can attend the WHP when the facility is in production. When the WHP is not in production, the maximum POB on the WHP may be expanded to 20 personnel during campaigns based on the design capacity of each muster point with extra safety equipment.

3.2.2 Montara Venture FPSO

The Montara Venture FPSO is a converted Suez max crude oil tanker. The FPSO is permanently moored (for the operational life of the field) in the Montara field utilising a turret mooring system.

Summary details of the FPSO are provided in Table 3-1.

Table 3-1: Details of the Montara Venture FPSO

Aspect	Detail
Vessel name	Montara Venture (ex-Freeway/ Genmar Alta)
IMO number	8714982
Dead weight tonnage	146,251 mt
Length	274.3 m
Moulded breadth	43.2 m

Aspect	Detail
Moulded depth	23.8 m
Maximum oil storage capacity (98%)	965,977 bbl

The Montara Venture FPSO has been built and equipped to include the following:

- 1 x three-stage oil separation train;
- Gas reinjection compressor;
- Gas dehydration via glycol contactor;
- Glycol re-generation;
- Produced water treatment;
- Fuel gas treatment;
- Inert gas system;
- Chemical injection and storage;
- Seawater cooling water lift pumps;
- Electrical power generation and distribution;
- Crude offloading facility;
- Submerged turret production and hydraulic power unit systems; and
- Flare tower.

The maximum personnel on board for the FPSO is 58 personnel, based on the accommodation and safety equipment provisions. The expected normal complement for operation and maintenance of the facility is 34 crew plus an average of 17 contractors and casual visitors. Minimum manning distribution is 18 crew.

Activities normally undertaken by a marine crew (such as cargo loading and discharge, cargo tank inspections and maintenance) are undertaken by suitably trained operations personnel.

The Montara Venture FPSO is moored by a single point mooring (SPM) system. The system comprises nine chain and wire mooring legs secured to the seabed by piles, a buoy and riser system and a fluid, gas, power and utility swivel system. Each mooring line is composed of chain and wire rope segments, which is connected to a submerged turret production (STP) buoy at the turret level and to nine driven anchor piles driven to a depth of 25 m at the extents of the mooring pattern.

The turret for the FPSO is an inboard design to allow the vessel to freely weathervane. The FPSO is designed to remain on station during all weather conditions and will be permanently moored. Operations on the turret are limited to maintenance and repair activities. The turret provides connections for all dynamic risers and umbilical lines.

Vessel stability during normal operational and adverse weather conditions is maintained by ensuring cargo tanks and ballast tanks are at optimum levels. This is achieved by effective distribution of crude to the crude storage tanks which, due to the number of tanks and their varying capacity, provide operational flexibility.

The vessel has a fully segregated ballast system to prevent contamination from the cargo tanks, with hydraulic valves for ballast control. However, in heavy weather or an emergency case the cargo pumps can be used for salt water ballasting and de-ballasting of 4C Cargo Oil Tank.

"Loading and Stability Information" has been produced which provides sufficient information to check the vessels stability according to IMO A749 (18) criteria. Static stability information including draft, trim, heel, GZ curve, Metacentric Height (GM), bending moment and shear force for all standard and operational loading conditions is also provided. This booklet which is located offshore enables personnel to manage the loading and stability aspects of the installation in compliance with Class requirements.

Optimum loading and ballasting arrangements are calculated with the assistance of the load computer. Stability calculations have been performed to Class requirements for the intact and damage condition for various tank configurations. The Ballast System has been identified as a safety critical element; and is subject to the Performance Standard Report (MV-70-REP-F-00002).

3.2.3 Wells

The Montara operations activity consists of both subsea and dry platform wells. The subsurface completion consists of the wellbore drilled to penetrate the oil-bearing sands, and all equipment items installed within the wellbore are designed to allow well fluids to be produced in a safe and controlled manner. These items include the steel or steel/ chrome alloy casing and liner (chrome alloy materials used in flow wetted areas to prevent CO_2 related corrosion) cemented into the wellbore.

The production string consists of production tubing, chemical injection points, isolation packers, landing nipples, sand control screens and other specialised equipment to provide a flow path for the reservoir fluids to the wellhead.

The Skua 10 and 11 are horizontally completed wells that have three additional hydraulic control lines that support the operation of two downhole zone isolation valves.

The dry platform production wells all feature downhole pressure gauges. Skua 10 and Skua 11 are the only subsea wells with downhole pressure gauges.

A Surface Controlled Subsurface Safety Valve (SCSSV) is installed in each well's tubing string at approximately 300 m below the seabed to prevent uncontrolled flow in an emergency. The SCSSV's are a fail-safe (closed) design that requires continuous hydraulic control pressure supplied from the control system on the FPSO to remain in the open position.

3.2.4 Subsea trees

The subsea trees provide the interface between the subsurface completion and the subsea flowlines. The components of the subsea wells are as follows:

- Surface casing, wellhead and tubing hanger;
- Production guide base; and
- Subsea tree.

The production guide base is mechanically locked to the wellhead and provides connection between the tree choke valves and the gas lift and production flowlines.

Each subsea tree assembly consists of:

- Subsea tree connector;
- Valve block with pressure and temperature transducers, tree valves and actuators;
- Hydraulic flowline connectors;
- Removable subsea control module; and
- Removable annulus and production choke modules.

The tree valves serve to shut off and seal in the well from the surface and control the routing of fluids through the tree.

The subsea trees are controlled from the FPSO via the MCS interface in the CCR. The valves are held open by hydraulic pressure via control lines from well control panels and will fail-safe (closed) upon loss of hydraulic control pressure for any reason.

3.2.5 Dry platform trees (WHP)

The dry platform trees provide the interface between the subsurface completion and the flow control pipework on the WHP. The components of the dry platform wells include the surface casing, wellhead and tubing hanger and the dry surface trees.

Each tree assembly consists of a starter head and tree block with pressure and temperature transducers, tree valves and actuators. The ancillary pipework located on the WHP hosts the choke valves, chemical injection points and flow control valves.

The tree valves serve to shut off and seal in the well from the surface and control the routing of fluids through the tree.

The dry platform trees are controlled from the FPSO via the ICCS interface in the CCR. The valves are held open by hydraulic pressure via control lines from well control panels and will fail-safe (closed) upon loss of hydraulic control pressure for any reason.

A wellhead hydraulic control panel (WHCP) is provided on the WHP for control of the Montara wells. The WHCP is used to manipulate the tree valves and SCSSV's for the Montara wells. Since the Montara wells have been developed with sand control screens and integrated inflow control devices (ICDs), facilities on WHP for handling sand are not required.

3.2.6 Swift Manifold

A single manifold is located at the Swift field to incorporate multi-phase metering, chemical/ controls umbilical and gas lift distribution and production fluid co-mingling. The manifold is a carbon steel structure and will co-mingle the hydrocarbons from Swift, Swallow and Skua wells into the WHP flowline and support a subsea distribution unit for the subsea production control system. A multi-phase flow meter is incorporated into the manifold and valving has been arranged so that flowlines can be isolated to allow individual well testing at periodic intervals.

3.2.7 Flowlines

All subsea flowlines and spools are carbon steel, with the exception of the connection to the FPSO where there is a transition to flexible flowlines. A summary of the flowlines is provided in **Table 3-2**.

Table 3-2: Summary of flowlines within the Montara operations field

Tag	Component start	Component end	Length (m)	Diameter (inch)	Outer diameter (mm)	Design pressure (MPag)
14-WHP-RISER-A	WHP	FPSO	1,413	14	355.6	7
14-WHP-RISER-B	WHP	FPSO	1,387	14	355.6	7
14-SWIFTMAN-WHP	Manifold	WHP	17,775	14	355.6	28
10-SKUAPLET-SWIFTMAN	Skua PLET	Manifold	5,207	10	273.1	28
6-SWIFT1-SWIFTTEE	Swift North 1	Swift Tee	1,292	6	168.3	28
6-SWIFT2-SWIFTTEE	Swift 2	Swift Tee	55	6	168.3	28
6-SWIFTTEE-SWIFTMAN	Swift Tee	Manifold	1,129	6	168.3	28
6-SKUA10-SKUAPLET	Skua 10	Skua PLET	53.106	6	168.3	28

Tag	Component start	Component end	Length (m)	Diameter (inch)	Outer diameter (mm)	Design pressure (MPag)
6-SKUA11-SKUAPLET	Skua 11	Skua PLET	41.4	6	168.3	28
6-SWALLOW-SWIFTMAN	Swallow	Manifold	31.2	6	168.3	28

The flowlines are installed on the seabed untrenched, with the gas lift flowlines piggybacked onto the main production lines. All flowlines are carbon steel and have been coated with 3LPP for external corrosion protection. The WHP to FPSO production flowlines are concrete-coated to achieve on-bottom stability.

Internal corrosion protection is via continuous injection of corrosion inhibitor at the wellheads (via the umbilical) and each flowline has additional wall thickness for use as corrosion allowance.

Hydrocarbons produced from the wells will be transported via flexible risers connected through the STP Buoy. The flexible riser system consists of three risers approximately 150 m long each configured in a steep wave configuration running through the STP buoy to individual riser bases supported by buoyancy modules. Specifications of the flexible flowlines are provided in **Table 3-3**.

Table 3-3: Flexible flowline Specifications

Flowline	Internal diameter (mm)	Approx. length (m)	Design pressure (Barg)	Operating pressure (Barg)
2 x 10" production	254	150	70	60
1 x 6" gas lift	152.4	150	280	250

3.2.8 Umbilicals

The umbilicals supply instrument power, signal, hydraulic power and chemical injection from the FPSO to each of the subsea wells and the Swift manifold. A separate umbilical supplies these services in addition to electric power and fibre optic control/ communication from the FPSO to the WHP.

The umbilicals consist of thermoplastic hoses, insulated cables, plastic fillers and steel armour wire wrapped in a polymer outer sheath. They are laid directly on the seabed and are not buried or protected.

Suspended and Abandoned Subsea Infrastructure

Table 3-4 provides a listing of all subsea infrastructure that has been suspended/ abandoned. The list includes five exploration/ appraisal wells that were previously drilled prior to commencement of production facilities within the field.

Table 3-4: Suspended and abandoned subsea infrastructure

Infrastructure	Permit	Well type	Status	Location	
				Latitude	Longitude
Montara-1	AC/L7	Exploration well	Abandoned	-12.687971	124.505237
Montara-2	AC/L7	Exploration well	Abandoned	-12.698027	124.526773
Montara-3	AC/L7	Appraisal well	Abandoned	-12.676432	124.543895
Sea Eagle-1	AC/L8	Exploration well	Suspended	-12.5458944	124.4465444
Tahblik-1	AC/L7	Exploration well	Suspended	-12.731380	124.505237

No other subsea suspended/ abandoned infrastructure exists within the AC/L7 or AC/L8 permits, including no wet-parked or mothballed infrastructure or equipment.

Suspended wells

Jadestone plans to undertake monitoring of the two temporarily abandoned (suspended) wells, Sea Eagle-1 and Tahbilk-1 via vessel-based activities. These wells are intended to be used for future hydrocarbon exploitation in the Montara field. The ongoing monitoring of these wellheads is described within the NOPSEMA accepted Sea Eagle-1 and Tahbilk-1 Vessel Based Activity EP (TM-50-PLN-I-00004).

Abandoned wells

In 2021, both the primary and secondary barrier envelopes of Montara-1,2 and 3 were verified, and the wells confirmed to be plugged and abandoned as per the NOPSEMA accepted Well Operations Management Plan (WOMP) (Doc Number MV-00-PLN-W-00007 Revision 0 accepted on 22/06/21). A final abandonment report was submitted to NOPSEMA for these wells in September 2021. These wells (and any associated debris) are intended to be removed prior to end of field life, removal will be subject to a separate EP.

As the wells are abandoned, there are no pressure containment requirements and because of this, a high degree of corrosion prior to their removal can be accepted as all that is required is mechanical cuttings and recovery. Recovery of the wellheads will require a means to insert a mechanical cutting tool into the wellhead and 2-4m below mud line to cut the casings and conductor then recover the material above the cut point.

Expert advice has guided that based on the NACE Corrosion Engineers Handbook, page 188 for steel in soil <1000 ohm-cm, that a corrosion rate of 0.2mm/year for unprotected steel can be utilised. In the presence of paint and other protective films, corrosion would be delayed. On the basis of no cathodic protection from when the wells were first drilled, they can be left without cathodic protection for a further 126 years without compromising the ability to mechanically recover and lift to the recovery vessel. The wellheads are currently monitored every 6 years by ROV as outlined in Subsea Well ROV GVI & Seabed Survey Procedure (TM-50-PR-U-00001) until they are removed.

Removal of infrastructure associated with these abandoned wells is discussed further in Section 3.9.

3.3 Operational Activities

3.3.1 Commissioning

Commissioning of infill wells will be required; but will be part of the standard procedures as per the Safety Case and WOMP requirements.

As part of the engineering work required for these activities, an environmental impact assessment will be completed and evaluated against the in-force environment plan as part of the management of change of process required with the engineering change. If further impacts or controls are determined from the impact assessment due to changed emissions and discharges, the EP will be revised and resubmitted to NOPSEMA for assessment.

3.3.2 Hydrocarbon Processing

Production fluids from the subsea production wells co-mingle at the Swift manifold and are transferred to the WHP. Subsea well fluid and Montara well fluid can also be co-mingled or exported separately to the FPSO via two export flowlines.

On the FPSO the production fluids are processed through a three-stage separation system into three streams – oil, gas and water. The oil stream is then stabilised to meet specifications for storage, transport and sale. Separation of fluids and stabilisation of oil occur simultaneously in a single, three stage process train consisting of a high-pressure separator, medium pressure separator and low-pressure separator in series. Each separator is a three-phase flooded weir separator designed for gas, oil and produced water separation by gravity. The system is controlled through field transmitters, detection devices and controlling elements strategically located between discrete sections of the process.

The bulk of the produced water and gas are separated from the oil during the separation process. Gas from the separator is routed to the reinjection gas compression system; oil is routed to the crude oil heater and produced water routed to the produced water degasser. Further gas and water is removed by the second and third stage separators. Oil from second stage separation is routed to the third stage separator where it is pumped by the crude oil rundown pump(s) or gravitated through crude oil rundown cooler and subsequently to the storage tank.

3.3.3 Gas Treatment

Associated gases are routed from the separation process to the reinjection gas compression system. This gas stream is compressed, dehydrated and cooled prior to being used as fuel gas at the FPSO, and lift gas at each well, with the surplus reinjected into the Montara reservoir through the G2 reinjection well on the WHP. Gas for gas lift is exported from the FPSO via the gas swivel and gas lift flowline network. Dehydration is achieved via a glycol contactor located between the second and third stages of the three-stage reinjection compressor. Water recovered from gas dehydration is boiled off with stripping gas to LP flare at the glycol reboiler and still column.

3.3.4 Produced Water

Produced formation water associated with production fluids is routed from the separation process to the produced water storage tanks located port and starboard. Each produced water storage tank has a volume of 4,065 m3. Produced water is pumped by the produced water pumps located at the storage tank to the produced water module, located amidships. The produced water treatment system consists of two hydrocyclone units, a degasser, discharge cooler, produced water pumps and valving and pipework to route the water either directly overboard or diverted back to the produced water storage tanks. Both streams incorporate a monitoring system for monitoring discharged oil-in-water levels. The produced water system is designed to handle the produced water streams from the separators and to remove oily contaminants to provide a treated water outlet stream suitable for discharge overboard.

Produced water is then pumped by the produced water pumps from the produced water storage tanks overboard via the hydrocyclones (2). The hydrocyclones are designed to reduce the oil content from a maximum oily water concentration of 2,000 mg/L to a treated water discharge concentration below 30 mg/L for discharge overboard. If the oil content of the treated produced water stream is above the prescribed level, then the flow is diverted automatically back to the produced water tanks and recirculated until the oil in water level in the treated water stream is sufficiently reduced to resume overboard discharge.

3.3.5 Bilges

There are three bilge wells in the machinery space which collect oily water drainage from the various items of equipment in the space. These wells are monitored by high level alarms and are manually emptied to the bilge holding tank using the bilge pump. The contents of the bilge holding tank are then pumped to the starboard slop tank where it is treated for oil recovery and water handling.

3.3.6 Slops Water

Slops water consists of oily water from the open and closed drain system, bilge system, as well as tank stripping and washing operations that is collected in Slops Tanks on the FPSO.

The process plant is provided with three separate drains facilities:

- Open hazardous drains;
- Open non-hazardous drains; and
- Closed hazardous drains.

An open drain system is provided to collect drips and spills from various areas on the installation and direct the liquids to the slops tanks for treatment and disposal. Levels in the slops tanks are monitored remotely in the CCR utilising a continuous wave radar level measurement device fitted to each of the tanks with a high and high-high level alarm facility. Slops can be redirected to cargo storage tanks if required.

Open drains also collect rainwater and deck wash-down water, which may be contaminated with low levels of detergents, oil and grease, used machinery chemicals and general dirt from the deck.

Coaming (a raised border) is provided for the drains located in close proximity to the hydrocarbon containing vessels, produced water treatment equipment and on the chemical injection skid. For the large drip trays under the main process vessels there are two outlets at the aft end. Each outlet is sealed by a bubble cap which is removable for cleaning or a liquid seal to prevent gas breakthrough from the hazardous to the non-hazardous areas. Smaller drip trays have just one sealed outlet.

Open non-hazardous drains flow directly to the main deck via the grated process decks, where they can be discharged overboard via the scuppers. The scuppers are normally unplugged for safety reasons to allow hydrocarbon spills (during a major accident event) outside of primary containment (and rainwater or seawater) to drain, thus minimising the potential for a pool to collect and ignite. For a minor spill the scuppers may be plugged to allow for the containment and clean-up of hydrocarbons.

The closed hazardous drain system collects fluid from process vessels and elsewhere throughout the process.

The following areas have closed hazardous drain connections:

- M1 Oil Separation;
- M2 Produced Water Treatment;
- M3 Recycle Gas;
- M4 Reinjection Compression;
- M5 Chemical Injection;
- M7 Flare Knock Out;
- M8 Glycol Regeneration;
- M9 Fuel Gas Treatment; and
- M10 Cooling Water.

A hazardous closed drain header is provided for the main hydrocarbon containing vessels. This is routed to the LP flare drum.

Washing of crude oil cargo tanks generally takes place as part of an offloading operation. Periodic tank cleaning is typically undertaken on completion of crude oil washing to remove sludge for maintenance purposes or in preparation of tank inspections. Oil and water recovered from tank washing is circulated to the slops tanks.

The slops system consists of two tanks: one “dirty” and one “clean”. Both tanks use gravity to separate the oil from the water. When sufficient oil has collected in the slops tank, the cargo discharge or stripping pumps are used to pump the oil to the crude storage tanks. The water is transferred to the dirty slops tank for gravity separation and further transferred to the produced water storage tanks for treatment and discharge via the produced water treatment system.

Slops tank water (from the clean tank) can also be over boarded via the Pump Room oil in water monitor.

3.3.7 Volatisation of product

A degree of volatisation of the crude oil product occurs while it is held in the FPSO’s storage tanks. These volatile organic compounds (VOCs) and light hydrocarbons are contained in the head space within each tank, the volume of which varies as crude oil is transferred into and out of the tanks. The build-up of VOCs, with the inherent risk of combustion, is minimised by the FPSO’s inert gas system.

The purpose of the FPSO inert gas system is to create an atmosphere inside tanks in which the hydrocarbon oil vapours cannot burn due to low oxygen content. To control oxygen levels, inert gas is introduced into storage tanks where it displaces the oxygen within the tanks.

The VOCs may be released to atmosphere by displacement with inert gas. The rate of release increases as product is transferred into a tank, reducing the volume of the head space therefore displacing VOCs.

The inert gas source for the FPSO is exhaust gas from the boiler up-take. A seawater scrubber pump provides water to remove sulphur dioxide (SO2) and soot particles from the gas, cool the exhaust gas and maintain a water level in the scrubber. The draw off water from the scrubber is sent overboard through the Inert Gas drain system.

3.3.8 Crude oil storage

Stabilised crude is contained within the FPSO's ten dedicated crude storage tanks comprising centre tanks 1 through 6 and wing tanks 1 and 3 (on both port and starboard). Product is held in these tanks before offloading to export tankers. The crude oil cargo storage tank capacities are given in **Table 3-5**.

Table 3-5: Cargo storage tank capacities

Crude cargo storage tank	Capacity (m3)	Capacity (bbls)
#1 Centre	12,867	80,930
#2 & #5 Centre	2 x 29,152	183,356
#3 & #4 Centre	2 x 14,576	91,678
#6 Centre	17,787	111,874
#1 Wing (Port & Starboard)	2 x 6,6164	38,771
#3 Wing (Port & Starboard)	2 x 11,570	72,769
Total (98%)	153,578	965,977
Total (100%)	156,712	985,691

Stabilised crude oil flows to the selected cargo tanks via two drop lines and enters the appointed tank(s) via the manual crude rundown system to the respective tanks. Levels in the tanks are monitored remotely in the CCR utilising a continuous wave radar level measurement device fitted to each of the cargo tanks with a level alarm facility.

Oil is gravity pumped into centre oil tanks #3 and #4 via the rundown cooler. Control of flow between cargo oil tanks is achieved via the cargo oil pumps located in the pump room and a system of headers within the tanks and hydraulically activated valves. Wing tanks #2 and #4 (port and starboard) are ballast tanks. Produced water and slops wing tanks are located port and starboard aft of the COT #4 P/S wing tanks and adjacent to COT #6C (**Figure 3-1**).

Crude Oil Washing (COW) of cargo tanks generally takes place as part of an offloading operation to ensure the removal of wax deposits and crude build-up on structural members within each tank. The washing medium is stabilised crude.

Washing is carried out by jetting stabilised crude at high pressure around each tank by rotating COW guns which gradually lower the jet angle down the tank and fixed bottom COW guns.

In addition to crude oil washing operations, tank cleaning is done periodically for maintenance purpose and inspections.

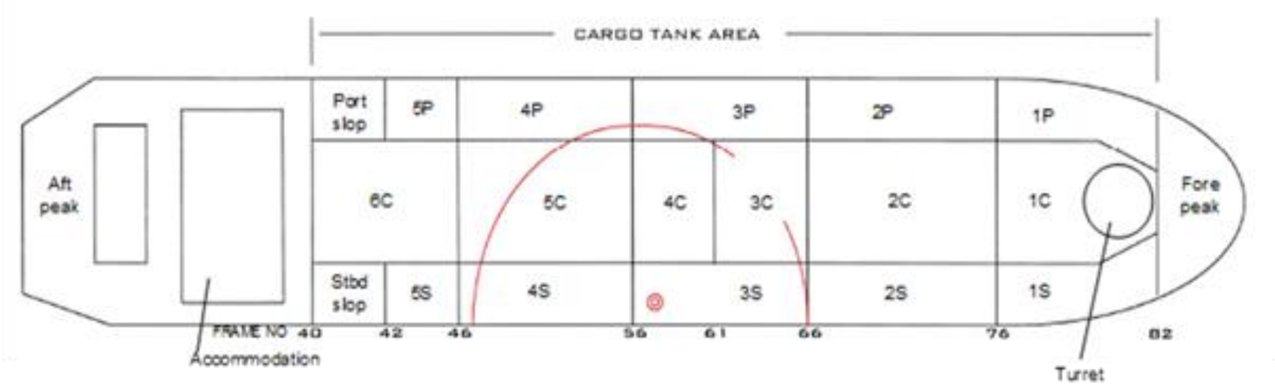


Figure 3-1: FPSO tank configuration

3.3.9 Crude Offloading

Crude oil is offloaded to a commercial offtake tanker moored in tandem configuration at the stern of the FPSO. The frequency of offtake depends on production rates.

Prior to crude offloading a Discharge Plan is developed to ensure safe and effective management of the FPSO stability, and stresses and strains on the hull.

Procedures associated with crude offtake activity require:

- The development and agreement of a Discharge Plan;
- Floating hose with breakaway coupling;
- Crude transfer operations and communications; and
- Static tow operation.

Prior to an offload, the offtake tanker arrives near the FPSO location and waits in a defined area approximately five nautical miles away until required. A contracted offtake crew of three or four personnel consisting of a pilot, marine superintendent, the agent and surveyor are transferred offshore to the FPSO prior to an offload operation. In some instances, the surveyor performs the agency work, thus only three personnel are required. The FPSO core crew is not increased during the offtake.

A contracted support vessel will always be in attendance to provide a static tow to the offtake tanker. The offtake tanker will be moored with a mooring hawser shackled to the mooring attachment point on the stern of the FPSO and equipped with a load-cell pin which provides a mooring force reading on a readout panel located in the CCR. An emergency release system for the mooring hawser is provided.

Due to operational requirements, the transfer of the offtake crew and hose handling may be carried out using the FPSO workboat.

The cargo pumps comprise 3 x 3,500 m3/h steam turbine driven pumps located in the pump room. There is also a steam driven stripping pump of capacity 300 m3/h and a jet stripping system comprising 3 x 800 m3/h eductors for complete emptying of the cargo tanks. The jet stripping eductors are driven by the cargo oil pumps. The Montara Shipboard Oil Pollution Emergency Plan (SOPEP) (MV-70-PLN-G-00002) and Montara Operations OPEP (MV-70-PLN-G-00001) detail the preventative and response arrangements related to pollution events.

Offloading takes nominally between 20–30 hours. The offtake tanker may be on station for up to 48 hours allowing time for connection and disconnection.

The Emergency Shutdown (ESD) Systems and controls in place for tanker offtakes include:

- A low pressure in the discharge line will result in a process shut down which will stop the cargo pumps;
- In case of an emergency at the offloading station, a local pushbutton is available to stop the cargo pump;
- ESD-1 will activate on low IG Pressure; and
- Gas detection or manual ESD station will stop the cargo pumps.

3.3.10 Flaring

Flaring will be minimised as produced gas will be used as fuel gas, or re-injected into the gas injection well. In the case of shutdown of the reinjection system, gas is temporarily diverted via the HP and LP flare knock-out (KO) drums to the flare system. Purge gas for the flare headers, required for safety reasons and from the glycol system will also be routed to the flare.

The flare is located on the centreline at the bow. Its boom is approximately 55 m long raked at 60 degrees to the horizontal. The flare system incorporates separate high pressure (HP) and low pressure (LP) headers and knock-out drums located forward of the separation module on the port side.

The HP Flare knockout drum is designed for collection of excess gas from First and Second Stage Separators and emergency loads from systems designed for more than 1,000 kPag. The HP Flare is fitted with a sonic type tip with multiple nozzles creating sonic exit velocity to improve combustion.

The LP Flare KO Drum is designed for collection of excess gas from the Third Stage Separator, Produced Water Degasser and emergency loads from systems designed for 1,000 kPag or less. Gas is routed to the LP Flare Tip and flared to reduce emission of methane gas. The design of the LP Flare Tip is open flare type within the HP sonic flare. This design maximises the effect of high velocity to minimise smoke associated with flaring for both the HP and LP flares.

Flaring during routine stable process operating conditions will be restricted to the continuous loads to HP and LP flare headers. These sources include associated gas from separator pressure control, flash gas from crude oil stabilisation and produced water degasser, flare header purge and pilot gas as an ignition source in case the flare needs to be activated in an emergency. This routine operational flaring is expected to be below 4 MMscf/d. Up to 3.5 MMscf/d is from the separators. Other small continuous loads are from the flare header purge and pilot gas, which contribute approximately 0.5 MMscf/d.

The above estimate of 4MMscf/d is based upon routine operations that is, the reinjection system being operational. The actual annual total volume will be larger than this estimate given there will be planned maintenance undertaken on the reinjection system and unplanned down-time.

3.3.11 Light Well Intervention

Light well intervention (LWI) activities may be necessary over the course of field life to maintain well integrity levels and to optimise production from the existing wells. It is estimated that the frequency is in the order of four interventions over the five-year period.

While LWI activities do not make use of a drilling BOP, additional barriers including lubricators, check valves, wireline blowout preventers, stuffing boxes and riserless well control packages (subsea) are installed on the well to ensure that the two-barrier philosophy is maintained during the activity. These barriers can either be automatic or manually operated if required in the event of an emergency. These interventions can utilise slickline, braided line, electric line (utilising a tractor or as required), digital line or coiled tubing. The intervention may be performed from a vessel for subsea wells (Riserless Light Well Intervention – RLWI), or from the helideck in the circumstance of wells at the Montara Wellhead (WHP) Platform wells.

LWI operations and activities include the following well tasks:

- Installation, testing and operation of Intervention Equipment and well control interface (including displacement/ venting of lubricators as required);
- Removal of Debris Caps and Crown plugs;
- Deployment and operation of well survey equipment and production logging tools;
- Tractor/ well stroker deployed tools in horizontal sections of the well;
- Cement bond logging and corrosion logging tools;
- Heavy duty fishing;
- Heavy flow control devices/ straddle;
- Deployment and operation of perforation tools;
- Non-explosive and explosive tubing punches;
- Multifinger tubing caliper runs;
- Mechanical/ chemical scale breaker/ dissolver runs;
- Removal and pulling of TRSSV hold open sleeves, insert TRSSV's or similar;
- Removal and resetting of Gas Lift Valve and setting of straddles and gas lift straddles as required;
- Setting and pulling of plugs, running drift runs, and other diagnostic runs;
- Chemical injection for scale removal and hydrate remediation;
- Acid stimulation/ injection;
- Annulus flushing;
- Venting of production tubing above a deep-set well barrier;
- Flushing of intervention equipment, surface/ subsea tree and flowlines with fluids (MEG, Brine or methanol) or Gas (Nitrogen); and
- Wax or scale removal.

Each well intervention campaign covers one or more wells and can generally last up to 30 days per well. Each well intervention program can comprise one or more of the scopes listed above.

Provided below are further descriptions on the LWI activities relevant to wells at the wellhead platform, and subsea wells. The impacts and risks associated with the activities described below, along with required management measures, are assessed in Section 7.5.

<u>Wells at the Wellhead Platform</u>

Equipment for LWI activities undertaken for wells at the WHP will be established on the helideck with access to the well heads made possible through an access port in the helideck. Once equipment is set up at the WHP, the following steps will occur:

- Install and test pressure control equipment (PCE) onto well;
- Entry into the well with required tooling;
- Tooling/ component recovery into PCE;
- Draining well fluids from PCE to WHP closed drain system and/ or venting of gas to atmosphere;
- Change out tooling and components from inside of PCE and re-run additional tooling into well as required to achieve objective of the LWI;

- Once achieved recommence production from the well. Any fluids used during the intervention works will (i.e. inhibited brine, scale dissolver chemicals, etc.) be produced to the FPSO.

Subsea Wells

Equipment for RLWI activities undertaken for subsea wells will be managed from a RLWI vessel. Once on location, the following steps will occur:

- Vessel maintains station using dynamic positioning;
- PCE is deployed to the wellhead during which the ROV is used to monitor placement;
- Control of the tree valves is transferred to the RLWI vessel;
- After removal of the crown plugs, the well is entered using wireline to achieve the well objectives. A pressure control head (PCH) is run with the tool and made up to the PCE;
- In the event well fluids are required to be pumped into the well, a hose (kill line) will be used to deliver fluids from the RLWI vessel. If annulus fluids need to be flushed, the fluids will be pumped into the flow line and routed to the FPSO for handling;
- Gas lift inventory in the A annulus will either be flowed to the flowline or bled off to the RLWI vessel and cold vented;
- Upon completion of the individual wireline or slickline runs, with the tool recovered in the PCE, well barriers below the tool are established;
- The lubricator section above the well barriers is flushed back to the vessel with inhibited fluids to remove well fluids/ gas from the lubricator section;
- The PCH and toolstring is then retrieved to surface through the water column to change the tool string. During disconnection of the PCH a small quantity of well fluids may be discharged at depth adjacent to the lubricator; and
- Upon completion of the RLWI activity, the crown plugs will be replaced, well barriers confirmed, the well returned to production, the PCE and ROV recovered, and control of the well returned to production. Any fluids used during the intervention works (i.e. inhibited brine, scale dissolver chemicals, etc.) will be produced to the FPSO.

3.4 Chemicals and Hazardous Materials

3.4.1 Chemical injection

Chemical injection is required at all the wells and topside facilities. The chemical types/ functions required are:

- Scale inhibitor;
- Corrosion Inhibitor (both liquid and gas phase types);
- Hydrate inhibitor;
- Biocide;
- Emulsion Breaker;
- Water clarifiers; and
- Pour Point Depressant.

Biocide injection has been provided to prevent the possible organic generation of H2S, and consequent corrosion from sulphate reducing bacteria.

Chemicals will be stored and supplied from the FPSO to the wells via the combined chemical/ control umbilicals. The chemical injection system consists of topsides chemical injection skid packages on the FPSO for hydrate inhibitor, PPD, corrosion inhibitor, and scale inhibitor. For all the chemicals except methanol, air operated plunger type pumps are provided for pumping fluid from the tote tank to the chemical injection points. Injection rate controls are provided for each injection line for the topsides injection only.

3.4.2 Hazardous Materials

In addition to hydrocarbons associated with the processing and storage facilities, hazardous materials include diesel, lube oils, hydraulic oil, aviation fuel, acetylene, oxygen, nitrogen, hydrogen, radioactive materials, paint and thinners, and proprietary cleaning agents as well as chemicals for chemical injection listed in the preceding section. Safety Data Sheets (SDSs) for all hazardous substances are maintained on a database aboard the FPSO as well as hard copies that are kept in the general office of the FPSO.

Hazardous materials are stored in accordance with the relevant SDS requirements in the following locations on the FPSO:

- Topsides chemical skid M5;
- Paint locker, located in alleyway near Accommodation, next to emergency generator switchboard room;
- Hazardous waste storage area;
- Oxygen/ acetylene lockers on poop deck;
- Aviation fuel tanks main deck aft of laydown Skid M12;
- Diesel oil and lube oil storage;
- Propane flare pilot fuel located on the KO Drum module;
- Machinery space chemicals and lubricants and grease storage;
- HPU skid; and
- Laboratory.

On the WHP, hazardous materials are stored, again in accordance with the relevant SDSs, in the following locations:

- Nitrogen storage adjacent to the laydown area on the main deck; and
- Diesel tank for generator and crane are stored in pedestal storage tank.

The following hazardous materials will be stored in either of the bunded laydown areas:

- Lube oil for generator set and crane;
- Cleaning agents; and
- General purpose hydraulic fluid for the crane.

The following controls are in place for the storage of bulk chemicals:

- Bunding and closed drains;
- SDS information available;
- Spill kits; and
- Signage.

3.4.3 Production Hydrocarbons

Montara crude is a medium crude oil. The oil is characterised by a low viscosity (4.5 cP) and a medium density of 845 kg/m3 (API 35.8) categorising it as a Group III oil in accordance with the International Tanker Owners Pollution Federation (ITOPF 2011). Assay data indicates that approximately 27% (by volume) of the Montara crude is considered persistent under international oil property benchmarks.

The oil from Skua, Swift and Swallow fields that are comingled with Montara oil to varying degrees are considered Group II oils (International Tanker Owners Pollution Federation (ITOPF 2011) with low viscosities of 3.0, 3.8 and 3.2 cP and medium densities of 42.7, 43 and 49.5 API, respectively.

Fuel Oil

The FPSO is equipped with two diesel bunkering stations. One station is located on the aft starboard side above the slops tank and the other station is located on the midship starboard. Specific bunkering procedures are contained in Jadestone's Montara Marine Facility Manual (MV-90-PR-H-00001). The bulk fuel oil/ diesel tanks are within the hull, with capacities as shown in **Table 3-6**.

Table 3-6: Fuel tank capacities

Tank	95% capacity (m3)
Side tank forward (P&S)	778
Side tank aft (P&S)	571
Side	906
Aft	544
Settling tanks (S)	64
Diesel service tank	64
Total	2,927

The diesel fuel is used by:

- Solar turbines, for power generation and gas reinjection;
- Steam boilers;
- Midships crane;
- Essential diesel generators;
- Emergency diesel generator;
- Emergency Starting Air Compressor;
- Fire pumps;
- Fast Rescue Craft;
- Facility Work Boat;
- Totally Enclosed Motor Propelled Survival Craft (TEMPSC); and
- Well services.

Contingency plans are in place for dealing with emergencies including spills with the Montara Operations OPEP detailing the response to oil spills.

During bunkering, there shall be direct contact via agreed VHF channel between the transfer vessel and the FPSO. Should there be a spill at any time, pumping will be stopped immediately; and the general alarm sounded. The vessel SOPEP, Montara Operations OPEP and Montara Incident Response Plan (MV-70-PLN-F-00001) will be initiated.

The FPSO generally operates on fuel gas, however if due to maintenance or unplanned events the maximum diesel usage per month would be between 400–600 t, which would require one to two supply boat bunker trips per month (depending on boat size).

3.4.4 Naturally Occurring Radioactive Materials

Naturally Occurring Radioactive Materials (NORMs) can sometimes be present in piping and vessels of an oil processing facility.

NORMs are in the category of low specific activity (LSA) radioactive materials. LSA radioactive materials can emit only a limited amount of radiation which cannot deliver a fatal radiation dose. This EP addresses risk with NORMs in relation to removal and disposal ashore. NORMs are managed in accordance with the Montara Radiation Management Plan (MV-70-PLN-F-00002). This plan has been developed in accordance with the Northern Territory Radiation Protection Act, to outline the potential sources, storage, transportation, and emergency management requirements.

3.5 Maintenance and inspections

The facilities are maintained to ensure that over the field life they can perform their intended functions such that risk to personnel, the environment and assets is minimised in a cost-effective manner.

The facility is designed for continuous service with a design life of 20 years. The FPSO vessel, turret and mooring systems have been designed to allow all essential maintenance and mandatory inspections to be performed in the field whilst in continuous operation without dry-docking, with in-water survey in lieu of dry docking (UWILD) for Class.

Shore-based maintenance support services (where appropriate) are provided by contractors to assist with planned maintenance, unscheduled breakdown and non-core activities.

A combination of maintenance methods and techniques are employed including, but not restricted to:

- Frequency based inspection and testing;
- Breakdown maintenance;
- Subsea control valve testing;
- Well tree valve testing;
- Treatment of water if the flushing of flowlines is required;
- Performance monitoring;
- Vibration analysis;
- Non-destructive testing;
- Thermographic imaging;
- Oil analysis; and
- High Voltage Motor Current Spectrum Analysis.

Maintenance strategies have been developed to contribute directly toward corrosion prevention and the maintenance of Technical Integrity. These are based on an examination of the critical failures, critical failure frequencies, failure modes and mechanisms and identification of alternative maintenance strategies which reduce failure frequencies and optimise resource utilisation. The technical specifications of the facilities have been taken into consideration along with specialist consultation and the industry experience of Jadestone personnel.

Jadestone utilises Integrity Management from within the Computerised Maintenance Management System (CMMS) as defined by Performance Standards. All systems and equipment shall be maintained to meet the specified functions in accordance with these Performance Standards and process requirements.

Maintenance activities are detailed and recorded in the CMMS. Each maintenance activity has a priority based on its criticality identified during Safety Integrity Level (SIL) analysis, the Formal Safety Assessment and associated studies. A history of the maintenance for a piece of equipment can be recalled by the system at any time, and reminders are automatically generated by the system for periodic inspection, testing and maintenance. It is maintained via the intranet by the Operations team, and subject to audit and review. Maintenance Management System workshops were held to determine equipment priority level and captured in the CMMS.

Subsea control valves are required to be opened and closed depending on operational requirements. Each time a subsea tree or manifold is closed completely, control fluid is vented. Shutting in a single subsea tree releases approx. 14 L of control fluid. The volume of the subsea tree valve actuators vary, with the largest discharge volume being 16.6 L for the Manifold gate valves. In the case of an emergency shutdown and closure of all subsea actuated valves, 130 L of fluid is vented.

The subsea infrastructure is designed to be maintenance free over the entire life of the field, however there are a number of sub-assemblies in the trees that may wear or fail in service that are replaceable. On the subsea trees, Subsea Control Modules (SCMs), production choke inserts and annulus choke inserts are replaceable components and spares are maintained in inventory. The Swift manifold also has a replaceable SCM and the Subsea Distribution Unit (SDU) is designed to for in-service replacement.

Other activities completed on the subsea infrastructure during the life of field include repairs to damaged components, replacement of umbilicals, anode-retrofits, external inspection, measurement, non-destructive testing, rectification of scour or freespans, and cleaning of marine growth.

A freespan is an unsupported length of flowline suspended between two or more elevated points on the seabed. Stabilization of freespans is by installation of supporting appurtenances underneath the flowline at the mid-point of the span. Methods of stabilization include concrete mattresses, grout bags, concrete sleepers, and inflatable grout pyramids.

If the span is in evidence and remains over length during inspection, an engineering assessment would be conducted to determine the risk of damage (Subsea Inspection Procedure MV-00-PR-F-00006). If the risk assessment determines that freespan rectification is required, management of change process will ensue.

3.6 Utilities

3.6.1 Power Generation and Distribution

Main electrical power for the FPSO is provided by two gas turbine generators. The gas turbines are dual fuelled units, normally operating on fuel gas produced from the process train but also capable of operating on diesel. Hydraulic power, chemical injection, electric power and fibre optic control/ communication are supplied to the WHP via the 1.8 km long subsea umbilical from the FPSO. The subsea umbilical cable will also provide fibre optic communications between the WHP and the FPSO.

Auxiliary power is provided by the three (3) 800 kW diesel powered generators located in the facility's machinery space below deck. A 600 kW emergency generator located in the emergency generator room supplies the emergency switchboard. Emergency generator start is fully automatic on loss of voltage on the essential switchboard. It can also be manually started in the emergency generator room.

In case of main power failure, the emergency diesel generator supplies power to services that are essential for safety. The emergency lighting philosophy is based on approximately 1/3 of lights powered from the main supply, 1/3 from the emergency supply and 1/3 from the emergency supply with battery back-up. If main power and emergency power are unavailable, the 24 V DC UPS system supplies power to sustain critical users requiring a no-break supply during the period of emergency or the loss of main power supply.

WHP power generator is not required for normal operations, only for maintenance visits.

During operations, WHP is powered by the FPSO via a subsea umbilical. In the event there is not a power supply to WHP, for example during a shutdown of the FPSO, the WHP generator is used for maintenance purposes.

3.6.2 Boilers

Two boilers located in the machinery space provide steam. These have been converted to dual fuel, operating normally on fuel gas with the option to operate on diesel. The system is designed to 2,650 kPag, with normal supply at 2,452 kPag. Generated steam is used for driving the cargo discharge pumps, cargo tank heating coils, production heat exchangers and the freshwater generators. The boiler exhaust gas is the source of inert gas used to inert the cargo tanks.

3.6.3 Compressed air systems

There are two compressed air systems on the FPSO which provide instrument air:

- Starting air:
  - The starting air system for the three essential diesel generators and emergency diesel generator; and
  - A diesel driven Emergency Air Compressor with an 80 L capacity air receiver supplying the emergency generator starter system.
- Control and working air:
  - The instrument and plant air system consist of three Instrument Air Compressors and two instrument air dryers.

3.6.4 Nitrogen generation package

The nitrogen generation package provides nitrogen for the supply of inert gas to the flare and process facilities. It is in the engine room third deck level. Filtered Instrument air is supplied to the nitrogen generator membrane separators. Using reverse osmosis, two streams of gas are produced: one 95–99% pure nitrogen and the other is oxygen rich and vented.

Nitrogen is supplied to the following areas and equipment:

- Produced Water Module;
- Separation Module;
- Reinjection Compressor Module;
- Glycol regeneration Module;
- Flare Knockout Drum Module;
- Chemical Injection Module;
- Turret–STP Compartment;
- Boiler Fuel Gas Line; and
- Chemical injection storage area (for Methanol tank blanketing).

If the nitrogen generators are temporarily out of service, nitrogen can be supplied by contingent nitrogen cylinders which are connected to the distribution header.

3.6.5 Fresh water generators

Two fresh water generators, located in the machinery space, provide potable water. The system is supplied with seawater from the seawater system.

Potable water is supplied to the accommodation for domestic services (via UV sterilizers and clarifiers). Potable water is also supplied to the essential diesel engine expansion tanks, emergency generator room, eye wash and safety shower systems and the utilities water system on deck. The fresh water storage tank has a capacity of 422 m^3. Freshwater can also be bunkered to augment the water generators if required.

3.6.6 Seawater lift pumps

Two seawater lift pumps are installed in caissons penetrating through the 4-starboard wing ballast tank and provide seawater for cooling purposes. The seawater from the pumps passes through two manually operated strainers to remove any marine solid particles in the seawater. Marine growth is controlled by sterilisation via electrolysis by the marine growth prevention system (MGPS) which is injected into the caisson, following which it is deoxygenated and sterilised by electrolysis (by release of chlorine from the salt solution) and then circulated through a heat exchange prior to discharge back into the ocean. The heated water is discharged at up to 45ºC above ambient seawater temperature. The seawater cooling is provided to the crude oil rundown cooler, re-injection compressor, power generation modules, produced water discharge cooler and glycol cooler.

3.6.7 Sewage, grey water and putrescible waste system

The sewerage system consists of a Grey Water collection system and a Black Water collection system from the accommodation. The sewerage treatment package has been sized to cope with the potential for extended POB of 78 personnel, although there will be considerably fewer POB during normal operations.

The sewage treatment unit is a self-contained system for the treatment of sewage to prevent the pollution of surrounding waters. The system uses the aerobic principle of sewage digestion, coupled with treatment of the final effluent, and is generally accepted as the most compact, efficient and flexible system for use on an FPSO.

The sewage treatment package receives the sewage which enters the first of three chambers where the sewage is exposed to bacteria and aeration which breaks down the sewage before discharge overboard from the final chamber, in accordance with MARPOL regulations. During planned maintenance periods on the sewage treatment system, sewage will be discharged from the system untreated into the marine environment for a limited amount of time (24–48 hours) at a frequency expected to be approximately 4–6 times annually.

An FPSO with a crew of approximately 25–30 discharges in the order of 30 m^3 of treated domestic wastewater per day during normal production operations.

Putrescible waste from the galley shall be discharged to sea after maceration to a particle size of less than 25 mm in accordance with MARPOL.

Under ECR 0768, sewage from the toilet located on the unmanned WHP is contained in a portaloo that is 'exchanged' for a new one when necessary. Due to the limited and infrequent volumes discharged, associated only with inspection and maintenance activities, this is not considered further in this Environment Plan.

3.6.8 Solid waste management

Non-hazardous solid waste materials are expected to include paper, rope, cardboard, sacking, timbers, scrap metal, domestic packaging (food and drink containers) and plastic.

Hazardous waste can be defined as materials with potential to endanger the health or safety of personnel, or harm the environment. Hazardous waste associated with the facilities may include fuel and lubricating oils, aerosol cans, batteries, acids/ caustics, chemicals associated with operation and maintenance processes, spent fluorescent tubes, paint and thinners and proprietary cleaning agents.

All dangerous goods or materials will be assessed case by case. Empty packaging that has previously carried hazardous waste shall also be treated as hazardous waste unless adequate precautions have been taken to ensure that there is no potential for harm to the marine environment, personnel and/or the facility.

Storage and handling of mixed class of dangerous goods in packages and intermediate bulk containers and corrosive substances will follow the guidelines set in AS/NZS 3833 and 3780 respectively. The transport of hazardous wastes is regulated using the Multimodal Dangerous Goods Form in accordance with MARPOL 73/78 Annex III Regulation 4, and in accordance with State and Territory legislative requirements.

3.7 Emergency Shutdown

The Montara Emergency shutdown is staged and follows the Montara Emergency Shutdown System Philosophy (MV-00-PHL-G-00001). The types of shutdown include:

- FPSO and Field Shutdown;
  - ESD 0 – Abandon Field;
  - ESD 1 – Total Facility Shutdown;
  - ESD 1.1 – Total Production Shutdown;
  - ESD 2 – Emergency Production Shutdown with Blowdown;
- WHP shutdown;
  - WESD 0 – Abandon WHP;
  - WESD 1 – Total Installation Shutdown; and
  - WESD 2 – Total Production Shutdown.

3.8 Support Facilities

3.8.1 Aviation

Regular crew change and freight exchange are met by fixed wing aircraft followed by a helicopter transfer to the facility.

It is anticipated that there will be an average of two crew change flights per week plus additional flights on an as-required basis for visitors, maintenance campaigns, non-standard operational activities etc.

The FPSO helideck is located aft of the accommodation. A helicopter refuelling system is installed on the upper deck, starboard side, forward of the accommodation block.

3.8.2 Supply vessels and support operations

Regular supply vessel runs are made to the facility and typically occur once every two to three weeks. General cargo is offloaded by the mid-ships crane and galley stores via the aft crane. In conjunction with the visits to the FPSO, supply boats may visit the WHP to deliver maintenance supplies.

Support vessels are utilised over field life for activities such as inspection, maintenance and remedial works including ROV inspection of subsea systems, as well as static tow during offtake. Underwater operations may be carried out using diving or ROV support vessels.

The following types of underwater operations may be undertaken during the life of operation, but are not limited to:

- Inspection of subsea equipment;
- Metrology;

- Non-destructive testing;
- Side scan sonar surveys of subsea equipment;
- Hull survey;
- Cleaning of the sea chests;
- Ship's valve replacements;
- Repairs to damaged components;
- Replacement of worn or failed components;
- Anode-replacements;
- Rectification of scour or freespans; and/or
- Cleaning of marine growth.

All subsea inspection/ intervention work must comply with the following as a minimum:

- Specific Simultaneous Operations (SIMOPS) Matrix;
- Support vessels can only enter the FPSO 500 m petroleum safety zone (PSZ) with the FPSO OIM's permission; and
- Support vessels can only anchor in permitted anchorage positions in the field.

3.9 Maintenance and removal of property

3.9.1 Maintenance of property

Section 572(2) of the OPGGS Act requires that a titleholder must maintain in good condition and repair all structures that are, and all equipment and other property that is:

(a) in the title area; and

(b) used in connection with the operations authorised by the permit, lease, licence or authority

Through ongoing monitoring and maintenance (as described in **Section 3.5**), Jadestone will ensure that property is monitored, maintained and repaired as required throughout operations. This includes

- Routine inspections on operational and suspended infrastructure
- Assurance activities
- Maintenance activities

3.9.2 Asset Lifecyle and removal of property

Jadestone is committed to managing the lifecycle of its assets through the implementation of Jadestone's Management of Aging Assets Philosophy (JS-00-PHL-G-00001) which applies to all Jadestone's operating assets. The objectives of this philosophy are to:

- Describe the systematic approach taken to implement, verify and assure the management of ageing assets;
- Identify how the organisation supports delivery on a sustainable basis;
- Describe how planning and implementation is affected; and
- Identify how validation and assurance activities influence the overall program.

The current expected field life for Montara is estimated at 2032 therefore, no end of facility life (EOFL) decommissioning activities for the subsea or topsides infrastructure is scheduled to occur within the 5-year in-force period of this EP. Design life in the context of facilities is used in procurement to avoid any obsolescence issues arising during the nominated period, whereas facility integrity is indefinite subject to

ongoing integrity management. As required, re-lifing projects occur which consider the age and integrity of property and future use in the consideration of life extension
Life extension beyond original design life is an ongoing independently certified process which is subject to an agreed ongoing integrity management program), and the current strategy for decommissioning the Montara field is to undertake removal of property at the end of field life. Property may also be decommissioned and removed prior to this date, if that property is determined at any time to have no future utility.

Section 572 (3) of the OPGGS Act requires that a titleholder remove from the title area all structures that are, and all equipment and other property that is, neither used nor to be used in connection with the operations:

(a) in which the titleholder is or will be engaged; and
(b) that are authorised by the permit, lease, licence or authority.

Unless other arrangements are made to the satisfaction of NOPSEMA decommissioning activities are not covered as part of this EP (including the plug and abandonment of wells, or removal of wellheads) and will be subject to separate approval. Prior to the end of field life (currently estimated as 2032) whilst the title is still in force, a decommissioning plan will be in place that sets out the strategy for removal of property from the permit area. As parts of the facilities and infrastructure become redundant, these will be part of a removal plan whilst the decision for removal of these will be subject to approval and costs. Cost optimisation can be achieved through multi-asset campaigns to share mobilisation/demobilisation fees, decrease vessel day rates and improve labour and services unit cost rates. Therefore, for infrastructure to remain in field under a maintenance and inspection regime (refer above), the assets will need to be assessed to ensure that:

- risks to other marine users by their presence is low
- environmental risks of leaving infrastructure in situ for a period of time are low
- the ability to remove the infrastructure at a future date is not compromised by leaving the infrastructure in situ for a period of time
- the costs to recover standalone pieces of equipment are considered disproportionate to the costs of leaving in situ until a later period when cost optimisation can occur.

3.9.3 Decommissioning Planning Process

As part of ongoing validation of the Montara Asset Decommissioning & Restoration (D&R) liability, Jadestone completes an external review of the facilities D&R technical basis and associated cost estimate annually with a report compiled every 3 years which effectively follows a 3-year cycles of 2-years top down review followed by a bottom up budget in the 3rd year. The cost estimate study is based on the available technical information using previous Operator D&R studies, facilities engineering documents, current Australia D&R Regulations and current Australia project execution cost norms.

The suspension of assets will require flushing and de-oiling to leave the infrastructure without hydrocarbon inventory and ensure integrity is maintained as part of the “lighthouse keeping” process required before D&R operations are executed. This includes:

1. WHP well and topsides flushing and purging
2. Subsea Flowlines, umbilicals and risers flushing and de-oiling
3. FPSO flushing/purging equipment as needed, flush and de-oil all processing equipment prior to disconnection and sail-away

Preliminary cost estimates have been completed to consider the costs associated with heavy lift vessels to remove infrastructure, allowance for deck strengthening on the WHP to allow for lifting, and site remediation and restoration works to clear debris post removal. The base case for decommissioning at Montara is complete removal, however consideration will also be given to partial abandonment in situ which is subject to further assessment, management approvals, studies, regulatory approvals and stakeholder consultation; and these options may change during the approvals process.

The timeframe allocated to planning for decommissioning allows for the preparation of a Cessation of Production EP and/or decommissioning EP and to have each assessed by NOPSEMA sufficiently in advance of activities commencing to ensure each EP is accepted prior to activities commencing and prior to end of field life. Jadestone's commitment to having a decommissioning framework is provided in management control 177: *No later than five years prior to the end of field life, Jadestone will have a decommissioning framework that details how JSE will meet the obligations under s.572 of the OPGGS Act. This will include*

- timeframes for regulatory approval documents
- inventory of all in-field infrastructure
- status of all in-field infrastructure
- overall decommissioning concept.

4. 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 approach to the evaluation of impacts and risks due to an activity (**Section 4.1**), and the outcomes of the impact and risk assessment undertaken for operation of the Montara operations activity (**Section 4.6**).

4.1 Assessment Method

The environmental impacts and risks associated with the proposed operations activities within production licenses AC/L7 and AC/L8 have been assessed using the Jadestone Risk Management Framework (JS-70-PR-F-00009 Rev 1) 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 10Ac).

The impact and risk management process is shown in **Figure 4-1**.

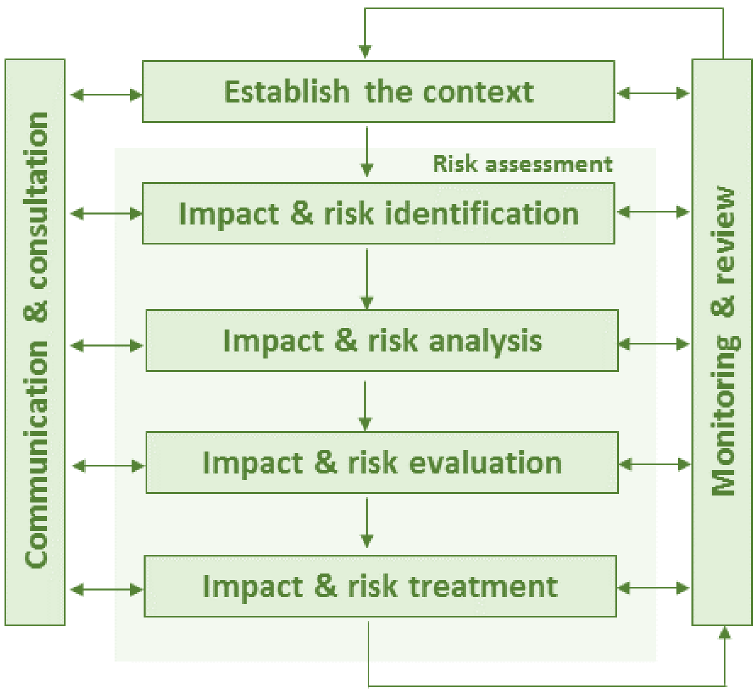


Image source: NOPSEMA (GN0165 Risk Assessment Rev 5 2017)

Figure 4-1: Impact and risk evaluation process

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

4.2 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 4.6**).

4.2.1 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).

4.2.2 Risk ranking process

Risks are ranked using the Jadestone Qualitative Risk Matrix (**Table 4-1**). Environmental ranking of a measure between **Low** to **Extreme** is determined by evaluating the likelihood of the accidental event occurring, and evaluation the expected severity of the consequence with standard expected control measures in place.

Table 4-1: 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 based on 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 4-2**).

Table 4-2: Definition of consequence level

Consequence		**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 or unplanned 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 or unplanned events (**Table 4-3**). A likelihood level is not assigned to planned events.

Table 4-3: 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 impacts and 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.

4.3 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 variability in severity. The degree of environmental impact and the corresponding level of acceptability is assessed against a number of guiding principles:

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

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

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 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 or risk.

A reduction of impacts to as low as reasonably practicable follows the process as described for the reduction of risks to ALARP in **Section 4.5.**

4.4 Demonstration of Acceptability

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

Table 4-4: Jadestone's acceptability matrix

Guiding principles	Impact level				
	1	2	3	4	5
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
Conservation and management advice	Activity does not contact/ interact with sensitivities protected by conservation and management advice	Activity triggers 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
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
Reputation	Slight impact – no media coverage	Limited impact – State media coverage	Considerable impact – national coverage	National impact – persistent national coverage	International impact – international coverage
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
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

4.5 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 4-2**.

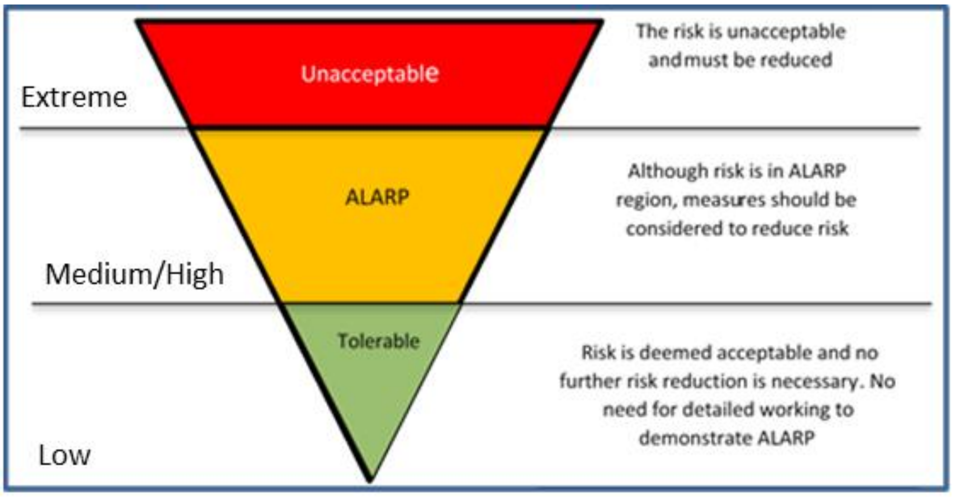


Figure 4-2: ALARP triangle

4.6 Evaluation Summary

An impact and risk assessment workshop was conducted by Jadestone on the 31st of August 2018 to generate a register to reflect the Jadestone Impact and Risk Management Framework (JS-70-PR-F-00009). 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, maintenance, operations, emergency response and environmental personnel.

The assessment process undertaken by Jadestone in August 2018 for the operations activities within production licenses AC/L7 and AC/L8 identified eight planned aspects and five 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 Montara Operations Impact and Risk Register, and summarised in **Table 4-5**.

Table 4-5: Summary of the environmental impact and risk assessment rankings for aspects and hazards associated with planned and unplanned events during the Montara operations

Hazard	Consequence Ranking
Planned activities	
1. Light emissions	Negligible
2. Noise emissions	Negligible
3. Atmospheric emissions	Negligible
4. Liquid discharges	Negligible
5. Chemical discharges	Negligible
6. Produced Water discharges	Negligible
7. Physical presence	Moderate
8. Seabed disturbance	Negligible
9. Spill response activities	Negligible

Unplanned activities	*Consequence*	*Likelihood*	*Residual Ranking*
1. Unplanned Flaring	Minor	Unlikely	Low
2. Marine pest introduction	Moderate	Unlikely	Medium
3. Interaction with Fauna	Minor	Likely	Medium
4. Unplanned release of solid waste	Minor	Likely	Medium
5. Unplanned release of (Non-hydrocarbon) liquids	Negligible	Rare	Low
6. Worst Case Diesel Spill	Major	Unlikely	Low
7. Worst Case Crude Spill	Minor	Unlikely	Low

4.7 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;
2. Determine the environment that may be affected (EMBA);
3. Identify sensitive receptors;
4. Determine priority receptors; and
5. ALARP and acceptability evaluation for spill response activities.

4.7.1 Determine Oil Spill Modelling Thresholds

Threshold concentrations for each of the hydrocarbon component types (floating oil, entrained oil and dissolved aromatic hydrocarbons) are specified as inputs for the model to determine what contact is recorded for each hydrocarbon type and the location, to ensure that recorded contacts are for 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 EMBA and the subsequent impact 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 B**.

4.7.2 Determine the EMBA

The EMBA for hydrocarbon concentration thresholds for the worst-case spill scenario for this EP is shown in **Figure 5-1**. These contact concentrations are used to inform spill response preparedness and planning as they are the most conservative, environmentally meaningful, impact thresholds for oil (**Appendix B**). A detailed description of the spill scenario resulting in the EMBA is provided in **Section 8.7**.

4.7.3 Sensitive Receptor Identification

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

Sensitive receptor assessment considers:

- <u>Protected Area Status</u>: used as an indicator of the biodiversity values contained within that area e.g. World Heritage Area, Ramsar site and Marine Protected Area;
- <u>Biologically Important Areas (BIA) of Listed Threatened Species</u>: 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;
- <u>Social values</u>: socio-economic and heritage features (e.g. commercial fishing, recreational fishing, amenities, aquaculture);
- <u>Economic values</u>: recreational and commercial fishing areas;
- <u>Listed species status and predominant habitat (surface versus subsurface)</u>: 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 EMBA have been identified, the potential oil pollution risks are described and evaluated (refer **Sections 8.4** and **8.5** impacts and risks sections); in addition, the environmental risks from implementing spill response activities are described and evaluated (refer **Section 7.9**).

Sensitive receptors are further evaluated by considering what values are contained within them when determining appropriate spill response strategies (refer **Section 7.9**). This informs the Oil Pollution Emergency Plan (OPEP) and guides spill response preparedness and planning.

The next step is to determine those sensitive receptors within the EMBA that are considered to be at 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.

4.7.4 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 EMBA will be contacted at the same time or at all. Instead, the 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 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 EMBA) specific to a particular spill are selected using the following criteria:

- Sensitive receptor within 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 periods1; AND
- Any other area of interest within the EMBA including areas that have a high social value or are a concern raised through stakeholder consultation (refer **Section 6**).

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 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 (refer Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008), **Section 6, Figure 6-1**).

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 (refer **Section 8.7**), 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.

4.7.5 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 priority receptors, and, to ensure

[1] 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.

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 4-3**.

The process promotes a clear link between the nature and scale of the maximum credible worst-case spill scenario and the identified priority receptors 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 4-4**).

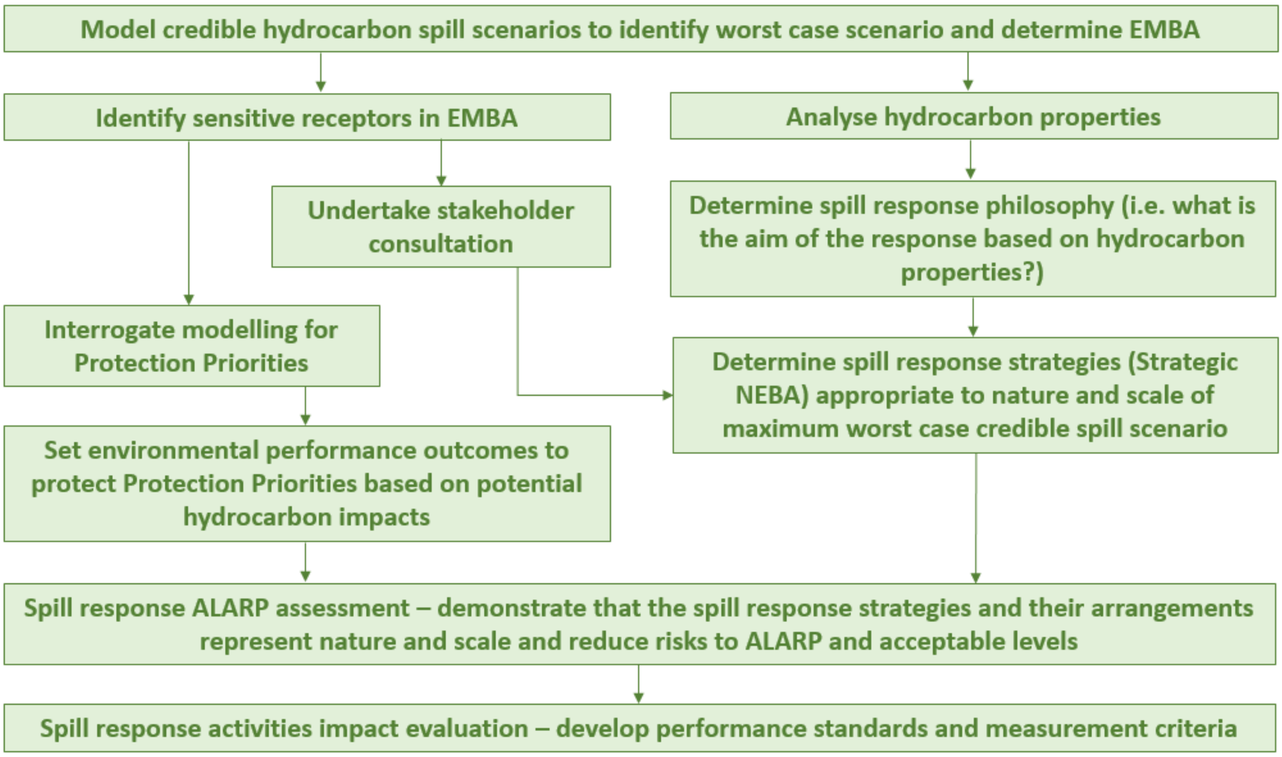


Figure 4-3: Spill scenario evaluation and ALARP determination process

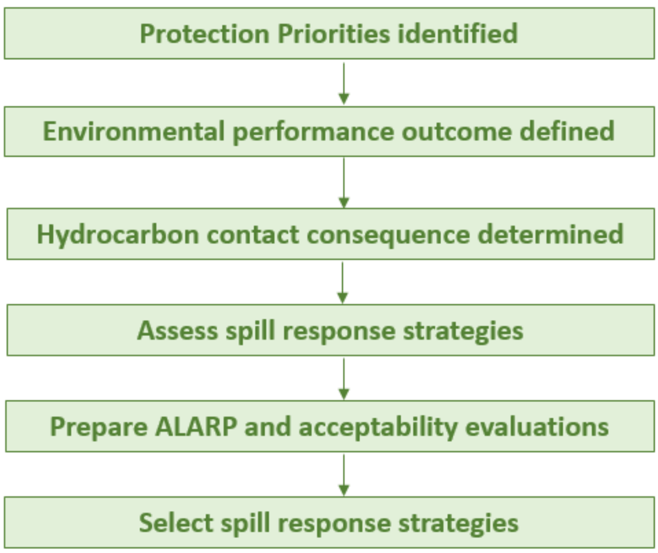


Figure 4-4: Spill control analysis and ALARP determination process

5. EXISTING ENVIRONMENT

5.1 Definition of Areas

Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009, 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 2.3**); and
- The **Environments that May Be Affected (EMBAs)** – the geographical area encompassing the environment that may be affected by the unplanned events associated with the activities described (**Section 3**). Refer to **Section 8.7.4** for more detail on how the thresholds were defined and the modelling underpinning the EMBAs delineation.

The spatial extent of the EMBAs and location of the Operational Area is presented in **Figure 5-1**.

To assist in the later impact assessment, four sub-categories of EMBA were defined:

4. Surface hydrocarbons EMBA– hydrocarbons that are 'on' the water surface (1 g/m^2);
5. Entrained hydrocarbons EMBA– hydrocarbon that is entrained 'in' the water; (100 ppb);
6. Dissolved hydrocarbons EMBA– the dissolved component of hydrocarbon in' the water (70 ppb); and
7. Shoreline loading EMBA – hydrocarbons greater than 10 g/m^2.

Collectively the total area of impact they intersect with is referred to as the "EMBAs".

The environmental values and sensitivities in the EMBAs have been used to inform the assessment of unplanned events, particularly diesel and oil spill response planning and oil spill risk assessment (**Section 8.7** and **Section 8.8**). Full details of the environmental values and sensitivities in the EMBA is contained in **Appendix C**, and not discussed any further here.

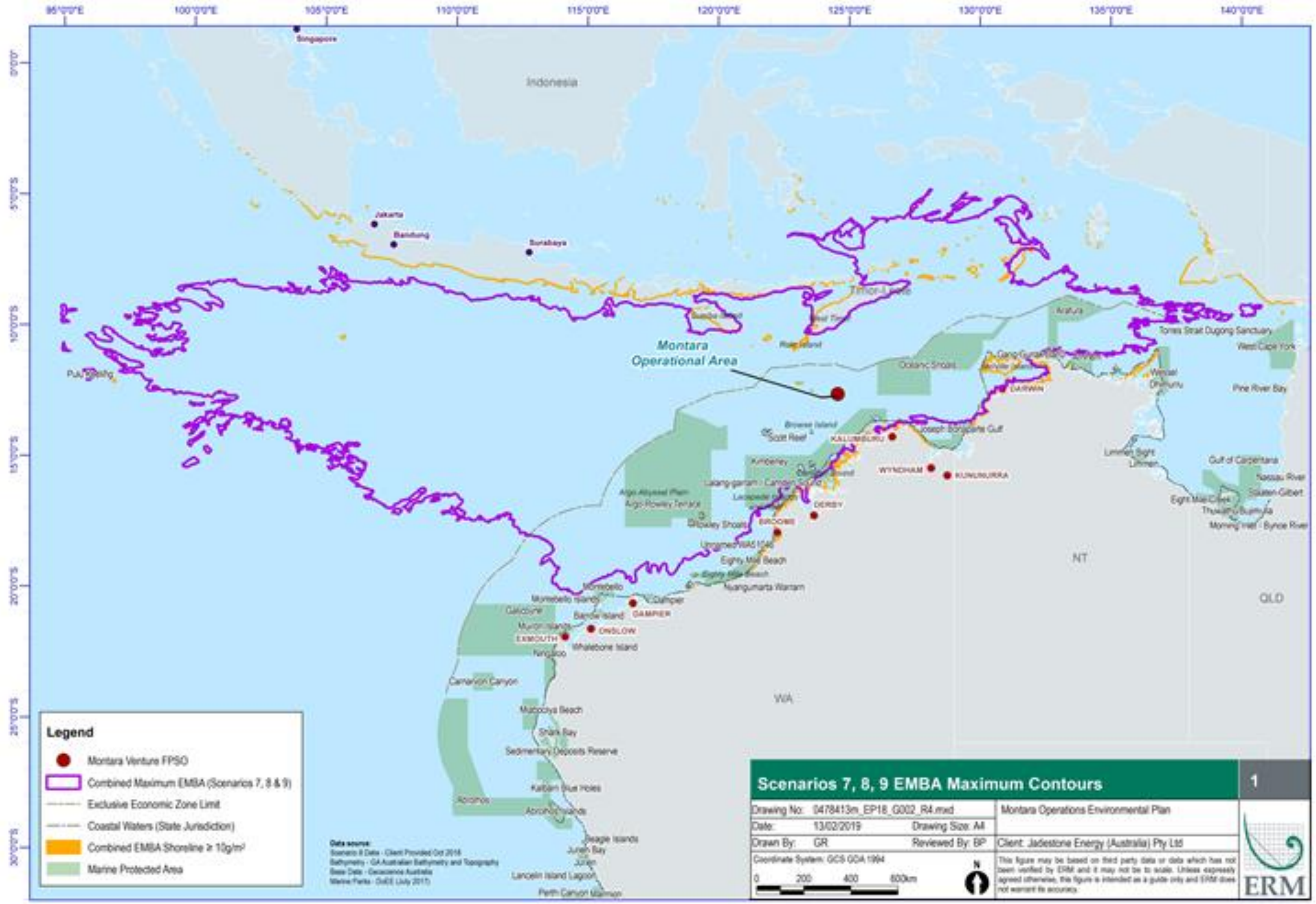


Figure 5-1: Montara Operations and EMBA

5.2 Marine Regional Setting

Australia's offshore waters have been divided into six marine regions in order to facilitate their management by the Australian Government under the EPBC Act. The Montara operations activity is located within the North West Marine Region (NWMR). The NWMR encompasses Commonwealth waters from the Western Australia/ Northern Territory border in the north, to Kalbarri in the south. The main physical features and values of the NWMR are:

- Ashmore Reef, Cartier Island, Seringapatam Reef and Scott Reef (**Appendix C**), which have been identified as regionally important areas supporting a high biodiversity of marine life and supporting foraging and breeding aggregations. Ashmore Reef and Cartier Island are located approximately 160 km and 100 km north-west, respectively, from the Operational area;
- A number of key ecological features (KEFs) have been identified in the region (Section 5.4.6). The Continental Slope Demersal Fish Communities has been identified as an important marine community, due to its high species diversity and endemism. The Carbonate Bank and Terrace System of the Sahul Shelf has also been identified as regionally important as it is a unique sea floor feature; contributing to the biodiversity and productivity of the local area; and
- Other priority areas in the NWMR include Rowley Shoals and Ningaloo Reef. However, these areas are at least 700 km from the Operational area.

Within the NWMR the Operational Area lies at the junction of two provincial bioregions summarised in **Table 5-1**.

Table 5-1: Provincial bioregions in Operational Area

Area	Description
Timor Province	The Timor Province covers an area of 24,040 km^2 and predominantly covers shelf terrace and the continental slope, extending into waters 200 – 300 m deep in the Arafura Depression. The oceanographic environment is mainly influenced by tides, with some influence from the Indonesian Throughflow current. These open waters support pelagic species, including whale sharks, an unusual array of threadfin fish species and distinct genetic stocks of red snapper.
Northwest Shelf Transition	The Northwest Shelf Transition covers the mostly shallow waters (<100 m) between Cape Leveque (WA) and the Tiwi Islands (NT). This transition has a diverse seafloor topography including submerged terraces, carbonate banks, pinnacles, reefs and sand banks.

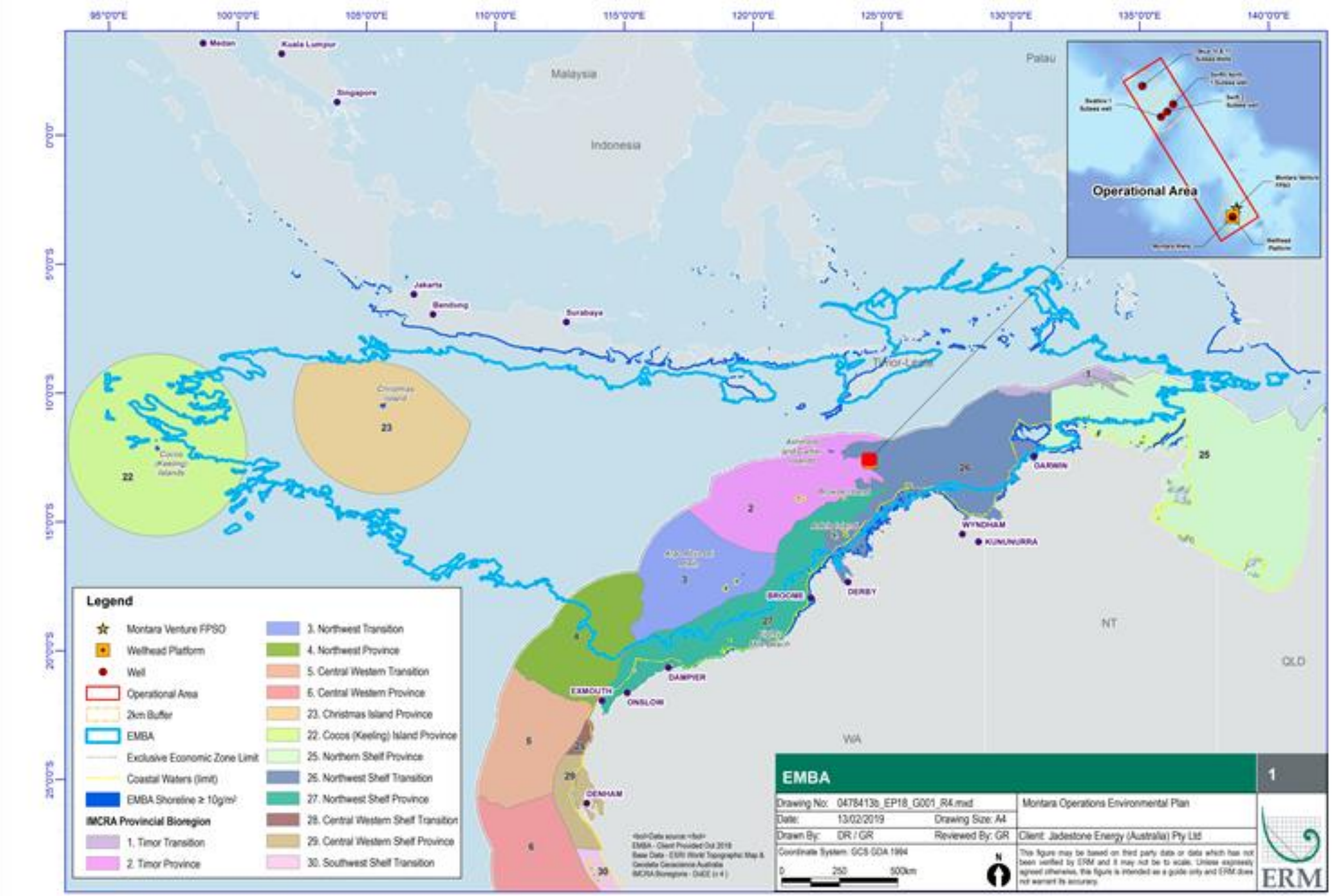


Figure 5-2: ***Provincial Bioregions relevant to the Operational Area***

5.3 Physical Environment

Climate

The Operational Area experiences a monsoonal climate with two predominant seasons including a hot wet summer season, October to March and a cool dry winter season April to September, which are referred to as the northwest and southeast monsoons, respectively. The climate is influenced by two major atmospheric pressure systems: the subtropical ridge of high pressure cells referred to as highs or anticyclones, and a broad tropical low pressure region called the monsoon trough (RPS Metocean 2008). These two major systems create three discrete weather phenomena that influence conditions within the Operational area and wider EMBA:

- The north-west monsoon season occurs from October to March, or wet season, and is characterised by north-west to south-west winds. The monsoon season is generally associated with broad areas of cloud and rain including periods of widespread heavy rainfall;
- Steady north-east to south-east winds (south-east trade winds) from April to September (dry season) caused by development and intensification of anticyclones over south-western Australia, bring predominantly fine conditions with low rainfall in most areas; and
- Cyclonic activity occurs between November to April and the area will experience on average three cyclones a year. Cyclones can bring very large amounts of rain, with strong swell and rough seas common during these events.

In general, January to February and May to July are the windiest months however, peak wind velocities are associated with tropical cyclones that occur during the wet season. Cyclone probability is estimated to be one per annum within 180 km of the site and four per annum within 1,100 km of the site.

Mean annual rainfall in the region is 1,770 mm. Mean air temperature ranges from 24.9ºC in July and 29.6ºC in December. The closest meteorological station to the Montara field is located at Troughton Island approximately 630 km south-west of the Operational area (Bureau of Meteorology (BoM) 2012) (**Table 5-2**).

Table 5-2: Meteorological conditions representative of the Montara Field (Troughton Island)

Month	Mean Monthly Maximum Temperature (Cº)	Mean Monthly Minimum Temperature (Cº)	Mean Rainfall (mm)	Mean Relative Humidity (%)
January	31.8	26.3	273.0	77
February	31.4	26.1	137.9	78
March	31.9	26.4	145.3	74
April	32.7	26.8	31.2	64
May	31.1	25.3	40.5	58
June	28.9	23.2	7.6	56
July	28.1	22.1	2.8	58
August	28.8	22.5	0.6	62
September	30.2	24.5	0.3	69
October	31.7	26.3	2.9	69
November	32.9	27.4	9.4	69
December	32.9	27.3	120.1	69

Month	Mean Monthly Maximum Temperature (Cº)	Mean Monthly Minimum Temperature (Cº)	Mean Rainfall (mm)	Mean Relative Humidity (%)
Annual	31.0	25.3	828.9	67

5.3.1 Oceanography (Tides and Currents)

Broad scale oceanography in the north-west Australian offshore area is complex, with major surface currents influencing the Region, including the Indonesian Throughflow, the Leeuwin Current, the South Equatorial Current and the Eastern Gyral Current (**Figure 5-3**).

The oceanographic regime of the north west Australian offshore area is strongly influenced by the Indonesian Through Flow (ITF) which transports warm, low salinity, oligotrophic waters through a complex system of currents, linking the Pacific and Indian Ocean via the Indonesian Archipelago (Department of State Development (DSD) 2010) (**Figure 5-3**). The strength of the ITF fluctuates seasonally and reaches maximum strength during the south-east monsoon (May to September) and weakens during the north-west monsoon.

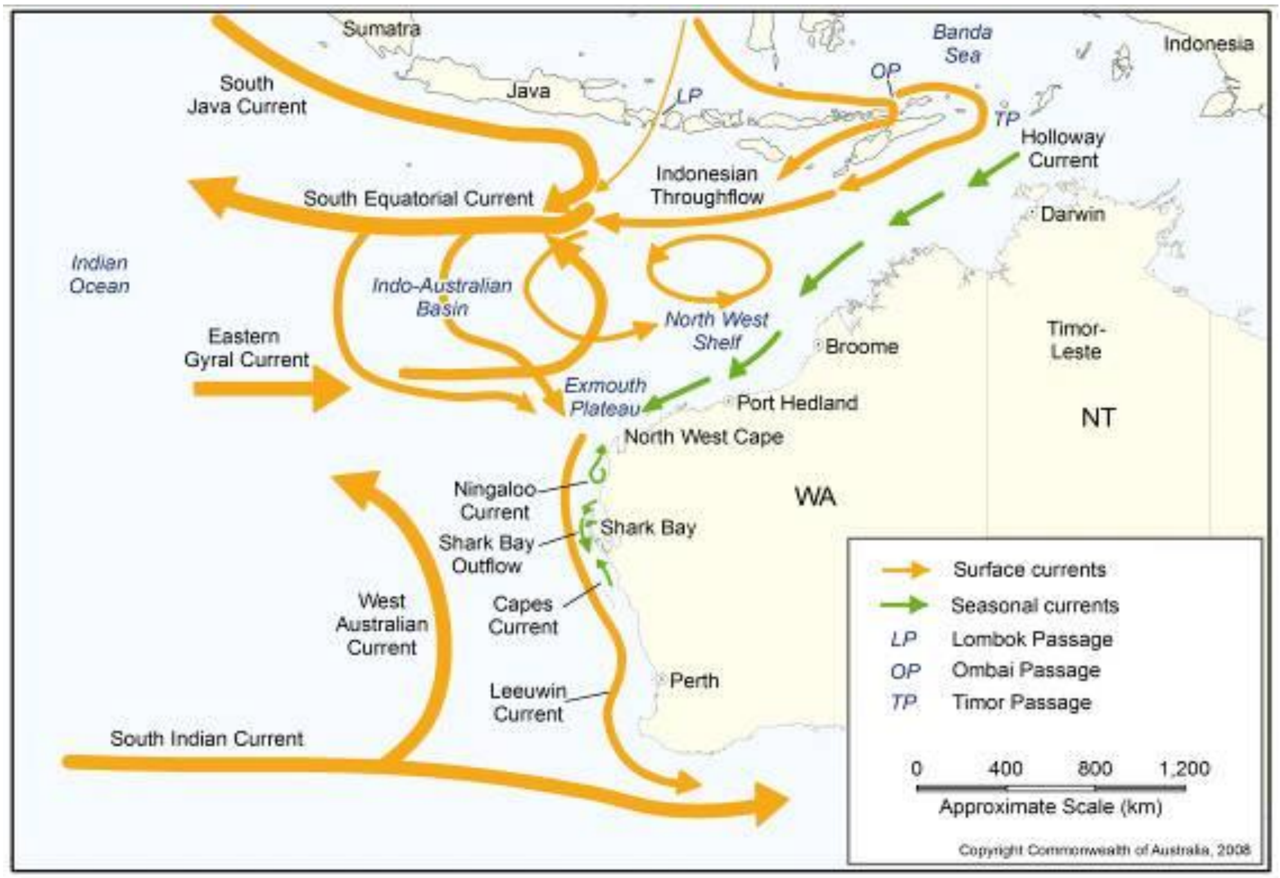
Currents in the Kimberley region are also generated by several more localised factors, including tidal forcing, local wind forcing, inertial oscillations, shelf waves, seiche and trapped waves. Studies undertaken in the vicinity of Scott Reef and Seringapatam Reef suggest that the ITF does not directly influence these systems, but it is the eddies that peel off the min ITF current and travel along the shelf-break that have a greater influence on the reefs. In general, the tidal regime and wind forcing are the major contributors to local currents in the area. The currents in the Operational area and wider EMBA are influenced by the semi-diurnal tides that have four direction reversals per day. Both the semidiurnal and diurnal tides appear to travel north-eastwards in the deep water leading to the Timor Trough prior to propagation eastwards and southwards across the wide continental shelf. The NWMR experiences some of the largest tides along a coastline adjoining an open ocean in the world.

In the eastern section of the EMBA, the area is influenced primarily by strong diurnal tidal flows and less by ocean currents. The Joseph Bonaparte Gulf is subject to the highest tidal range in the region (up to 7–8 m).

Wind driven currents from monsoons and cyclones and drift currents (ITF) are likely to prevail during neap tides or during periods of strong influence when one of the current reversals may be suppressed. Maximum tidal range is 5.7 m and tidal currents flood to the southeast and ebb to the northwest and under normal conditions (i.e. no storms), maximum recorded current speed at the surface is 0.95 m/s, mainly due to the tide. Current speeds decrease with depth below the surface. The strength and direction of tidal current flow is also strongly influenced by local bathymetry.

Wind induced currents result from local wind forcing at the surface and are most pronounced during cyclones with development of transient oscillations known as inertial currents following the passage of cyclones. Wind driven surface currents and their direction are generated by prevailing seasonal winds from the west in summer and from the east and south east during winter. The following current data has been estimated for one in 50-year storm conditions:

- Surface currents = 2 m/s;
- Mid depth currents = 1 m/s; and
- Seafloor currents = 0.67 m/s.



Source: DEWHA (2008)

Figure 5-3: Key ocean currents influencing Western Australia

5.3.2 Waves

Surface waves and sea swell in the region can vary widely in direction depending on wind direction, locations of major storms and local bathymetric effects such as the shelf break or proximity to islands such as Ashmore Reef. Waves are subject to the following key influences:

- Locally generated wind waves, seas: generally, from west during wet season and from the east during the dry season; and
- Remotely generated swells: South to south westerly swells persist from storms in the southern Indian Ocean and occasional, low amplitude waves up to 1 m originate from earthquakes in the Sunda Trench, between Australia and Indonesia.

In general, the maximum and mean sea swells are larger in winter than summer as a result of the strong easterly wind-generated seas and larger winter swell from the Southern and Indian Oceans. Occasional monsoonal storms and cyclones can result in much larger waves and swell. Extreme winds associated with cyclones can generate waves up to 21 m in height from any direction (RPS Metocean 2008).

Significant wave heights are experienced in the Montara field are as follows:

- Greater than 2 m, 7.7% of the time; and
- Greater than 4 m, 0.4% of the time.

The following wave data has been estimated for one in 50-year storm conditions as:

- Maximum wave height = 16.1 m;

- Significant wave height = 8.6 m; and
- Peak wave period = 11.4 seconds.

5.3.3 Temperature, Salinity and Turbidity

Seawater temperature in the region generally ranges from 25ºC to 31ºC at the surface and 22ºC to 25ºC at the seafloor. The sub-tropical water temperatures are largely influenced by the ITF and a highly-pronounced thermocline, which is controlled by the ITF (Brewer et al. 2007).

Water quality monitoring at the Montara Venture found surface water temperatures ranged from 28.0ºC to 28.7ºC, with a slight reduction of <1ºC at 20 m depth. Salinity of surface waters was consistently around 33.9 PSU, with low variability (Jacobs 2017).

Turbidity in the surface waters (0.5 m to 23 m depth) near the Montara Venture are typically low (<0.2 NTU; Jacobs 2017).

5.3.4 Bathymetry and Seafloor Geology

Bathymetry of the region is broadly categorised into three distinct zones based on water depth and geometric features. The three zones are (Baker et al. 2008, Heap and Harris 2008):

- Continental shelf;
- Continental slope; and
- Abyssal plain.

The inner continental shelf in the northwest region extends from the coast to approximately 30 m water depth and the middle continental shelf lies between 30 m and 200 m. The outer continental shelf and slope region descends from approximately 200 m water depth. The slope continues to descend over hundreds of kilometres until reaching the almost flat i.e. a less than 1:1,000 gradient, abyssal plain at water depths of approximately 4,000 m. The continental slope is steepest along the western flank of Scott Reef where a steep drop occurs. These steep slopes are incised by erosional gullies and canyons.

The Operational area is located on the continental shelf and the Montara field (within the Operational area) slopes from the east (76 m) to west (86.5 m) and is characterised by a north-south trending gentle scarp. To the south of the area a slight mound rises to 78 m water depth.

The shallow geology of the Operational area is interpreted as a thin, discontinuous layer of unconsolidated surficial sediment overlying a variably consolidated calcarenite sequence. The thickness of unconsolidated sediment varies across the site and ranges from being very thin or absent up to a local maximum of 3.7 m within the Montara survey corridor.

Geophysical interpretation and results from seabed sampling indicate that the unconsolidated sediments are fine to coarse carbonate sands. The sediments appear to be coarser closer to areas of significant relief and at the base of shallow depressions. Sub-bottom profilers did not achieve significant penetration into the calcarenite material, indicating that the upper surface of the calcarenite is relatively hard.

5.3.5 Sediment Quality

Sediment quality sampling undertaken near the Montara Venture found that concentrations of metals, metalloids, hydrocarbons and phenolic compounds in sediment samples were either below the laboratory limit of reporting (LOR) and/or the ANZECC/ARMCANZ Sediment Quality Guidelines detailed in Simpson et al. (2013) (Jacobs 2017).

5.3.6 Sediment Particle Size Distribution

The particle size distributions (PSD) of sediments sampled near the Montara Venture were dominated by fine and coarse sands, with very little clay (Jacobs 2017).

5.4 Conservation Values and Sensitivities

Conservation values and sensitivities listed and protected under the EPBC Act include Matters of Environmental Significance (MNES) and Other Protected Matters. MNES occurring, or potentially occurring, in the Operational Area are summarised in **Table 5-3**. The full EPBC Act Protected Matters report is provided in **Appendix D**.

Table 5-3: Summary of conservation values and sensitivities in the Operational Area

MNES and Other Matters Protected under EPBC Act	Operational Area
Commonwealth Marine Area	✓
Listed Threatened Species	✓ (22)
Listed Migratory Species	✓ (35)
Listed Marine Species	✓ (62)
Whales and other cetaceans (many of which are also Listed Threatened or Migratory Species)	✓ (13)
Australian Marine Parks	✕
State and Territory Marine Parks (MP) and Marine Management Areas (MMA)	✕
World Heritage	✕
Wetlands of International Importance (Ramsar)	✕
National Heritage Places	✕
Commonwealth Heritage Places	✕
Threatened Ecological Communities	✕
Key Ecological Features (KEFs)	✕
Nuclear actions and water resources, in relation to coal seam gas or coal mining	✕
Great Barrier Reef Marine Park	✕

5.4.1 Matters of National Environmental Significance (MNES)

Commonwealth Marine Areas

The Operational Area is within the EEZ and Territorial Sea which is a Commonwealth Marine Area. The Commonwealth marine area is any part of the sea, including the waters, seabed, and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not State or Northern Territory waters.

5.4.2 Listed Threatened and Migratory Species

The PMST search (**Appendix D**) identified 22 Listed Threatened Species (LTS) and 35 Listed Migratory Species (LMS) as having the potential to occur within the Operational area. The LTS included:

- Three species of marine mammals;
- Seven species of marine reptiles;
- Six shark species; and
- Five marine bird species.

The relevant sections of this EP discuss the likelihood of these species and their biologically important areas occurring within the Operational Area. Those species that have been identified as likely to be present in the Operational area are summarised in **Table 5-4** to **Table 5-10** and further detailed below.

Sensitive habitat areas such as an aggregation, resting or feeding or known migratory routes for these species are shown as Biologically Important Areas (BIAs) (**Figure 5-4** to **Figure 5-9**). 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 advice are considered to identify any requirements that may be applicable to the risk assessment.

5.4.3 Others matters protected by the EPBC

Listed marine species

A total of 62 Listed Marine Species are either likely to, or may, occur within the Operational Area, including 13 bird species (**Section 5.5.6**) and 19 reptile species (**Section 5.5.4**). Twelve of these species are also Listed Threatened Species.

Whales and other cetaceans

The Protected Matters search determined that 23 cetacean species or their habitat, may occur within the Operations Area. These species are discussed in **Table 5-6**. Whales and cetaceans occurring in the broader EMBAs are discussed in **Appendix C**.

5.4.4 Marine Parks

No State Marine Parks or AMPs intersect with the Operational Area.

5.4.5 Terrestrial Values

The Operational Area is over 200 km from the closest landfall and therefore does not contain any terrestrial sensitivities or values. Specifically, the following terrestrial values are not represented within the Operational Area:

- Ramsar wetland sites;
- State protected wetlands;
- marine and coastal zone;
- nationally important wetlands; and
- State protected terrestrial areas.

5.4.6 Key Environmental Features (KEFs)

Key ecological features (KEFs) are elements of the Commonwealth marine environment that are considered to be of regional importance for either a region’s biodiversity or its ecosystem function and integrity. The Operational Area does not include any KEFs. The nearest of the spatially defined KEFs is the Carbonate bank and terrace system of the Sahul Shelf at approximately 46 km from the Operational Area at its closest point.

5.5 Biological Environment – species and communities' descriptions

5.5.1 Benthic Habitat and Communities

The benthic habitats in the Operational area generally dominated by soft sediments, sand and mud, with occasional patches of coarser sediments. Spatial and temporal distribution of benthic fauna depends on factors such as sediment characteristics, depth and season.

A benthic habitat assessment was undertaken in the area of Petroleum Production Licence AC/L7 during the 2010 wet season, which included the Montara field and surrounding areas (ERM 2011). Surveys were carried out using a towed video system and seabed sediment samples were also collected for sediment and macrobenthic fauna analysis. Benthic habitats surveyed were characterised by homogenous, flat, featureless soft sediment; predominately comprised of sand with small rubble/shell fragments and marked by low relief ripples with evidence of bioturbation. Sparse patches of epifauna were recorded and included hydroids, octocorals (soft corals, gorgonians and seapens), black corals and ascidians.

Macrobenthic faunal assemblages surveyed had a generally low and highly patchy abundance of individuals. Polychaete bristleworms from the Phylum Annelida contributed the highest relative abundance of macrobenthic assemblages across the surveyed area, ranging from approximately 40 to 60% followed by Malacostracan crustaceans (shrimps, crabs etc.; approximately 13 to 19%). Gastropoda was represented by 33 taxa across the surveyed area with abundance ranging from approximately 0.5 to 5% (ERM 2011).

Hydrozoa and Bryozoa were the other common groups encountered in samples. All other taxa identified across the surveyed areas were minor contributors to macrobenthic assemblages (relative abundance <5%) (ERM 2011).

5.5.2 Plankton and invertebrates

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.

5.5.3 Fish, Sharks and Rays

The Operational Area PMST report (**Appendix D**) identified:

- Five threatened/ migratory; and
- Six migratory.

A description of fish, sharks and rays is provided in **Table 5-4**.

Numerous marine species occur in the region and have wide distributions that are associated with feeding and migration patterns linked to reproductive cycles. While the distance offshore, depth and lack of suitable foraging benthic habitat may preclude a number of these species, many are likely to occur within the Operational area in transit to and from key mating and foraging grounds. Pelagic foragers are also likely to be feeding within the area.

The Operational area intersects with the Whale Shark foraging BIA (**Figure 5-4**).

Three offshore banks assessment surveys (2010, 2011 and 2013) were undertaken to identify and assess the level of impact, if any, to the submerged marine banks in the region of the 2009 Montara oil spill (Heyward et al. 2010, 2011a, 2013). The surveys used Baited Remote Underwater Video Stations (BRUVS) to characterise fish assemblages and included the following shoals/banks in the region: Vulcan Shoal, Barracouta Shoals, Echuca Shoal, Eugene McDermott Shoal, Goeree Shoal, Heywood Shoal, Shoal 25 and Wave Governor Bank. BRUVS were deployed on the seafloor from the shallowest areas of the shoals to depths of approximately 60 m for at least 60 minutes (Heyward et al. 2011a). No individuals from the Syngnathidae family were reported (Heyward et al. 2010, 2011a, 2013).

Table 5-4: Fish, Sharks and Rays EPBC listed species

Common Name (Scientific Name)	EPBC Act Status[2]	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Whale Shark (*Rhincodon typus*)	V,M	Foraging, feeding or related behaviour known to occur within area	✓	Conservation advice *Rhincodon typus* whale shark (Threatened Species Scientific Committee, 2015d)	Ceased 2010	
Great White Shark (*Carcharodon carcharias*)	V,M	Species or species habitat may occur within area	No	No	Recovery Plan for the White Shark (*Carcharodon carcharias*) (Commonwealth of Australia, 2013)	
Northern River Shark (*Glyphis garricki*)	E	Species or species habitat may occur within area	No	✓Approved Conservation Advice for *Glyphis garricki* (northern river shark) (DoE 2014a)	Sawfish and river shark multispecies recovery plan (Commonwealth of Australia, 2015b)	
Green Sawfish (*Pristis zijsron*)	V	Species or species habitat known to occur within area	No	✓Approved conservation advice for *Pristis zijsron* green sawfish (Threatened Species Scientific Committee, 2008b)	Sawfish and river shark multispecies recovery plan (Commonwealth of Australia, 2015b)	
Freshwater/ Largetooth sawfish (*Pristis pristis*)	V, M	Species or species habitat known to occur within area	No	✓ Approved Conservation Advice for *Pristis pristis* (largetooth sawfish) (DoE 2014b)	Sawfish and river shark multispecies recovery plan (Commonwealth of Australia, 2015b)	

[2] CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory

Common Name (Scientific Name)	EPBC Act Status[2]	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Narrow Sawfish (*Anoxypristis cuspidata*)	M	Species or species habitat may occur within area	No	No		
Oceanic Whitetip Shark (*Carcharhinus longimanus*)	M	Species or species habitat may occur within area	No	No		
Shortfin Mako (*Isurus oxyrinchus*)	M	Species or species habitat likely to occur within area	No✓	No	No	
Longfin Mako (*Isurus paucus*)	M	Species or species habitat likely to occur within area	No✓	No	No	
Giant Manta Ray (*Manta birostris*)	M	Species or species habitat may occur within area	No✓	No	No	
Reef Manta Ray (*Manta alfredi*)	M	Species or species habitat may occur within area	No✓	No	No	

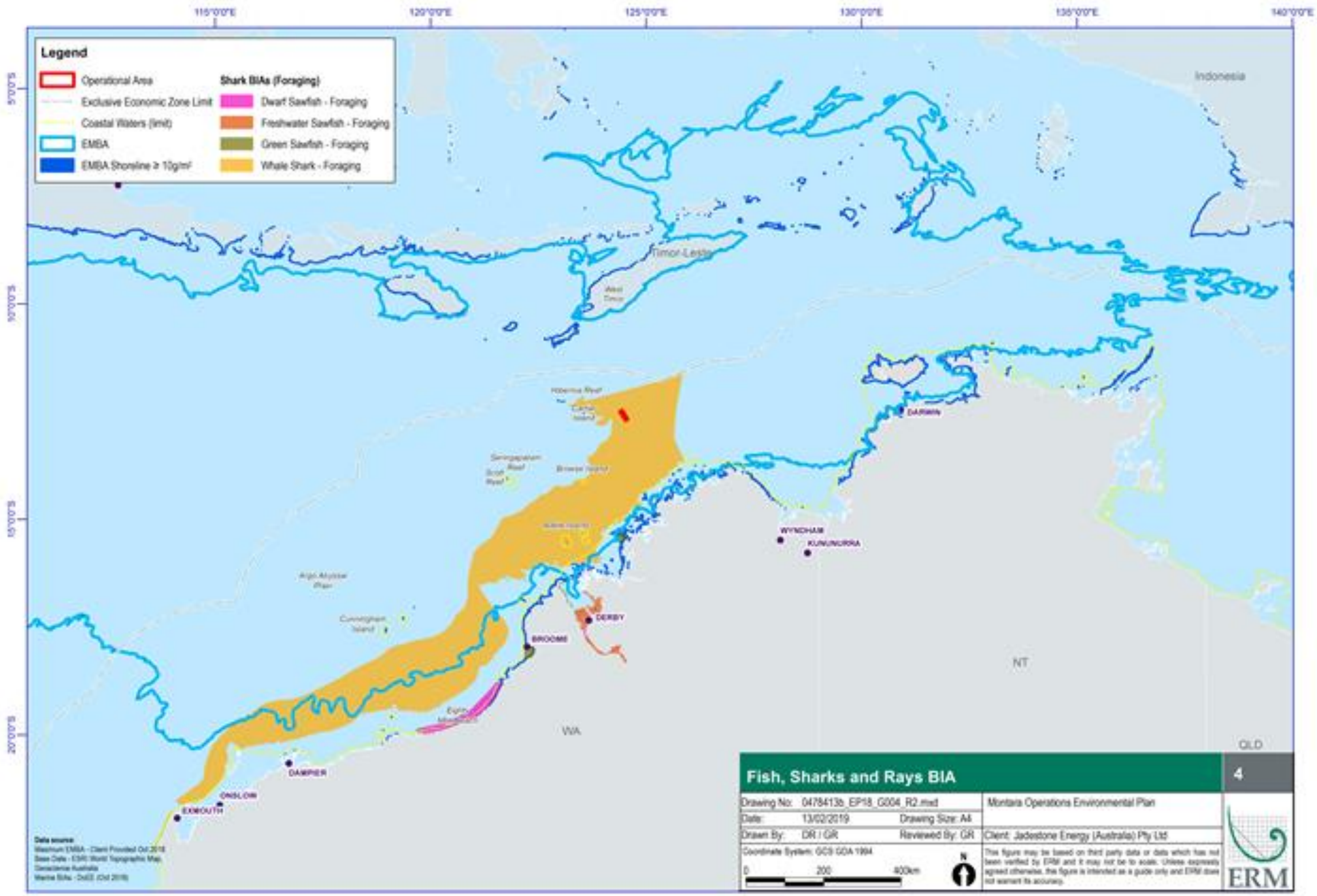


Figure 5-4: ***Biologically important areas for fish, sharks and rays***

Whale Shark (Vulnerable/Migratory)

Whale sharks (*Rhincodon typus*) have a broad distribution in tropical and warm temperate seas. The whale shark is a highly migratory fish and only visits Australian waters seasonally (DoEE 2017b). They are known to aggregate at Ningaloo Reef (approximately 1,500 km south-west of the Operational area) between May and June, and in the Queensland Coral Sea (approximately 2,400 km east of the Operational area) between November and December (DoEE 2017b). Neither of these locations are within the EMBA.

Whale sharks are not known to feed or breed in the Operational area, however, whale sharks may occur in the Operational area due to their widespread distribution and highly migratory nature, albeit in very low numbers. The Operational area is located in the migratory BIA for the whale shark (**Figure 5-4**). The species migrates south to Ningaloo reef to feed during coral spawning, occurring in March/ April. It is unlikely that whale sharks will be encountered in significant numbers at the Operational area.

Great White Shark (Vulnerable/Migratory)

The Great White Shark (*Carcharodon carcharias*) is widely, but sparsely, distributed in all seas, including cold temperate waters, having been recorded from central Queensland around the south coast to north-west WA, with movements occurring between the mainland coast and the 100 m isobath (DoEE 2017b). The species is known to undertake migrations along the WA coast, with individuals occasionally travelling as far north as North West Cape during spring, before returning south for summer (DoEE 2017b). Given a preference for cooler, southern waters inhabited by seals and sea lions, great white sharks are considered unlikely to be encountered in either the Operational area or EMBA. No great white shark BIAs are intersected by either the Operational area (**Figure 5-4**).

Northern River Shark (Endangered)

The Northern River Shark (*Glyphis garricki*) is known to inhabit rivers, tidal sections of large tropical estuarine systems, macrotidal embayments, as well as inshore and offshore marine habitats, although adults have only been recorded in marine environments (DoEE 2017b). Limited data suggests that the species displays a preference for highly turbid, tidally influenced waters with fine muddy substrate. However, the presence of individuals in offshore areas suggests that northern river sharks undertake movements away from rivers and estuaries and are therefore likely to move between river systems (DoEE 2017b). Given the offshore location of the Operational area and the species' preference for turbid, inshore waters, it is unlikely that the species will be encountered in the Operational area, although their preferred habitat occurs within the EMBA.

Shortfin and Longfin Mako Sharks (Migratory)

The shortfin mako (*Isurus oxyrinchus*) and the longfin mako (*Isurus paucus*) are both offshore epipelagic species found in tropical and warm-temperate waters (DoEE 2017b). Both species occur in Australia in coastal waters off WA, NT, QLD and NSW at depths ranging from shallow coastal waters to at least 500 m (DoEE 2017b). These species may migrate through the Operational area and may be found within the wider EMBA.

Reef Manta Ray (Migratory)

The reef manta ray (*Manta alfredi*) is commonly sighted inshore, but also found around offshore coral reefs, rocky reefs and seamounts, tending to inhabit warm tropical or sub-tropical waters (Marshall et. al. 2011a). Long-term sighting records of the reef manta ray at established aggregation sites suggest that this species is more resident to tropical waters and may exhibit smaller home ranges, philopatric movement patterns and shorter seasonal migrations than the giant manta ray (Marshall et al. 2011a).

Based on the species' habitat preferences it is unlikely that the reef manta ray will be encountered in the Operational area. Given the EMBA overlaps with a number of coral and rocky reefs in the region, it is possible the species may be encountered within the EMBA.

Giant Manta Ray (Migratory)

The giant manta ray (*Manta birostris*) inhabits tropical, marine waters worldwide. In Australia, the species is recorded from south-western WA, around the north coast to the southern coast of New South Wales (Australian Museum 2014). The species is commonly sighted along productive coastlines with regular upwelling, oceanic island groups, particularly offshore pinnacles and seamounts. Nearer to shore the giant manta ray is commonly encountered on shallow reefs, while being cleaned, or is sighted feeding at the surface inshore and offshore. It is also occasionally observed in sandy bottom areas and seagrass beds (Marshall et al. 2011b).

Based on the species' habitat preferences it is unlikely that the giant manta ray will be encountered in the Operational area. Given the EMBA overlaps with a number of coral and rocky reefs in the region, it is possible that the species may be encountered within the EMBA.

Freshwater/Largetooth Sawfish (Vulnerable/Migratory)

The freshwater, or largetooth, sawfish (*Pristis pristis*) may occur in all large rivers of northern Australia from the Fitzroy River in WA, to the western side of Cape York Peninsula, Queensland, although is mainly confined to the primary channels of large rivers (DoEE 2017b). In northern Australia, this species is thought to be confined to freshwater drainages and the upper reaches of estuaries, occasionally being found as far as 400 km inland. Few records exist of adults at sea, occurring in fresh or weakly saline water (DoEE 2017b).

Based on the distribution, and preferred habitat of the species, it is considered unlikely that freshwater sawfishes will be found at the Operational area. Given the species' known distribution individuals are likely to be found within the EMBA.

Green Sawfish (Vulnerable/Migratory)

In Australian waters, green sawfishes (*Pristis zijsron*) have been recorded in the coastal waters off Broome in WA, around northern Australia to Jervis Bay, NSW (DoEE 2017b). It is unknown whether green sawfish migrate into Australian waters as adults or juveniles from populations outside Australia (DoEE 2017b). This species inhabits muddy bottom habitats and enters estuaries, although it has also been recorded in inshore marine waters, estuaries, river mouths, embankments and along sandy and muddy beaches, usually in shallow waters (DoEE 2017b).

Based on the offshore, deeper-water activity location, and the species' preference for turbid, inshore water, it is unlikely green sawfishes will be encountered in the Operational area. Based on the known distribution of the species, individuals are known to exist within the EMBA.

Narrow Sawfish (Migratory)

Narrow sawfishes (*Anoxypristis cuspidate*) are bentho-pelagic inhabiting estuarine, inshore and offshore waters to at least 40 m depth (IUCN 2017). Inshore and estuarine waters are critical habitats for juveniles and pupping females, while adults occur predominantly offshore (D'Anastasi et al. 2013). Based on the species' habitat preference it is highly unlikely to be found within the Operational area, although may be encountered within certain areas of the EMBA.

Oceanic Whitetip Shark (Migratory)

Oceanic whitetip sharks (*Carcharhinus longimanus*) are widespread throughout tropical and subtropical waters of the world (30° N to 35° S) (IUCN 2019). They are an oceanic and pelagic species that regularly occurs in waters of 18 to 28°C, usually >20°C (IUCN 2019). 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 (Last and Stevens 2009). Based on the species' habitat preference and distribution it is highly unlikely to be found within the Operational area, although may be encountered within certain areas of the EMBA.

5.5.4 Marine Reptiles

The Operational Area PMST report (**Appendix D**) identified:

- Seven threatened/ migratory

A description of marine reptiles is provided in **Table 5-5**.

Table 5-5: Marine Reptiles EPBC listed species

Common Name (Scientific Name)	EPBC Act Status[3]	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Leaf- scaled Seasnake	CE	Species or species habitat may occur within area	No	✓ *Approved Conservation Advice for* Aipysurus foliosquama *(Leaf-scaled Sea Snake).* Threatened Species Scientific Committee, 2011	No	No
Loggerhead Turtle (*Caretta caretta*)	E,M	Species or species habitat likely to occur within area	No	No	✓ Recovery plan for marine turtles in Australia (DoEE 2017)	✓ Marine debris
Green Turtle (*Chelonia mydas*)	V,M	Species or species habitat known to occur within area	No	No	✓ Recovery plan for marine turtles in Australia (DoEE 2017)	✓ Marine debris
Leatherback Turtle (*Dermochelys coriacea*)	E,M	Species or species habitat likely to occur within area	No	✓ Approved conservation advice for *Dermochelys coriacea* (Leatherback Turtle) (Threatened	✓ Recovery plan for marine turtles in Australia (DoEE 2017)	✓ Marine debris

[3] CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory

				Species Scientific Committee, 2008a)		
Hawksbill Turtle (*Eretmochelys imbricata*)	V,M	Species or species habitat likely to occur within area	No	No	✓ Recovery plan for marine turtles in Australia (DoEE 2017)	✓ Marine debris
Olive Ridley Turtle (*Lepidochelys olivacea*)	E, M	Species or species habitat likely to occur within area	No	No	✓ Recovery plan for marine turtles in Australia (DoEE 2017)	✓ Marine debris
Flatback Turtle (*Natator depressus*)	V, M	Species or species habitat likely to occur within area	No	No	✓ Recovery plan for marine turtles in Australia (DoEE 2017)	✓ Marine debris

Marine Turtles

Six threatened/ migratory marine turtles are present in the Operational Area. Marine turtles are oceanic species, except during nesting seasons where they come ashore to lay eggs. Marine turtles utilise reefs, soft-sediment habitats, seagrass and algal meadows as feeding areas, depending on species, and nest above the high-water mark on sandy beaches and islets within their geographical ranges. The nesting periods are species-dependent, although generally occur between September and March, peaking in December (Pendoley 2005). Hatchlings appear between January and May and immediately leave the shore, moving into open ocean environments for a number of years before returning to inshore areas.

Marine turtles have been observed in the vicinity of the Operational area. Surveys conducted in response to the Montara oil spill in 2009 recorded a total of 25 individual turtles in open water. Two species were confidently identified; loggerhead and green turtles (Watson et al. 2009). Land based surveys recorded green and hawksbill turtle tracks on the islands associated with Ashmore Reef (Watson et al. 2009).

The Operational area does not intersect with any marine turtle BIAs (Figure 5-5). The Operational Area is approximately 80km to the nearest nesting site at Cartier Island.

Green Turtle (Vulnerable/Migratory)

Green turtles (*Chelonia mydas*) are found in tropical and subtropical waters throughout the world (Marquez 1990; Bowen et al. 1992). The closest known significant breeding/nesting grounds to the Operational area are the Ashmore Reef and Cartier Island CMRs, approximately 125 and 84 km to the northwest of the Operational area, respectively (Figure 5-5).

Green turtles may occasionally pass through the Operational area, as satellite tracking studies have shown that green turtles migrate between breeding grounds and feeding grounds off the northwest coast (Pendoley 2005). However, due to the water depths the area does not provide foraging habitat.

Flatback Turtle (Vulnerable/Migratory)

The flatback turtle (*Natator depressus*) is found in the tropical waters of northern Australia, Papua New Guinea and Irian Jaya. It is the most widely distributed nesting marine turtle species in the Northern Territory (Chatto and Baker 2008), nesting on a wide variety of beach types around the entire coastline. The flatback turtle also nests in the Kimberley Region of Western Australia, with Cape Dommett (Bowlay and Whiting 2007) and Lacrosse Island being important nesting areas for the species. The closest nesting sites to the Operational area are approximately 500 km to the south-east (Lacepede Islands).

While flatback turtles make lengthy reproductive migrations, up to 1,300 km from nesting beaches (Limpus et al. 1983), movements are generally restricted to the continental shelf (DoEE 2017b). Flatback turtles nesting within the Pilbara region migrate to their foraging grounds in the Kimberley region along the continental shelf at the end of the nesting season (RPS 2010). Due to their migrations between the Pilbara and the Kimberley regions of WA, individual flatback turtles may transit the Operational area during migration. However, given the distance from known aggregation areas, it is unlikely that significant numbers of flatback turtles will be encountered within the Operational area. Due to the water depths the area does not provide foraging habitat.

Hawksbill Turtle (Vulnerable/Migratory)

Hawksbill turtles (*Eretmochelys imbricata*) are found in tropical, subtropical and temperate waters in all oceans of the world. There are no known nesting or breeding areas in or near to the Operational area.

Leatherback Turtle (Endangered/Migratory)

The Leatherback turtle (*Dermochelys coriacea*) has the widest distribution of any marine turtle, and can be found in tropical, subtropical and temperate waters throughout the world (Marquez 1990). No major centres of nesting activity have been recorded in Australia, although scattered isolated nesting (1-3 nests per annum) occurs in southern Queensland and Northern Territory (Limpus and McLachlin 1994). As such, it is expected that very few leatherback turtles will be encountered in the Operational area.

Loggerhead Turtle (Endangered/Migratory)

The loggerhead turtle (*Caretta caretta*) has a global distribution throughout tropical, sub-tropical and temperate waters (Marquez 1990). The closest known breeding/nesting grounds to the Operational area are found at Muiron Island and the beaches of the Northwest Cape (Baldwin et al. 2003), approximately 1,500 km south-west of the Operational area and outside the EMBA. Loggerhead turtles have been recorded in the reserves of Ashmore Reef (125 km) and Cartier Island (84 km), west- northwest of the Operational area (Guinea 1995). Loggerhead turtles are unlikely to be encountered within the Operational area in significant numbers.

Olive Ridley Turtle (Endangered/Migratory)

The olive ridley turtle (*Lepidochelys olivacea*) has a circum-tropical distribution, with nesting occurring throughout tropical waters. No concentrated nesting has been found in Australia, although low density nesting occurs along the Arnhem Land coast of the Northern Territory, including the Crocodile, McCluer and Wessel Islands, Grant Island and Cobourg Peninsula (Chatto and Baker 2008). Therefore, Olive Ridley turtles are unlikely to be encountered within the Operational area in significant numbers. No olive-ridley turtle BIAs are intersected by the Operational area.

Leaf- scaled seasnake (Critically Endangered)

The leaf-scaled seasnake *(Aipysurus foliosquama)* is listed as critically endangered under the EPBC Act and the BC Act. The species is found only on the reefs of the Sahul Shelf in WA, especially on Ashmore and Hibernia Reefs primarily on the reef flats or in shallow waters of the outer reef edges to depths of 10m (Minton and Heatwole 1975).

It is expected that few leaf-scaled seasnakes will be encountered in the Operational area due to the distance from the nearest reefs and shallow waters.

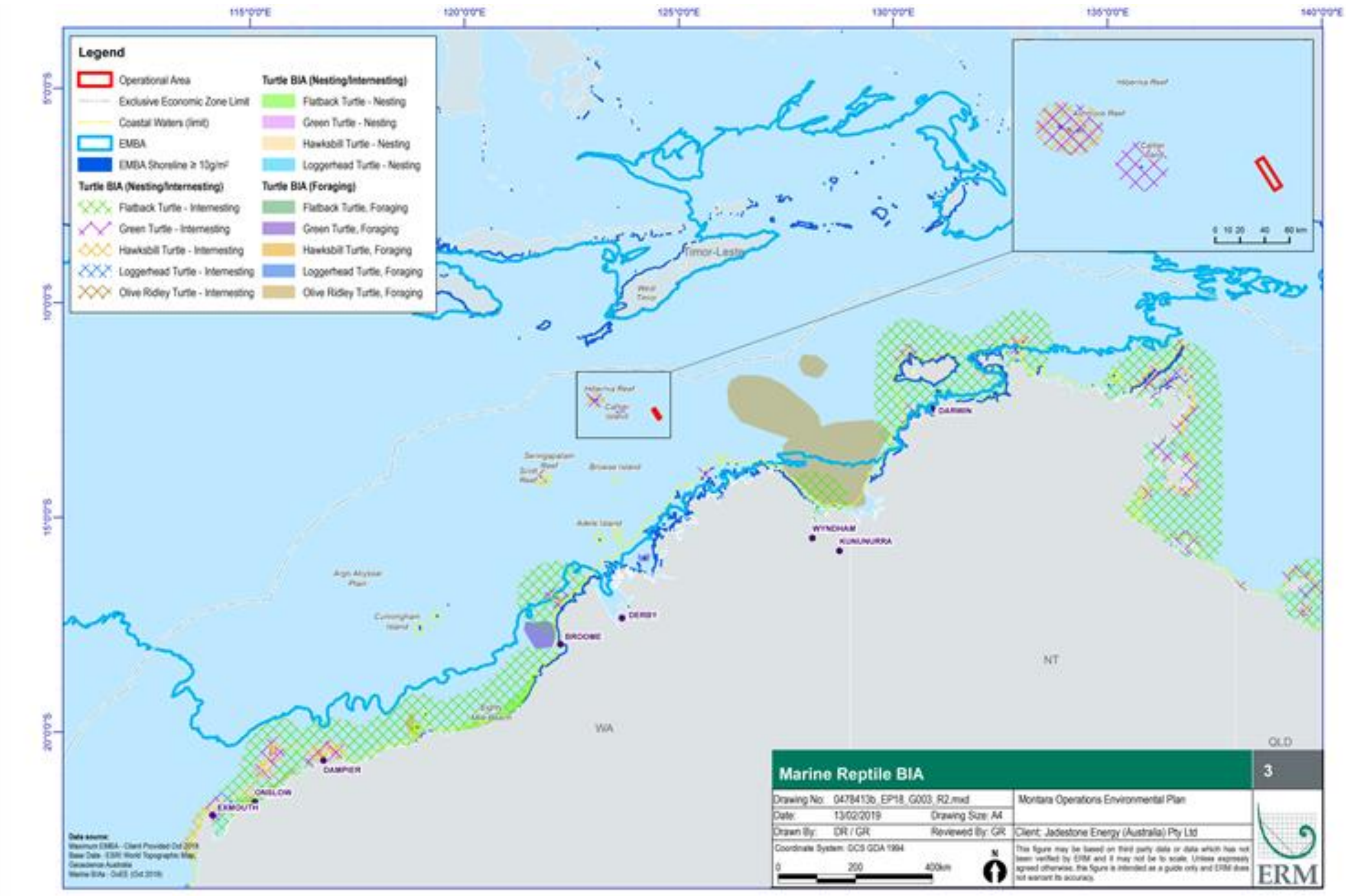


Figure 5-5: ***Biologically important areas for marine reptiles***

5.5.5 Marine Mammals

The Operational Area PMST report (**Appendix D**) identified:

- Three threatened/ migratory; and
- Five migratory

A description of marine mammals is provided in **Table 5-6**.

Cetaceans

The region is thought to be an important migratory pathway between feeding grounds in the Southern Ocean and breeding grounds in tropical waters for several cetacean species. Pygmy blue whales (*Balaenoptera musculus*), fin whales (*Balaenoptera physalus*), dwarf minke whales (*Balaenoptera acutorostrata*) and Antarctic minke whales (*Balaenoptera bonaerensis*) may travel through the region on their way to breeding grounds, which are thought to be in deep oceanic waters around the Indonesian Archipelago.

During ambient noise monitoring at the southern (AC/L7) permit area in June–December 2011, numerous cetacean vocalisations were recorded (McPherson et al. 2012). Two species of odontocetes (toothed whales and dolphins) were identified during the first six-months of deployment, false killer whales and common bottlenose dolphins.

Pygmy blue whales (*B. m. brevicauda*) were detected at the nearby Cash-Maple (AC/RL7 block) permit area, which coincided with the timing of the northern and southern migrations (McCauley 2011). Humpback whales were only recorded during two periods in July and August 2011 at the Southern station. The vocalisations of bryde's whales were also detected at the southern permit area at the time of survey. Based on the most recent scientific literature (Cerchio et al. 2015) and re-analysis of data, some of the Bryde's whales (*Balaenoptera edeni*) reported are now believed to be the calls of Omura's whale (*Balaenoptera omurai*) (McPherson et al. 2017). Omura's whales therefore appear to be present year-round along the region's continental shelf but showed seasonal differences in occurrence at specific sites (McPherson et al. 2017). Overall, they are most commonly detected in the Timor Sea in winter.

Table 5-6: Marine Mammal EPBC listed species

Common Name (Scientific Name)	EPBC Act Status[4]	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Blue whale (*Balaenoptera musculus*) Including Pygmy Blue Whale	E,M	Species or species habitat likely to occur within area	No	No	✓ Conservation management plan for the blue whale: A recovery plan under the EPBC Act 1999 2015-2025 (Commonwealth of Australia, 2015a)	✓ Marine debris
Sei Whale (*Balaenoptera borealis*)	V, M	Species or species habitat likely to occur within area	No	✓ Conservation advice *Balaenoptera borealis* sei whale (Threatened Species Scientific Committee, 2015b)	Ceased in 2015	✓ Marine debris
Fin Whale (*Baleenoptera physalus*)	V, M	Species or species habitat likely to occur within area	No	✓ Conservation advice *Balaenoptera physalus* fin whale (Threatened Species Scientific Committee, 2015c)	Ceased 2015	✓ Marine debris
Bryde's Whale (*Balaenoptera edeni*)	M	Species or species habitat likely tooccur within area	No	No	No	✓ Marine debris

[4] CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory

Common Name (Scientific Name)	EPBC Act Status[4]	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Orca, Killer Whale (*Orcinus orca*)	M	Species or species habitat may occur within area	No	No	No	✓ Marine debris
Sperm Whale (*Physeter macrocephalus*)	M	Species or species habitat may occur within area	No	No	No	No
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) (*Tursiops aduncus*)	M	Species or species habitat may occur within area	No	No	No	No
Humpback Whale (*Megaptera novaeangliae*)	M	Species or species habitat likely to occur within area	No	✓ Ceased	Ceased 2015	✓ Marine debris

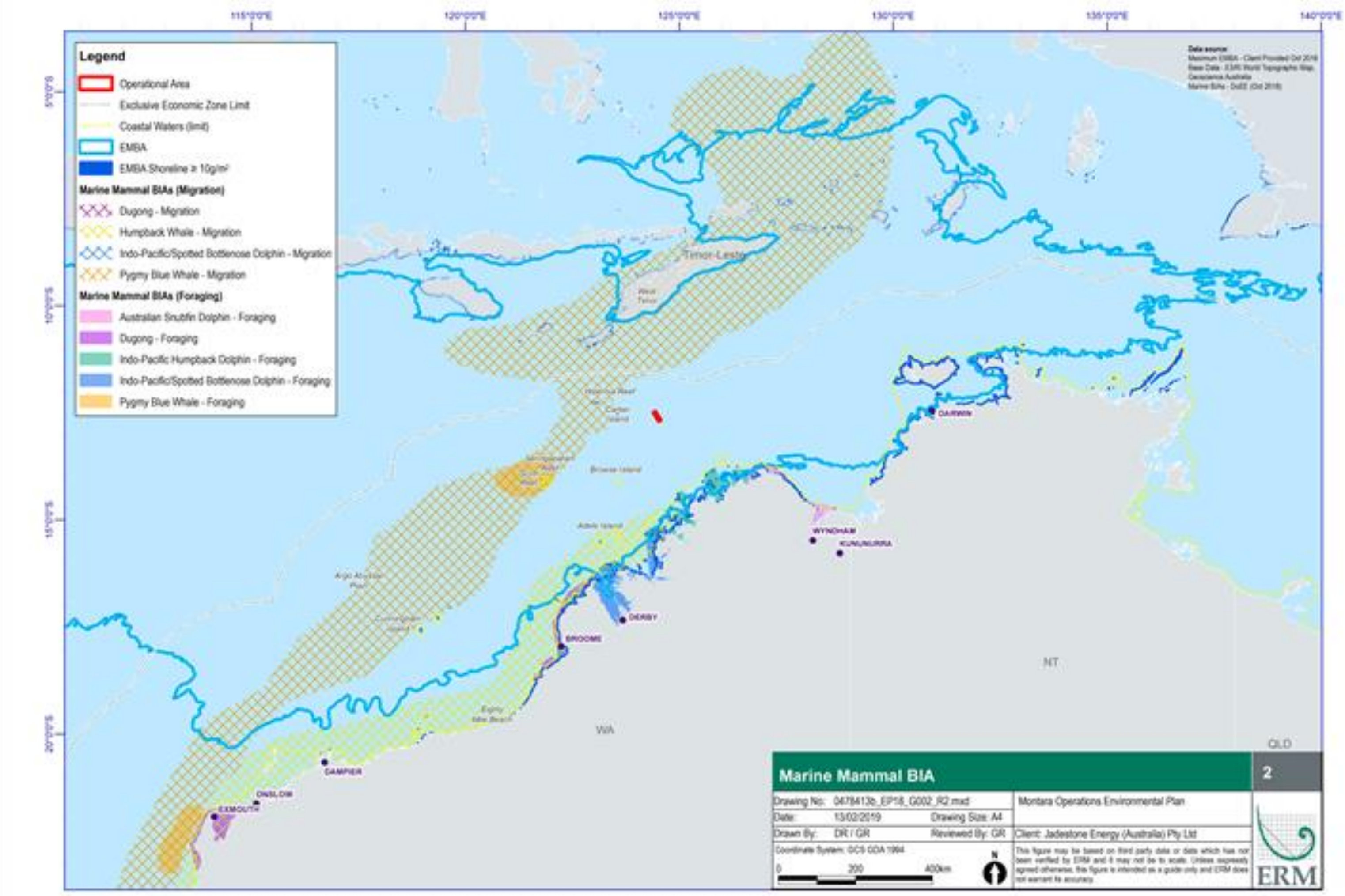


Figure 5-6: ***Biologically important areas for marine mammals***

Blue Whale (Endangered/Migratory)

Blue whales (*Balaenoptera musculus*) are widely distributed throughout the worlds' oceans. There are two subspecies in the Southern Hemisphere: the southern blue whale (*Balaenoptera musculus intermedia*) and the pygmy blue whale (*Balaenoptera musculus brevicauda*) (DEWHA 2008). In general, the southern blue whale is found south of 60° S and pygmy blue whales are found north of 55° S (DEWHA 2008), making it likely that any blue whales frequenting the waters of the Operational area would be pygmy blue whales.

Blue whale migration is thought to follow deep oceanic routes, although little is known about their precise migration routes (DoEE 2017b). Sea noise loggers set at various locations along the coast of Western Australia have detected a seasonal presence indicating a pattern of annual northbound and southbound migration of pygmy blue whales past Exmouth and the Montebello Islands and locations to the north (McCauley and Jenner 2010). Pygmy Blue whales appear to migrate south from Indonesian waters passing Exmouth through November to late December each year. Observations suggest most Pygmy Blue whales pass along the shelf edge out to water depths of 1,000 m depth contour. The northern migration passes Exmouth over an extended period ranging from April to August (McCauley and Jenner 2010). They are believed to calve in tropical waters in winter and births peak in May to June, however the exact breeding grounds of this species are unknown (Bannister et al. 1996).

The Operational area does not include any recognised blue whale migratory routes or known feeding, breeding or resting areas. However, low numbers of blue whales migrating to and from Indonesian waters may occasionally pass through the Operational area, most likely during the southern migration (October to November) (DoEE 2017b). Ambient noise monitoring conducted for PTTEP AA in and around the Montara field documented the presence of cetacean species over a full 12-month period between December 2010 and December 2011. The data support the well documented seasonal timings of pygmy blue whales in the region, and the low numbers recorded are consistent with the field area being outside the recognised BIAs for this species.

Sei Whale (Vulnerable/Migratory)

Sei whales (*Balaenoptera borealis*) are a cosmopolitan species, found in the waters off all Australian states (DoEE 2017b). The Australian Antarctic waters are important feeding grounds for sei whales, as are temperate, cool waters (DoEE 2017b). The species has also been observed feeding in the Bonney Upwelling area in South Australia, indicating the area as potentially being an important feeding ground.

Breeding in this species is known to occur in tropical and subtropical waters (DoEE 2017b). Currently, the movements and distributions of sei whales are unpredictable and not well documented. However, information suggests that sei whales have the same general pattern of migration as most other baleen whales, although timing is later in the season and such high latitudes are not reached (DoEE 2017b).

Based on the cosmopolitan distribution of the species, sei whales may be encountered in low numbers within the Operational area. Individuals of the species may be encountered within the EMBA, although large numbers are unlikely.

Fin Whale (Vulnerable/Migratory)

Fin Whales (*Balaenoptera physalus*) are found in the waters all around Australia and the Australia Antarctic Territory (DoEE 2017b). The Australian Antarctic waters are also thought to be important feeding grounds for fin whales, while feeding has been observed in the Bonney Upwelling area indicating the area to be of importance as a feeding ground for the species (Morrice et al. 2004). No known mating or calving areas are known from Australian waters. Currently, the migration routes and locations of winter breeding grounds for this species are uncertain (DoEE 2017b).

Based on the cosmopolitan distribution of the species, fin whales may be encountered in low numbers within the Operational area.

Bryde's Whale (Migratory)

Bryde's Whales (*Balaenoptera edeni*) are a cosmopolitan species, found in the waters of all Australian states, including both Christmas and the Cocos Islands (DoEE 2017b). Two forms of Bryde's whale are known: the coastal and offshore form. The coastal from appears to be limited to habitat within the 200 m depth isobar, moving along the coast in response to availability of suitable prey (Best et al. 1984); the offshore form is known in deeper water (500 m to 1,000 m).

Ambient noise monitoring conducted in the Southern, Cash-Maple and Oliver permits by JASCO (2012) over a 12-month period between December 2010 and December 2011 recorded whale calls that were attributed to Bryde's whales year-round at all three permits, with no seasonal cycle observed. These data demonstrate that individuals may be encountered within the Operational area.

Humpback Whale (Migratory)

Humpback whales (*Megaptera novaeangliae*) have a wide distribution, having been recorded from the coastal areas off all Australian states other than the Northern Territory (Bannister et al. 1996). Humpback whales migrate north and south along the eastern and western coasts of Australia from calving grounds in the tropical north to feeding grounds in the Southern Ocean (DoEE 2017b). Peak migration off the north-western coast of Australia occurs from late July to early September. From June to mid-September the inshore waters (landward of the 100 m isobath) between the Lacepede Islands and Camden Sound (approximately 400 km south-west of the Operational area) are used as a calving area for this species (Jenner et al. 2001).

The Operational area is located outside of the recognised humpback whale migratory routes, which are usually within 30 km of the coastline. The EMBA overlaps with the humpback whale BIA identified for breeding and calving at Camden Sound Marine Park, adjacent to the Kimberley coast (Figure 5-6).

Given the Operational area is situated north of the northernmost point of the humpback whale migration it is considered unlikely that the species will be encountered. Individuals may be encountered within the wider EMBA.

Orca/Killer Whale (Migratory)

Orcas, or Killer Whales (*Orcinus orca*), are a cosmopolitan species, found in the waters off all Australian states in oceanic, pelagic and neritic regions, in both warm and cold waters. Killer whales are known to make seasonal movements, and are likely to follow regular migratory routes, however little is known about either local or seasonal movement patterns of the species (DoEE 2017b).

Given the lack of known migration routes or areas of significance in the region, the species is not expected to be encountered in either the Operational area.

Sperm Whale (Migratory)

Sperm whales typically occur in WA along the southern coastline between Cape Leeuwin and Esperance (Bannister *et al.* 1996). Sperm whales are distributed worldwide in deep waters (greater than 200 m) off continental shelves and sometimes near shelf edges, averaging 20 to 30 nautical miles offshore (Bannister *et al.* 1996). The sperm whale is known to migrate northwards in winter and southwards in summer, however, detailed information on the distribution of sperm whales is not available for the timing of migrations. Sperm whales have been recorded in deep water off the North West Cape on the west coast of Western Australia (RPS 2010) and appear to occasionally venture into shallower waters in other areas (RPS 2010).

Spotted Bottlenose Dolphin (Migratory)

The spotted bottlenose dolphin (*Tursiops aduncus*) is generally considered to be a warm water subspecies of the common bottlenose dolphin (*Tursiops truncates*) and known to exist in waters off all Australian states. The spotted bottlenose dolphin appears to be restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands (DoEE 2017b). BIAs for this species are illustrated in Figure 5-6.

Due to the distance from the coast and deeper waters of the Operational area, spotted bottlenose dolphins are not expected to occur, particularly given the preference for shallower, coastal waters. Given their cosmopolitan distribution, the species may be encountered within the Operational Area.

5.5.6 Avifauna

The Operational Area PMST report (**Appendix D**) identified:

- Five threatened (of those three are also migratory; and additional
- Eight migratory.

A description of avifauna species is provided in Table 5-10.

Numerous species of birds frequent the Timor Sea area or fly through the area on annual migrations. Seabird feeding grounds, roosting and nesting areas are found at the offshore atolls in the wider region, particularly Ashmore Reef. Many species are listed under the Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA). Most seabirds breed at offshore sites, such as Ashmore Reef, Cartier Island and Browse Island, from mid-April to mid-May (Clarke 2010). Peak migration time of migratory shorebirds is between October and December (Clarke 2010). It is expected that some individuals of these species may pass through the Operational area during their annual migrations.

No designated avifauna migration, resting, foraging or breeding BIAs are present within the Operational area (**Figure 5-9**). The nearest breeding/roosting site to the Operational Area is Cartier Island approximately 80 km away. However, the FPSO and WHP attract a number of foraging and breeding listed migratory species in large numbers. This is described further below.

5.5.6.1 Bird activity in the operational area

The FPSO and WHP are surrounded by waters with typically low seabird densities and dominated by fauna of Brown Boobies (*Sula leucogaster*) and Common/Brown Noddies (*Anous stolidus*). Waters across tropical seas are typically low productivity (Dunlop et al. 2001), however the presence of offshore platforms act as fish attraction devices, concentrating the presence of schooling fishes and providing habitat and food for their predators. Seasonal migrations of Bridled Terns (*Onychoprion anaethetus*) occur through the area on their way north to the Celebes Sea in April/May and again in September/October on their southward return journey to breeding islands mainly across islands offshore of the Pilbara and mid-West Australian coast (Surman et al. 2018). To the west, Ashmore Reef (148 km away) contains over 100,000 breeding seabirds from 16 species, including the second largest breeding population of Brown Boobies and Brown Noddies in Western Australia (Clarke and Herrod 2016). To the south, both Adele Island (368 km SSW) and the Lacepede Islands (554km SSW, 22,000 pairs of Brown Boobies) also contain significant breeding seabird populations.

The EPBC status of these three species is provided in Table 5-7 below.

Table 5-7: EPBC status of species occurring on the FPSO and WHP

Common name	Latin Name	EPBC status and behaviour
Brown booby	*Sula leucogaster*	Listed migratory & listed marine Breeding known to occur in the area
Brown noddy (Common noddy)	*Anous stolidus*	Listed migratory & listed marine Breeding known to occur in the area
Bridled tern	*Onychoprion anaethetus*	Listed migratory & listed marine Breeding known to occur in the area

Initial observations have demonstrated that Brown Boobies and Bridled Terns are roosting on the FPSO in between feeding, while Brown Noddies are roosting, feeding and nesting at the facility. The occurrence of seabirds at the FPSO and WHP is dictated by the timing of breeding of seabirds at nearby Ashmore Reef. At Ashmore Reef, Brown Boobies, Brown Noddies and Bridled Terns nest between January and November of each year, with a peak in nesting of Brown Noddies between April to September, and peak nesting in Brown Boobies between April to July. Brown Boobies utilise the FPSO and WHP as a roosting site predominately during the non-breeding period, as they are relatively short-range foragers when breeding (<100km). However, the FPSO may also be used as a roost by non-breeding or juvenile birds during the breeding season.

Bridled Terns are likely to be passage migrants, as they pass through the area to and from their breeding sites (most coastal islands between the Montebello Islands and Cape Leeuwin) further south from overwintering areas in the Celebes Sea (Surman et al. 2018). The breeding population at Ashmore Reef is very small and unlikely to account for the activity of this species on the FPSO. Tracked individuals transited through the area late August and September during their southward migration, and late April to May on their northward migration (Surman et al. 2018).

Surveys have been completed in July 2020, May 2022 and August 2022 to determine the numbers of roosting and nesting birds on the facility. A survey conducted in August 2022 located 266 nests compared to 228 in May 2022 and 87 nests found in July 2020 on the FPSO and WHP. In addition, overnight roosting numbers of Brown Noddies had risen from 640 to ~1200 birds by May 2022 (but dropped to 460 in August 2022). The colony has expanded significantly since the 2020 site survey. Brown Noddies utilise elevated areas forward of the vessel, including heat shield covered cable trays, rooftops of module 13 and the Turret, as well as any horizontal surfaces created by I-beam superstructures. It also appears that the thermoregulatory benefits from the elevated flare create a preference for this area over areas aft of the vessel. Approximately 96.8 % of the identified nests were forward of the flare hazard zone.

A summary of the estimated population of the three species at Montara and within WA is provided in Table Table 5-8 with percentage estimates for the proportions at Montara for context.

Table 5-8: Estimated global, WA and Montara population numbers

Species	**Estimated Global Population**	**Estimated WA Population (breeding)**	**Estimated Montara Population**
Common/brown noddy (*Anous stolidus*)	180,000- 1,100,000	~300,000 27% of global population	1200 0.4% of WA population 0.1% of global population
Brown booby (*Sula leucogaster*)	200,000	22,000 WA 11% of global population	250 1.1% of WA population 0.1% of global population
Bridled Tern (*Onychoprion anaethetus*)	610,000 – 1,500,000	96,000 6.4% of global population	141 0.2% of WA population 0.01% of global population

Successful breeding at the FPSO has also led to a unique situation for Brown Noddy nesting. During the May 2022 survey two birds banded as chicks in 2020 were found in breeding condition, at nest sites with their mates in May 2022. The age of first breeding in Brown Noddies is usually 3 years, so this suggests that conditions are very good.

Ecologically, the site of the MV provides a novel nesting site that is both safe, free from natural predators, located adjacent to a reliable food source away from both intra and interspecific competition for resources that occurs on nearby Ashmore Reef.

Brown noddies also build their nests from whatever nesting materials are available, but mostly *Sargassum sp*. seaweed, feathers, dried fish and materials collected from the deck including twine, plastic tags and rubbish.

Table 5-9 shows expected presence of Brown Boobies, Brown Noddies and Bridled Terns at the FPSO and/or WHP (Pers. Comms. Dr. Chris Surman, 2022). Figure 5-7 shows nesting and roosting on the FPSO and Figure 5-8 shows roosting at the WHP.

Table 5-9: Presence of Brown Boobies, Brown Noddies and Bridled Terns at the FPSO and/or WHP

Species	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Brown Boobies								Peak				
Brown Noddies							Peak					
Bridled Terns				Peak				Peak				

Key:

	Anticipated peak period of roosting / nesting
	Presence at Montara FPSO and/or WHP

Figure 5-7 Brown Noddy nesting sites on the Montara Venture

A: Heat shield mesh port side, B: Banded adult on cable tray M9, C: Nest in cable tray port side M11, D: Nest in cable tray lined with rust and plastic, E: Banded bird and nest on steel beam above central walkway, F: Bird on egg in nest with sargassum and deck materials, G: Rooftop colony M13 with 33 nests, H: Two nests atop beam aft of turret, I: Four 92 obscured) nests adjacent lift point M13.

Figure 5-8: Roosting seabirds at the WHP

Table 5-10: Avifauna EPBC listed species

Common Name (Scientific Name)	EPBC Act Status[5]	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Red Knot (*Calidris canutus*)	E, M	Species or species habitat may occur within area	No	✓ Conservation advice *Calidris canutus* red knot (Threatened Species Scientific Committee, 2016a)	No	No
Australian Lesser Noddy (*Anous tenuirostris melanops*)	V	Foraging, feeding or related behaviour likely to occur within area	No	✓ Conservation advice *Anous tenuirostris melanops* Australian lesser noddy (Threatened Species Scientific Committee, 2015e)	No	Threat Abatement Plan to reduce the impacts of exotic rodents on Australian offshore islands of less than 100 000 hectares 2009
Curlew Sandpiper (*Calidris ferruginea*)	CE, M	Species or species habitat may occur within area	No	✓ Conservation advice *Calidris ferruginea* curlew sandpiper (Threatened Species Scientific Committee, 2015f)	No	No
Eastern Curlew (*Numenius madagascariensis*)	CE, M	Species or species habitat may occur within area	No	✓ Conservation advice *Numenius madagascariensis* eastern curlew (Threatened Species Scientific Committee, 2015g)	No	No

[5] CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory

Abbott's Booby (*Papasula abbotti*)	E	Species or species habitat may occur within area	No	✓ Conservation advice *Papasula abbotti* Abbott's booby (Threatened Species Scientific Committee, 2015h)	No	No
Common/brown Noddy (*Anous stolidus*)	M	Species or species habitat may occur within area	No	Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020)	No	No✓
Streaked Shearwater (*Calonectris leucomelas*)	M	Species or species habitat may occur within area	No	Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020)	No	✓No
Lesser Frigatebird (*Fregata ariel*)	M	Species or species habitat likely to occur within area	No	Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020)	No	No✓
Great Frigatebird (*Fregata minor*)	M	Species or species habitat may occur within area	No	Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020)	No	No✓
Common Sandpiper (*Actitis hypoleucos*)	M	Species or species habitat may occur within area	No	Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020)	No	No✓
Sharp-tailed Sandpiper (*Calidris acuminata*)	M	Species or species habitat may occur within area	No	Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020)	No	No✓
Pectoral Sandpiper (*Calidris melanotos*)	M	Species or species habitat may occur within area	No	Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020)	No	No✓
White- tailed tropicbird (*Phaethon lepturus*)	M	Species or species habitat may occur within area	No	Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020	No	No✓

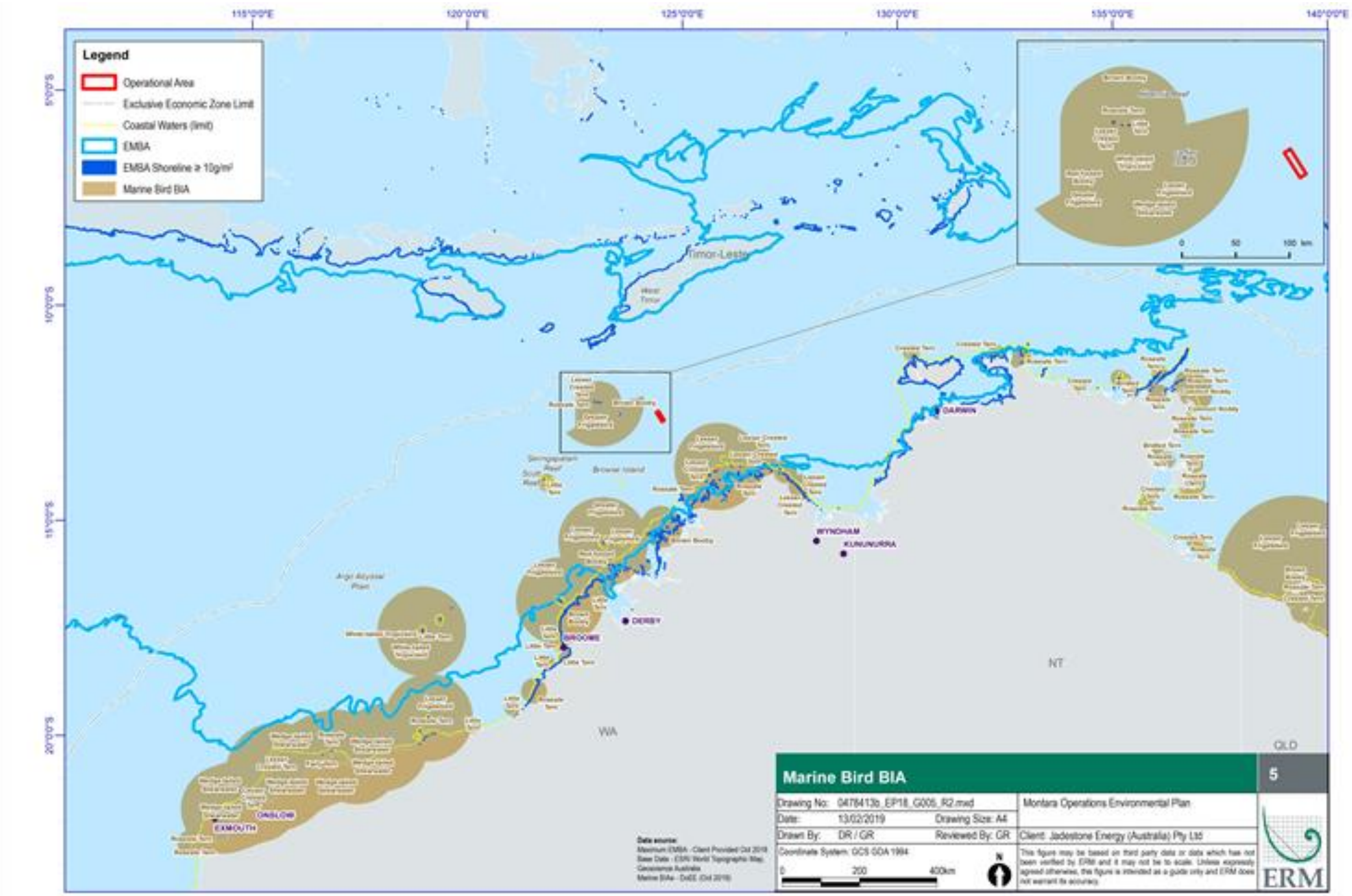


Figure 5-9: Biologically important areas for avifauna

Red Knot (Endangered/Migratory)

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*. It undertakes long distance migrations from breeding grounds in Siberia, where it breeds during the boreal summer, to the southern hemisphere during the austral summer. Both Australia and New Zealand host significant numbers of red knots during their non-breeding period (Bamford et al. 2008). As with other migratory shorebirds, the species occurs in coastal wetland and intertidal sand or mudflats, where they feed on intertidal invertebrates, especially shellfish (Garnet et al. 2011).

They are likely to be found in these habitats throughout the EMBA but is unlikely to occur frequently in the Operational area, aside from individuals occasionally transiting through during migrations, due to the lack of emergent habitat.

Australian Lesser Noddy (Vulnerable)

The Australian lesser noddy (*Anous tenuirostris melanops*) is usually only found around its breeding islands including the Houtman Abrolhos Islands and on Ashmore Reef and Barrow Island in WA (DoEE 2017b). This species may forage out at sea or in seas close to breeding islands and fringing reefs (Johnstone and Storr 1998; Storr et al. 1986; Whittell 1942). Given the distribution of the species and the breeding population at nearby Ashmore Reef and Cartier Island, this species may be present in the Operational area, although only in low numbers. Based on known distribution and the location of rookeries the species is known to occur within the EMBA.

Curlew Sandpiper (Critically Endangered/Migratory)

In Australia, curlew sandpipers (*Calidris ferruginea*) occur around the coasts and are also quite widespread inland. In WA, they are widespread around coastal and subcoastal plains from Cape Arid to south-west Kimberley, albeit rarely encountered in the north-west of the Kimberley region (DoEE 2017b). Curlew sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, as well as around non-tidal swamps, lakes and lagoons near the coast, occurring in both fresh and brackish waters (DoEE 2017b).

Given the offshore location of activities and habitat preferences, the species is unlikely to be encountered within the Operational area other than occasional numbers during migration, although may be present within the EMBA.

Eastern Curlew (Critically Endangered/Migratory)

Within Australia, the eastern curlew (*Numenius madagascariensis*) has a primarily coastal distribution. They have a continuous distribution from Barrow Island and Dampier Archipelago in WA, through the Kimberley and along the NT, Queensland, and NSW coasts and the islands of Torres Strait. They are patchily distributed elsewhere.

The species nests in the northern hemisphere, from early May to late June and does not breed in Australia. During the non-breeding season in Australia, the eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats (TSSC 2015). Given the offshore location of activities and habitat preferences, the species is unlikely to be encountered within the Operational area other than occasional numbers during migration, although may be present within the EMBA.

Abbott's Booby (Endangered/Migratory)

In Australia, Abbott's booby (*Papasula abbotti*) is only found on Christmas Island, where it nests in tall rainforest trees. It is a pelagic feeding species, spending long periods at sea and often foraging hundreds of kilometres from land (Olsen 2001). Given the offshore location of activities and habitat preferences, the species is may be present foraging within the Operational area and EMBA.

Brown Noddy (Migratory)

In Australia, the Brown noddy (*Anous stolidus*) occurs mainly in oceanic waters off the Queensland coast, although is also known from the north-west and central WA coast. The species is also rarely encountered off the coast of the NT, where only one breeding location of approximately 100-130 birds is documented (DoEE 2017b). During the breeding season, the species usually occurs on, or near islands, on rocky islets and stacks with precipitous cliffs, or on shoals or cays of coral or sand. During the non-breeding period, the species occurs in groups throughout the pelagic zone (DoEE 2017b).

Based on the distribution and habitat preferences the species may be encountered within the Operational area and occurs within the EMBA.

Streaked Shearwater (Migratory)

The streaked shearwater (*Calonectris leucomelas*) is usually found over pelagic waters and is known to breed on the coast and offshore islands mainly around Japan and Korea (Ochi et al 2010). The streaked shearwater migrates south during winter to Australia (Birdlife International 2015). The species does not breed in Australia. Streaked shearwaters are known to forage in areas of high concentrations of subsurface predators (e.g. tuna and dolphins) in tropical oceans during non-breeding periods (Yamamoto et al 2010). Given the distribution of streaked shearwaters, this species may be present in the Operational area, albeit in low numbers, and will occur within the EMBA.

Lesser Frigatebird (Migratory)

The lesser frigatebird (*Fregata ariel*) is considered the most common and widespread frigatebird over Australian seas (Lindsey 1986). They are commonly found in tropical seas, breeding on remote islands (Marchant and Higgins 1990). A BIA has been identified for this species at Ashmore Reef and Cartier Island to highlight breeding and foraging behaviours in the area (DoEE 2017b). The Operational area does not overlap with this BIA (Figure 5-9). Breeding is known to occur between March and September.

Given its distribution and the large breeding population at nearby Ashmore Reef and Cartier Island, this species may be encountered within the Operational area and will be present within the EMBA.

Great Frigatebird (Migratory)

Great frigatebirds (*Fregata minor*) are found in tropical waters globally. A BIA has been identified at Ashmore Reef and Cartier Island for the species to highlight breeding and foraging behaviours in the area (DoEE 2017b). The Operational area does not overlap with this BIA (Figure 5-9). Breeding is known to occur between May to June and in August (DoEE 2017b). Given the distribution of the species and its low population in nearby Ashmore Reef and Cartier Island, this species may be present in the Operational area in low numbers.

Common Sandpiper (Migratory)

The common sandpiper (*Actitis hypoleucos*) is a small, migratory species with a very large range through which it undertakes annual migrations between breeding grounds in the northern hemisphere (Europe and Asia) and non-breeding areas in the Asia-Pacific region (Bamford et al. 2008). The species congregates in large flocks and forages in shallow waters and tidal flats between spring and autumn. Specific critical habitat in Australia has not been identified due to the species' broad distribution (Bamford et al. 2008).

The common sandpiper may be present in coastal wetland and intertidal sand or mudflats throughout the wider EMBA, but is unlikely to occur in the Operational area, aside from individuals occasionally transiting through during migrations, due to the lack of emergent habitat.

Sharp-tailed Sandpiper (Migratory)

The sharp-tailed sandpiper (*Calidris acuminata*) is a migratory wading shorebird and undertakes long distance seasonal migrations between breeding grounds in the northern hemisphere and over-wintering areas in the southern hemisphere (Bamford et al. 2008). The species may occur in Australian between spring and autumn. The species is unlikely to occur within the Operational area due to the lack of suitable habitat but may occur seasonally in coastal wetland and intertidal sand or mudflats throughout the wider EMBA.

Pectoral Sandpiper (Migratory)

The pectoral sandpiper (*Calidris melanotos*) breeds in the northern hemisphere during the boreal summer, before undertaking long distance migrations to feeding grounds in the southern hemisphere (Bamford et al. 2008). The species occurs throughout mainland Australia between spring and autumn. The pectoral sandpiper prefers coastal and near-coastal environments such as wetlands, estuaries and mudflats.

Given the species' preferred habitat the pectoral sand piper is not expected to occur within the Operational area but is expected to occur in suitable habitats within the wider EMBA.

White-tailed Tropicbird (Migratory)

The white-tailed tropicbird (*Phaethon lepturus*) is primarily oceanic in tropical waters, rarely inshore, and only is near land when breeding. Nests are located on islands and atolls utilising a variety of habitats from closed canopy rainforest to bare sandy ground and rugged rocky terrain (CoA 2020).

Given the species' preferred habitat the pectoral sand piper is not expected to occur within the Operational area but is expected to occur in suitable habitats within the wider EMBA.

5.6 Social Values

The socioeconomic environmental values and sensitivities (cultural and socio-economic) within the Operational Area, which also include all relevant matters of National Environmental Significance (NES) protected under the EPBC Act, are summarised in ***Table 5-11***.

Table 5-11: Socio-economic Values and Sensitivities within the Operational Area

Value/ Sensitivity	Description	Operational Area Presence
World Heritage Properties	Sites accepted to the World Heritage listing are only inscribed if considered to represent the best examples of the world's cultural and natural heritage. There are no World Heritage properties that intersect with the Operational Area.	None
Shipping	The Operational Area is not located on a major international shipping route. Heavy vessels following the charted Osborn Passage will pass through both permits to the north of the Montara Venture FPSO. Support vessels servicing the nearby infrastructure do pass through the Operational Area (AMSA, 2014)	ü
Commercial Fishing	The Northern Demersal Scalefish Fishery (Area 2) has low levels of fishing activity in the vicinity the Operational Area. The following	Minimal effort

	fisheries are permitted, and It is feasible that they may operate in the Operations Area: • JA Northern Shark Fishery (WA) • Mackerel Area 1 (WA) • Western Tuna and Billfish Fishery	
Recreational Fishing	Remoteness of Operational area limits recreational fishing usage.	Limited
Traditional Fishing	Traditional Australian indigenous fishing activities are generally concentrated within 3 nm of the NT/WA coastline (DPIF 2015). Indonesian/Timor Leste indigenous fishing is concentrated in the vicinity of Sahul Bank, Echo Shoals and MoU Box and boats may pass through the Operational area to reach these fishing grounds.	Transit
Defence	No declared defence areas in Operational area.	–
Oil and Gas	Various petroleum exploration and production activities have been undertaken within the Timor Sea, including some within close proximity of the Operational area.	Adjacent
Tourism	No regular tourism activity occurs in the Operational area due to its remoteness.	–
Cultural Heritage	No known sites of shipwrecks or Aboriginal Heritage significance within the Operational area.	–

Through ongoing engagement with indigenous groups, Jadestone continues to seek further information on relevant cultural values for this activity.

Jadestone understands that First Nations peoples have deep connections to, and concerns about the protection of Sea Country, also referred to as Saltwater Country, and is viewed the same way they view their onshore Country, without separation.

Sea Country is an important part of First Nations peoples culture and whilst the many coastal and island First Nations groups around Australia have different languages and their own unique belief systems, ceremonies and relationships with Country, they all regard the estuaries, beaches, bays and marine areas, or Sea Country, as essential parts of their traditional estates.

First Nations groups who reside along the coasts or on islands believe that Sea Country contains the evidence of creation stories, about animals, plants and people, as well as the creation of landscape features such as islands and reefs. Coastal and island communities held cultural responsibilities to ensure Sea Country is cared for and Sea Country was managed very carefully, and they are playing an increasingly important role in the management of their Sea Country, through formalised roles and programs that work alongside various State and Commonwealth government structures.

Values and sensitivities regarding Sea Country may include different features such as:

- Historic and contemporary cultural harvesting of marine fauna and flora
- Sea and landscape features that hold dreamtime and creation stories, such as offshore islands; and
- Different marine and avian species that hold deep connections to lore and represent spiritual emblems.

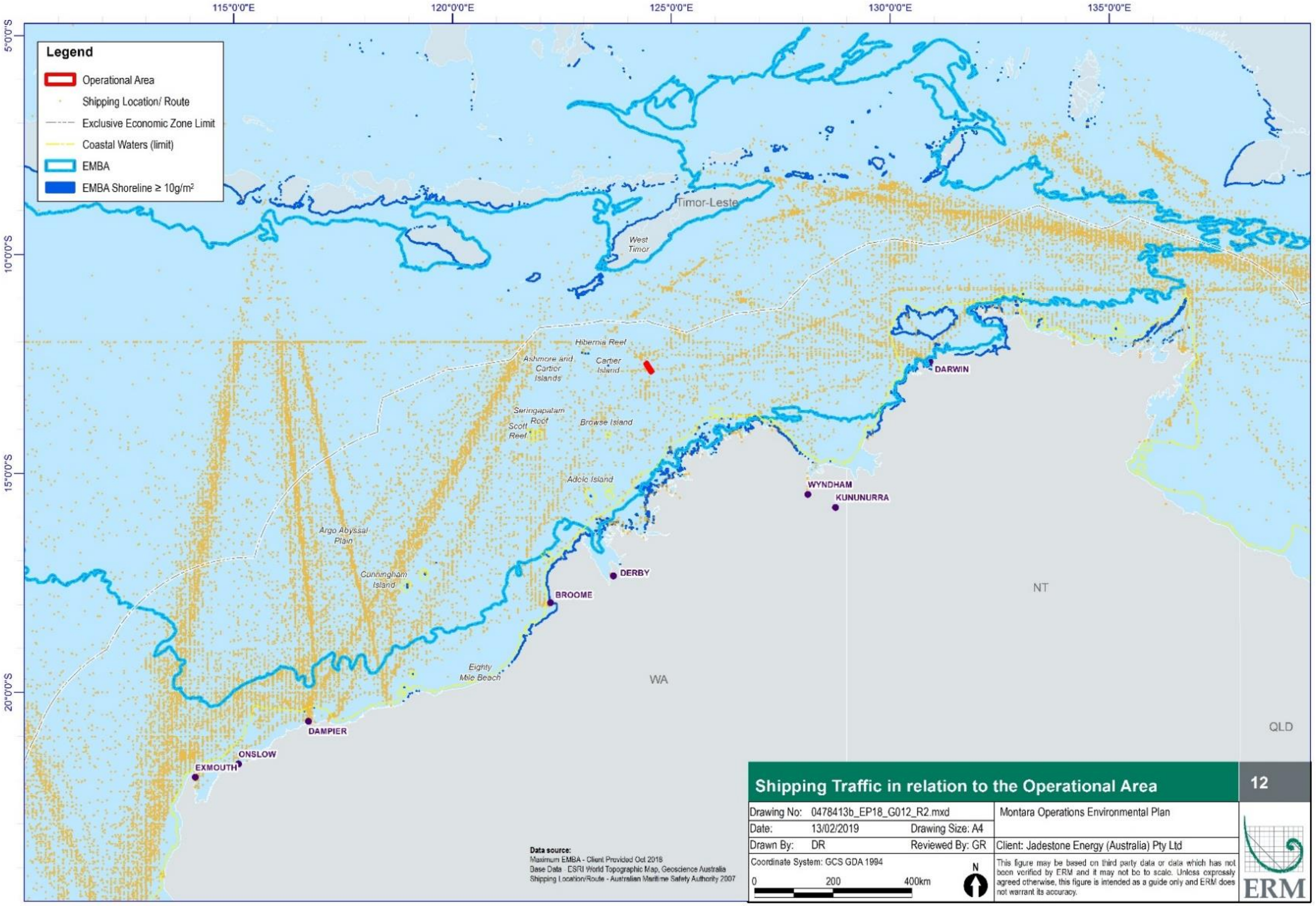


Figure 5-8: Shipping activity within the region

6. CONSULTATION OF RELEVANT PERSONS

6.1 Consultation background

Jadestone Energy (Jadestone) has a Stakeholder Management Plan (SMP) (JS-70-PR-I-00034) that guides its stakeholder consultation responsibilities and activities for both of its Australian operations – Montara and Stag.

The SMP has been written to assist in consistently engaging with relevant persons across its approvals. This provides a strategic and systemic 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 title and operatorship of the Montara Operations was transferred to Jadestone from the previous operator, PTTEP Australasia (Ashmore Cartier) Pty Ltd, on 6 August 2019. Montara is an existing facility that has been in operation since 1998. The previous operator had a Consultation Strategy that incorporated providing regular updates of Montara related activities to relevant persons. As a result, the identified relevant persons have been informed and consulted on a regular basis for some time.

Relevant persons were originally identified and classified according to criteria outlined in a 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 operations activity changed from having a floating storage and offtake vessel in the field, to a third-party tanker. Relevant persons were again identified as part of previous drilling scopes and as part of this EP revision.

The SMP has now been further updated for the purpose of complying with the decision of the Federal Court in Tipakalippa v National Offshore Petroleum Safety and Environment Management Authority (No 2) (the Tipakalippa decision), the outcome of the subsequent unsuccessful appeal outcome against that decision, and the NOPSEMA Guideline) Consultation in the course of preparing an environment plan (N-04750-GL2086 A900179 published on 15 December 2022.

6.1 Consultation purpose

Notwithstanding the consultation described in **Section 6.1** above, Jadestone is well advanced in the planning for and the arrangements for further consultation, including with recently identified additional relevant persons, for the purpose of ensuring its consultation satisfies the applicable Regulations and complies fully with the Tipakalippa decision, the appeal outcome and the NOPSEMA Guideline.

Jadestone also undertakes consultation for the purpose of compliance with its internal policies and procedures, and in recognition of its broader corporate responsibilities.

6.2 Applicable regulations

The OPGGS(E) Regulations 2009 stipulate several requirements in relation to consultation associated with an EP (**Table 6-1**).

Table 6-1: Regulatory Requirements

Legislation	Summary	Requirement
OPGGS Act S 280	No interference	A person carrying out activities in an offshore permit area should not interfere with other users of the offshore area to a greater

Legislation	Summary	Requirement
		extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person.
OPGGS(E)R 13	Environment description	Description of the environment (2)The environment plan must: (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. Note: The definition of environment in regulation 4 includes its social, economic and cultural features. (3)Without limiting paragraph (2)(b), particular relevant values and sensitivities may include any of the following: (a)the world heritage values of a declared World Heritage property within the meaning of the EPBC Act; (b)the national heritage values of a National Heritage place within the meaning of that Act; (c)the ecological character of a declared Ramsar wetland within the meaning of that Act; (d)the presence of a listed threatened species or listed threatened ecological community within the meaning of that Act; (e)the presence of a listed migratory species within the meaning of that Act; (f)any values and sensitivities that exist in, or in relation to, part or all of: (i)a Commonwealth marine area within the meaning of that Act; or (ii)Commonwealth land within the meaning of that Act.
OPGGS(E)R 11A(1)	Relevant persons	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 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.
OPGGS(E)R 11A(2)	Sufficient information	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.

Legislation	Summary	Requirement
OPGGS(E)R 11A(3)	Reasonable period	The titleholder must allow a relevant person a reasonable period for consultation.
OPGGS(E)R 11A(4)	Sensitive information	The titleholder must tell each relevant person the titleholder consults that: (a)the relevant person may request that particular information the relevant person provides in the consultation not be published; and (b)information subject to such a request is not to be published under this Part.
OPGGS(E)R 9(8)	Sensitive information	All sensitive information (if any) in an environment plan, and the full text of any response by a relevant person to consultation under regulation 11A in the course of preparation of the plan, must be contained in the sensitive information part of the plan and not anywhere else in the plan.
OPGGS(E)R. 14(9)	Ongoing consultation	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.
OPGGS(E)R 16(b)	Consultation report	The environment plan must contain: A report on all consultations between the titleholder and any relevant person, for regulation 11A, that contains: (i) A summary of each response made by a relevant person; (ii) An assessment of the merits of any objections or claim about the adverse impact of each activity to which the environment plan relates; (iii) A statement of the titleholder's response, or proposed response, if any, to each objection or claim; and (iv) A copy of the full text of any response by a relevant person.
OPGGS(E)R 10A	Measures adopted from consultations are appropriate	For regulation 10, the criteria for acceptance of an environment plan are that the plan: (g) demonstrates that: (i) the titleholder has carried out the consultations required by Division 2.2A; and (ii) the measures (if any) that the titleholder has adopted, or proposes to adopt, because of the consultations are appropriate.
OPGGS(E)R 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.

6.3 Applicable case law and guidance

The OPGGS(E)Regulations are the legal basis for undertaking offshore operations in the oil and gas industry. These regulations are administered by NOPSEMA who are responsible for ensuring compliance.

A judicial review of a NOPSEMA decision to accept the Barossa Development Drilling and Completions Environment Plan was undertaken by Justice Bromberg. Justice Bromberg found in favour of the Applicant (Dennis Murphy Tipakalippa) that NOPSEMA could not be reasonably satisfied that all relevant persons were consulted as is required under regulations 10A and Division 2.2A and set aside the accepted EP (*Tipakalippa v National Offshore Petroleum Safety and Environmental Management Authority (No. 2) [2022] FCA 1121* (the Decision)).

Santos NA Barossa Pty Ltd appealed the Decision made by Justice Bromberg, with a hearing held 15–16 November 2022. Justices Kenny, Mortimer and Lee reviewed the decision and found in favour of the Applicant and confirmed that the Santos EP should be set aside (*Santos NA Barossa Pty Ltd v Tipakalippa [2022] FCAFC 193* (the Appeal)).

Based on these findings NOPSEMA developed a Guideline "*Consultation in the course of preparing an environment plan Doc No N-04750-GL2086 A900179*" to assist Titleholders in comply with their obligations to consult relevant persons.

That guidance being:

1. The representative bodies (Land Councils and Prescribed Body Corporates (PBCs) remain relevant persons.
2. Traditional Owner Clans are also relevant persons, i.e. they need to be actively consulted, and therefore through that process need to be given every encouragement to respond, formally through their representative spokesperson/s, i.e. the Clan leaders, generally identified as Elders.
3. The residents of the Indigenous lands are to be consulted, although those residents are not required to be individually identified and consulted directly. Rather providing reasonable means for those residents to become aware of a project, and its associated potential impacts and remedies, with a reasonable means to respond to the titleholder and a reasonable time to respond, is likely to be sufficient.

Consequently, Jadestone has sought to:

1. Identify each relevant Traditional Owner Clan and the persons who can be regarded as their representative spokesperson/s.
2. Ensure every reasonable effort is made to provide the project information in a way that is clear and able to be understood by the Clan, and that the Clan (through their representative spokesperson/s) provide a response to the titleholder, even if a considered 'no response'.
3. Decide on the reasonable means by which residents are to become aware of a project, similarly in a way that is clear and able to be understood by residents, and their response opportunities.

Jadestone has taken particular care in gaining an understanding of the construct of a Traditional Owner Clan. That is, Native Title holders associated with a Prescribed Body Corporate (generally an Aboriginal Corporation) as a result of a Native Title Determination, or the Aboriginal peoples in the Northern Territory who are residents on Freehold Aboriginal Land, held by a Land Trust administered by a Land Council, will generally comprise multiple Clans with their own defined Clan estate.

Jadestone notes also that the Tipakalippa decision and the outcome of the subsequent appeal has implications for consultation with the fishing industry, i.e., how individual fishery licence holders are to be regarded.

This decision must be applied as law and has been thoroughly considered and applied in the development of this EP, including but not limited to the following (extracts from the decision, emphasis added):

138 *For the exercise of identifying the universe of relevant persons falling within the description in reg 11A(1)(d), the titleholder will have to be faithful to that description. The titleholder will need to properly understand its proposed activity and at least broadly understand the extent of the physical environment that may be affected, the values and sensitivities in that physical environment and thus the functions, interests or activities of each person or each category of persons that may intersect with that physical environment.*

139 *The exercise of identifying the universe of relevant persons within the description in reg 11A(1)(d) is capable of being described person by person, category by category, or alternatively, by the titleholder describing the methodology utilised in terms which, as stated above, demonstrate an understanding of the considerations that have to be and which were taken into account in order for the exercise to be faithfully consistent with the description of relevant person in reg 11A(1)(d) (a methodological demonstration). A critical aspect of such a demonstration would be the identification of the totality of the sensitivities and values considered relevant and how each was evaluated to discover their possible intersection with the functions, interests and activities of particular people or organisations.*

140 *If that were done in an environment plan, NOPSEMA could then properly arrive at the foundational conclusion for the remainder of its tasks in relation to the consultation criteria, that the environment plan demonstrates that the universe of relevant persons was identified by the titleholder consistently with the description of a relevant person provided by reg 11A(1).*

6.4 Relevant Persons Identification Methodology

6.4.1 Relevant Persons Methodology Workflow

To ensure that all Relevant persons for Montara are identified (self-identifying relevant persons excepted) Jadestone has now prepared, with regard to the Regulations and the applicable case law summarised in Section 6.3, a methodological approach to identification. This builds on the historical consultation already undertaken.

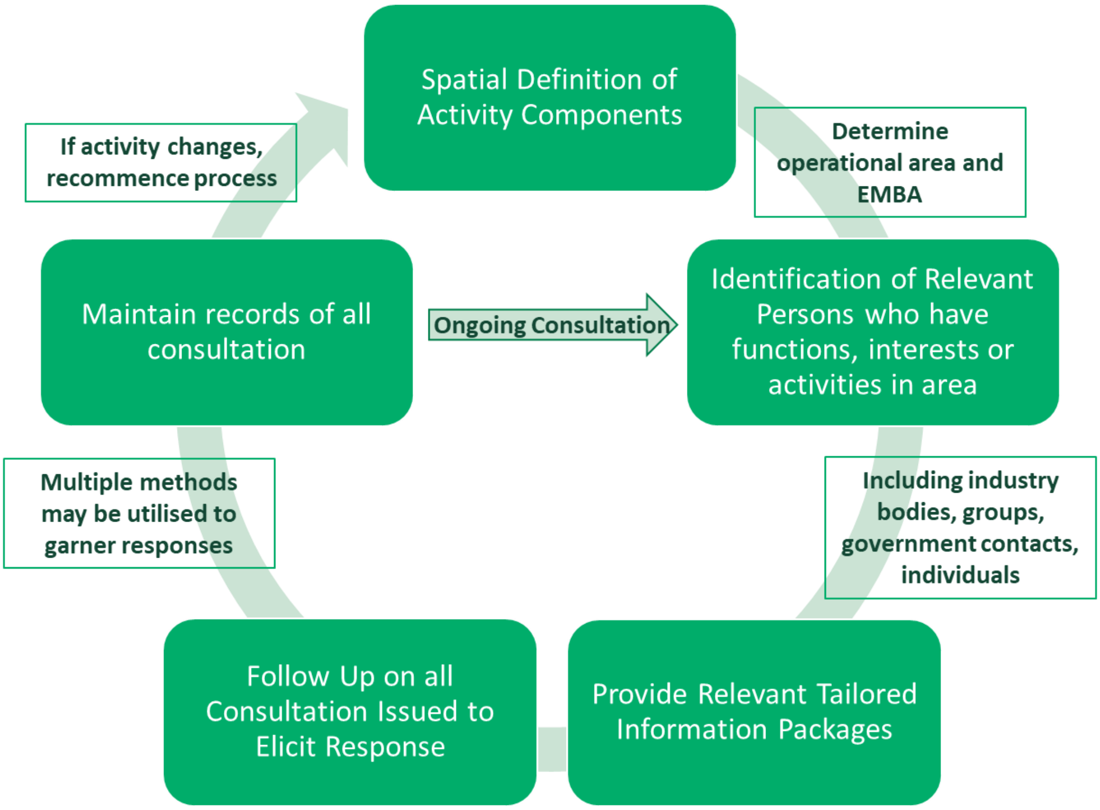


Figure 6-1: Relevant person identification and consultation process

6.4.2 Approach to identifying organisations and people

Organisations and people within each relevant person category were identified using the following steps and resources:

- Jadestone's stakeholder database for Montara contains a list of organisations and people identified since 1998. Following the methodology applied to identify relevant person categories the database was reviewed for the purpose of identifying potential gaps in relevant persons;
- Jadestone has also contracted consultants with experience in stakeholder consultation in the Australian petroleum industry, including the identification of relevant persons, consultation and negotiation with Indigenous peoples in the remote coastal areas of Northern Australia.

As a result of the above, and as a consequence of the Tipakalippa decision, the appeal outcome and the NOPSEMA Guideline, Jadestone identified gaps in relevant persons that had not been consulted with, being a number of individual commercial fishery licence holders in the Commonwealth, Western Australian and Northern Territory fisheries that intersect with the EMBA, the Traditional Owner Clans with coastline, near shore and sea country interests within or immediately adjacent to the EMBA, and cruise and charter operators operating in waters off of the coast of northwest Western Australia and the Northern Territory.

6.4.3 Approach to identifying commercial fishers

For the purpose of consultation Jadestone has access to lists of all the individual commercial fishery licence holders in the Commonwealth, Western Australian and Northern Territory fisheries that intersect with the EMBA.

The peak bodies representing the individual licence holders in each commercial fishery will continue to be consulted as relevant persons.

6.4.4 Approach to identifying First Nation peoples

The Tipakalippa decision, the appeal outcome and NOPSEMA Guideline has led to a significant change to the approach now required for identifying and consulting with Indigenous stakeholders. The past wide-spread practice of consulting only with the Land Councils and Prescribed Body Corporate (PBCs) (the Aboriginal Corporations representing land-owning Traditional Owner Clans), and not the land-owning Traditional Owner Clans themselves, is no longer appropriate. If a land-owning Traditional Owner Clan is identified as a relevant person, consultation is required to be with the Clan, and wherever possible face-to-face on country.

Given the Sea Country values and sensitivities (refer Section 5.6) Jadestone acknowledges First Nations peoples will be relevant persons in relation to the proposed activities set out in this EP.

Nevertheless, legislative requirements mean working through the Land Councils and the Aboriginal Corporations representing land-owning Traditional Owner Clans is generally the required means by which the consultation with the land-owning Traditional Owners Clans is to be facilitated.

Therefore, Jadestone Energy has sought the assistance of the Kimberley Land Council (KLC), the Northern Land Council (NLC) and the Tiwi Land Council (TLC), to obtain:

- details of the Traditional Owner Clans with coastline, near shore and sea country within the EMBA;
- advice on the most appropriate and effective means of consulting directly with those Clans.

Additionally, Jadestone will request the assistance of the Land Councils to consult with those Clans.

The Land Councils and the PBCs representing land-owning Traditional Owner Clans should continue to be identified as relevant persons.

6.4.5 Non-government Environment groups

Jadestone has also now carried out a review to identify the groups that may have interests in the environment of the area within the EMBA and more broadly and added in those groups as relevant persons.

6.4.6 Self-identified Relevant persons and interested persons

Promulgation of project information, by whatever means, may result in the addition of additional relevant persons through self-identification.

Interested persons will also be identified through the process of identifying relevant persons. Interested persons are any organisation or person for whom it might be reasonably expected will have an interest in, but not be affected by, the activity, nor have any regulatory or approval function or responsibility.

Interested persons can also self-identify through the public comment periods of environmental approvals processes.

Throughout the life of all projects, Jadestone will continuously assess the merit of the responses to consultation, including with relevant persons who self-identify.

6.5 Project Activities

Section 3 of this EP details the activity description including the location, timing, infrastructure, vessels and each relevant on-going Montara activity.

6.6 Environmental values and sensitivities

6.6.1 Spatial extent of the environment that may be affected

Section 5 of this EP sets out a detailed description of the environment that commences with the spatial extent of the EMBA, different zones and thresholds within those areas, enabling the first step in identification of Relevant person categories.

6.6.2 Totality of environmental values and sensitivities

The totality of the defined activities, the EMBA, the relevant values and sensitivities of that environment, identification and assessment of risks and impacts, have been re-assessed to identify where a person's or organisation's functions, interests or activities may be affected by the activities to be carried out in the EP.

Consistent with the description of relevant person provided by Regulation 11A(1), to be affected means the functions, interests or activities of a person or organisation would be changed by activities to be carried out under the EP, including the totality of the environment values and sensitivities considered relevant.

6.6.3 Relevant persons categories

Table 6-2: Assessment of Relevance of Identified Stakeholders
outlines the government departments and agencies that have been identified as relevant within Regulation 11A (1)(a), (b), (c), (d) and (e).

Table 6-2: Assessment of Relevance of Identified Stakeholders

Relevant person	Relevance to the Activity	Functions, interest or activities
Commonwealth government department or agency		
Australian Communications & Media Authority (ACMA) within the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDC)	Considered relevant persons under Regulation 11A(1)(a)	Administrator of submarine cable protection zones. Relevant when active activity may impact on subsea cables.
Australian Fisheries Management Authority (AFMA)	Considered relevant persons under Regulation 11A(1)(a)	AFMA is the Australian Government agency responsible for the efficient management and sustainable use of Commonwealth fish resources on behalf of the Australian community. AFMA manages and monitors commercial Commonwealth fishing to ensure Australian fish stocks and the Australian fishing industry is viable now and in the future. Relevant when the activity has the potential to impact on fisheries resources in AFMA-managed fisheries.
Australian Hydrographic Office (AHO)	Considered relevant persons under Regulation 11A(1)(a)	AHO is part of the Department of Defence, responsible for providing Australia's national charting service under the terms of SOLAS and the Navigation Act 2012 (Cth). Role includes provision of nautical charting (including charts in electronic form) and associated services in support of maritime safety. Responsible for the publication and distribution of nautical charts and other information required for the safe shipping and navigation in Australian waters. Relevant when the activity may impact operational requirements and where nautical products and other maritime safety and information is required to be updated, including Notice to Mariners.
Australian Maritime Safety Authority (AMSA)	Considered relevant persons under Regulation 11A(1)(a)	AMSA is the statutory authority established under the Australian Maritime Safety Act 1990. Principal functions are promoting maritime safety and protection of the maritime environment, preventing, and combating ship-sourced pollution in the marine environment, providing infrastructure to support safety of navigation in Australian waters, and providing national search and rescue service to the maritime and aviation sectors.

Relevant person	Relevance to the Activity	Functions, interest or activities
Clean Energy Regulator	Considered relevant persons under Regulation 11A(1)(a)	The Clean Energy Regulator administers schemes legislated by the Australian Government for measuring, managing, reducing, or offsetting Australia's carbon emissions, determined by climate change law. The Regulator has administrative responsibilities for the National Greenhouse and Energy Reporting Scheme, the Emissions Reduction Fund, the Renewable Energy Target, and the Australian National Registry of Emissions Units. As an economic regulator, the Regulator does not have any direct role or powers under our legislation to enforce work health and safety, environmental protection, or planning laws.
Department of Agriculture, Fisheries & Forestry (DAFF)	Considered relevant persons under Regulation 11A(1)(a)	Department responsible for managing biosecurity for incoming goods and conveyances. Relevant due to the potential for the transfer of marine pest between MODU, vessels and the mainland. Activities such as seismic surveys, drilling, exploration, geotechnical surveys, construction, and installation of sub-sea infrastructure have the potential to affect commercially important fish species, their prey and habitats, and the business activities of commercial fishers.
Department of Defence (DOD)	Considered relevant persons under Regulation 11A(1)(a)	Responsible for Australian defence activities. Relevant when the activity encroaches on known training areas and /or restricted airspace.
Department of Foreign Affairs and Trade (DFAT)	Considered relevant persons under Regulation 11A(1)(a)	Promotes and protects Australia's interests internationally. Manages relationships with countries bordering Australia's north, including Indonesia, Timor Leste and Papua New Guinea. Relevant when the activity may impact on waters outside Australia's maritime jurisdiction (such as an oil spill).
Department of Industry, Science & Resources (DISR)	Considered relevant persons under Regulation 11A(1)(a)	DISR is responsible for development and reform of policy relating to the resources sector, including oil and gas. Relevant due to influence on Commonwealth Government sector policy.
Director of National Parks, Parks Australia, part of the Department of Climate Change, Energy, the Environment and Water (DCCEEW)	Considered relevant persons under Regulation 11A(1)(a)	Parks Australia supports the Director of National Parks who has responsibility under federal environment law for six Commonwealth national parks, the Australian National Botanic Gardens and 60 Australian Marine Parks. Relevant when activities undertaken outside of an Australian Marine Park may impact on the values within a Marine Park.

Relevant person	Relevance to the Activity	Functions, interest or activities
Maritime Border Command (MBC), part of Australian Border Force (ABF), part of the Department of Home Affairs (DHA)	Considered relevant persons under Regulation 11A(1)(a)	MBC is enabled by ABF and the Australian Defence Force (ADF), supporting the whole of government effort to protect Australia's national interests by responding with assigned maritime and air assets for civil maritime security operations. Relevant when the activity may impact on border protection activities (eg vessel patrols).
National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)	Considered relevant persons under Regulation 11A(1)(a)	NOPSEMA is Australia's independent expert regulator for health and safety, structural (well) integrity and environmental management for all offshore oil and gas operations and greenhouse gas storage activities in Commonwealth waters, and in coastal waters where regulatory powers and functions have been conferred.
National Offshore Petroleum Titles Administrator (NOPTA)	Considered relevant persons under Regulation 11A(1)(a)	NOPTA is responsible for the day-to-day administration of petroleum & greenhouse gas titles in Commonwealth waters in Australia.
Office of Northern Australia (ONA), within the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDC)	Considered relevant persons under Regulation 11A(1)(a)	Office of Northern Australia (ONA) is the Australian Government's area of expertise for Northern Australia. ONA coordinates implementation of the Government's Northern Australia policy agenda to achieve a sustainable and contemporary northern economy. ONA provides policy advice, coordinates operational support for the Northern Australia Infrastructure Facility, supports Indigenous inclusion of First Nations involvement in the agenda, coordinates whole-of-government reporting, and facilitates governance structures.
NT Government department or agency		
Aboriginal Areas Protection Authority (AAPA)	Considered relevant persons under Regulation 11A(1)(b)	AAPA is an independent statutory authority established under the Northern Territory Aboriginal Sacred Sites Act, responsible for overseeing the protection of Aboriginal sacred sites on land and sea across the whole of Australia's Northern Territory. Relevant when the activity could impact on onshore and near shore Indigenous cultural sites.
Department of Chief Minister and Cabinet (NT)	Considered relevant persons under Regulation 11A(1)(c)	The Department of the Chief Minister and Cabinet plays a vital role in the economic, social and environmental development of the Northern Territory, including responsibility for overseeing or coordinating major government strategies.
Department of Environment, Parks and Water Security (DEPWS)	Considered relevant persons under Regulation 11A(1)(b)	Protect the environment and natural resources in the Northern Territory, including marine fauna management. Relevant when activities may impact on marine or coastal values.

Relevant person	Relevance to the Activity	Functions, interest or activities
Department of Industry Tourism and Trade (DITT)	Considered relevant persons under Regulation 11A(1)(b)	The Department of Industry, Tourism and Trade is the Northern Territory coordinating agency for economic and industry development. The Department administers and regulates petroleum tenure and activities in within the Territory's coastal waters, including petroleum resource exploration and development and the construction and operation of oil and gas facilities and transmission pipelines. The Department manages Northern Territory commercial fisheries. Relevant when the activity has the potential to impact on fisheries resources in Northern Territory managed fisheries.
Marine Safety Branch - Department of Transport (DOT) (NT), part of the Department of Infrastructure, Planning and Logistics (DIPL)	Considered relevant persons under Regulation 11A(1)(b)	Manage oil pollution preparedness for and response in NT waters. Relevant if the activity results in impacts to NT waters or coastlines.
Northern Territory Environment Protection Authority (NTEPA)	Considered relevant persons under Regulation 11A(1)(b)	NTEPA is an independent authority established under the Northern Territory Environment Protection Act. NTEPA provides advice on the environmental impacts of development proposals and advice and regulatory services to encourage effective waste management, pollution control and sustainable practices.
Northern Territory Gas Taskforce	Considered relevant persons under Regulation 11A(1)(b)	The Gas Taskforce drives the Northern Territory Government's vision for the Territory to become a world class hub for gas production, manufacturing, and services by 2030. Relevant as a supporter of the industry sector and potential facilitator in dealing with urgent project matters to do with Northern Territory Government Departments and Agencies.
Northern Territory Regional Harbourmaster, part of the Department of Infrastructure, Planning and Logistics (DIPL)	Considered relevant persons under Regulation 11A(1)(b)	Responsible for moorings in the Port of Darwin. Relevant when the activity could impact on Port operations.
WA government department or agency		
Department of Biodiversity, Conservation and Attractions (DBCA)	Considered relevant persons under Regulation 11A(1)(b)	Manage State marine parks and reserves and protected marine fauna and flora. Relevant when activities undertaken outside of a marine park may impact on the values within a marine park.
Department of Mines, Industry Regulation and Safety (DMIRS)	Considered relevant persons under Regulation 11A(1)(b)	The mission of DMIRS is to support a safe, fair, and responsible future for the Western Australian community, industry and resources sector.

Relevant person	Relevance to the Activity	Functions, interest or activities
		The DMIRS Resource and Environmental Regulation Group is responsible for regulating one of Western Australia's largest industry sectors, and plays a critical role in building Western Australia's economy while ensuring the State's resources are developed in a sustainable and responsible manner.
Department of Planning, Lands & Heritage (DPLH)	Considered relevant persons under Regulation 11A(1)(b)	Protect aboriginal heritage, assist with compliance with the Aboriginal Heritage Act 1972 and provide access to heritage information. Relevant if the activity results in impacts to Aboriginal heritage.
Department of Primary Industries and Regional Development (DPIRD)	Considered relevant persons under Regulation 11A(1)(b)	A primary responsibility of the Department of Primary Industries and Regional Development is to conserve, sustainably develop and share the use of Western Australia's aquatic resources and their ecosystems for the benefit of present and future generations, through managing fisheries and aquatic ecosystems, assessment and monitoring of fish stocks, enforcement and education, biosecurity management and licensing commercial and recreational fishing activity, including commercial aquaculture.
Department of Transport (DOT)	Considered relevant persons under Regulation 11A(1)(b)	In accordance with the Western Australian Emergency Management Act 2005 (the Act) and Emergency Management Regulations 2006 (the Regulations), the WA DoT is the Hazard Management Agency (HMA) for the Marine Oil Pollution (MOP) hazard in State waters. The MOP hazard is prescribed in the Regulations as an; 'actual or impending spillage, release or escape of oil or an oily mixture that is capable of causing loss of life, injury to a person or damage to the health of a person, property or the environment'.
Department of Water & Environmental Regulation (DWER)	Considered relevant persons under Regulation 11A(1)(b)	The department is responsible for managing and regulating the State's environment and water resources.
Local Government Authorities		
Belyuen Community Government Council	Considered relevant persons under Regulation 11A(1)(d)	Local government provides services to the Belyuen Community, which is located on the Cox Peninsula, approximately 120 km from Darwin.
City of Darwin	Considered relevant persons under Regulation 11A(1)(d)	Local government authority for land abutting Darwin Harbour.

Relevant person	Relevance to the Activity	Functions, interest or activities
City of Palmerston	Considered relevant persons under Regulation 11A(1)(d)	Local government authority for land abutting Darwin Harbour.
Shire of Derby / West Kimberley	Considered relevant persons under Regulation 11A(1)(d)	Local government area in the Kimberley region.
Shire of Wyndham / East Kimberley	Considered relevant persons under Regulation 11A(1)(d)	Local government area in the Kimberley region.
Tiwi Islands Regional Council	Considered relevant persons under Regulation 11A(1)(d)	Council governing the Tiwi Islands.
Victoria Daly Regional Council	Considered relevant persons under Regulation 11A(1)(d)	The Victoria Daly Regional Council is a local government area in the Northern Territory.
Wagait Shire Council	Considered relevant persons under Regulation 11A(1)(d)	The Wagait Shire Council is a local government area in the Northern Territory.
West Daly Regional Council	Considered relevant persons under Regulation 11A(1)(d)	The West Daly Regional Council is a local government area of the Northern Territory.
Oil and Gas Industry		
Australian Maritime Oil Spill Centre (AMOSC)	Considered relevant persons under Regulation 11A(1)(d)	AMOSC operates the Australian oil industry's major oil spill response facility. AMOSC's stockpile of oil spill response equipment includes oil spill dispersant and containment, recovery, cleaning, absorbent and communications equipment. Relevant due to the immediate availability of support in recovering from an oil spill event.
Carnarvon Energy	Considered relevant persons under Regulation 11A(1)(d)	Titleholder of exploration permits, production licences and retention leases in adjacent areas.

Relevant person	Relevance to the Activity	Functions, interest or activities
Eni Australia	Considered relevant persons under Regulation 11A(1)(d)	Titleholder of several exploration permits, production licences and retention leases in adjacent areas.
Inpex	Considered relevant persons under Regulation 11A(1)(d)	Relevant due to LNG operations at Bladin Point (within Darwin Harbour).
Melbana Energy	Considered relevant persons under Regulation 11A(1)(d)	Titleholder of NT/P87 & WA-544-P.
Oil Spill Response Limited (OSRL)	Considered relevant persons under Regulation 11A(1)(d)	OSRL is the largest international industry-funded oil spill response cooperative, and provides preparedness, response and intervention services anywhere in the world. Relevant due to the immediate availability of support in recovering from an oil spill event.
Santos	Considered relevant persons under Regulation 11A(1)(d)	Titleholder of WA-454-P, WA-545-P &NT/P84.
Shell	Considered relevant persons under Regulation 11A(1)(d)	Titleholder of exploration permits, production licences and retention leases in adjacent areas.
NT Commercial fishers and fishing associations		
Amateur Fishermens Association of the Northern Territory (AFANT)	Considered relevant persons under Regulation 11A(1)(d)	Represents the interests of recreational fishing in the Northern Territory. AFANT has significant political influence. Relevant when the activity could impact on recreational fishing in coastal waters.
Coastal Line Fishery (NT)	Considered relevant persons under Regulation 11A(1)(d)	Consultation through NTSC. Relevant when the activity could impact on commercial fishing activity.
Demersal Fishery (NT)	Considered relevant persons under Regulation 11A(1)(d)	Consultation through NTSC. Relevant when the activity could impact on commercial fishing activity.

Relevant person	Relevance to the Activity	Functions, interest or activities
Northern Prawn Fishing Industry Pty Ltd	Considered relevant persons under Regulation 11A(1)(d)	The NPF Industry Pty Ltd is a collective of trawler operators, processors and marketers acting together as a single voice for the industry in the Northern Prawn Fishery, which spans the pristine waters from Cape York to the Kimberley. Relevant when the activity could impact on commercial fishing activity.
Northern Territory Guided Fishing Industry Association (NTGFIA)	Considered relevant persons under Regulation 11A(1)(d)	NTGFIA is the industry body for guided fishing and recreational fishers. The Guided Fishing activity includes the use of mother ships moored offshore from which multi-day recreational fishing expeditions are based. Relevant due to significance as a significant and influential local industry sector.
Northern Territory Seafood Council (NTSC)	Considered relevant persons under Regulation 11A(1)(d)	Represents the seafood industry in the Northern Territory. Relevant when the activity could impact on commercial fishing activity.
Offshore Net & Line Fishery (NT)	Considered relevant persons under Regulation 11A(1)(d)	Consultation through NTSC. Relevant when the activity could impact on commercial fishing activity.
Spanish Mackerel Fishery (NT)	Considered relevant persons under Regulation 11A(1)(d)	Consultation through NTSC. Relevant when the activity could impact on commercial fishing activity.
WA Commercial fishers and fishing associations		
Kimberley Crab Fishery	Considered relevant persons under Regulation 11A(1)(d)	Consultation through WAFIC. Relevant when the activity could impact on commercial fishing activity.
Kimberley Gillnet & Barramundi Fishery	Considered relevant persons under Regulation 11A(1)(d)	Consultation through WAFIC. Relevant when the activity could impact on commercial fishing activity.
Kimberley Prawn Fishery	Considered relevant persons under Regulation 11A(1)(d)	Consultation through WAFIC. Relevant when the activity could impact on commercial fishing activity.

Relevant person	Relevance to the Activity	Functions, interest or activities
Pearl Producers Association (PPA)	Considered relevant persons under Regulation 11A(1)(d)	Peak representative organisation of the Australian South Sea Pearling Industry. Relevant when the activity could impact on commercial pearl farming. activity.
Western Australian Fishing Industry Council (WAFIC)	Considered relevant persons under Regulation 11A(1)(d)	Peak industry body representing the interests of the Western Australian commercial fishing, pearling and aquaculture sectors. Relevant when the activity could impact on commercial fishing activity.
Commonwealth Commercial fishers and fishing associations		
Australian Southern Bluefin Tuna Industry Association	Considered relevant persons under Regulation 11A(1)(d)	Peak body representing Southern Bluefin Tuna companies in Australia. The SBTF overlaps the EMBA.
Commonwealth Fisheries Association (CFA)	Considered relevant persons under Regulation 11A(1)(d)	The peak body representing the collective rights, responsibilities, and interests of a diverse commercial fishing industry in Commonwealth regulated fisheries. Relevant when the activity could impact on commercial fishing activity.
Seafood Industry Australia (SIA)	Considered relevant persons under Regulation 11A(1)(d)	Seafood Industry Australia is committed to ensuring there is appropriate consultation between the Australian seafood industry and oil and gas companies on matters including impact, access, regulation and the long-term impacts to fish-stocks from petroleum-related activities. SIA has facilitated a series of conversations between the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) and interested parties on what adequate consultation with oil and gas companies means, and how it can be improved. SIA is a member of the NOPSEMA Transparency Taskforce Steering Committee and recently chaired a reinvigorated Seafood and Petroleum Industry Roundtable. Relevant when the activity could impact on commercial fishing activity.
Recreational fishing associations		
RecFish West (WA)	Considered relevant persons under Regulation 11A(1)(d)	Peak body representing recreational fisheries in Western Australia. Relevant when the activity could impact on recreational fishing activity.
First Nations peoples		

Relevant person	Relevance to the Activity	Functions, interest or activities
Jikilaruwu Traditional Owner Clan	Considered relevant persons under Regulation 11A(1)(d)	Traditional Owner Clan on Bathurst Island, part of the Tiwi Islands. Relevant when the activity could impact on the coastline, coastal waters and sea country.
Kimberley Land Council (KLC)	Considered relevant persons under Regulation 11A(1)(d)	Peak Indigenous body in the Kimberley region. Relevant when the activity could impact on coastal waters and coastlines.
Larrakia Nation Aboriginal Corporation	Considered relevant persons under Regulation 11A(1)(d)	The Larrakia Nation Aboriginal Corporation was established in 1997 through the Northern Land Council, to provide a corporate identity for Larrakia people to uphold Native Title claims, to represent the Traditional Owners of the Darwin region and to speak on behalf of Larrakia people while delivering community and outreach services to the broader Darwin community, including land and sea Rangers. The Larrakia Rangers work across Larrakia land and sea country, which comprises the greater Darwin region west across the Cox Peninsula and east to the Adelaide River. Relevant when the activity could impact on the coastline, coastal waters and sea country.
Malawu Traditional Owner Clan	Considered relevant persons under Regulation 11A(1)(d)	Traditional Owner Clan on Bathurst Island, part of the Tiwi Islands. Relevant when the activity could impact on the coastline, coastal waters and sea county.
Mantiyupwi Traditional Owner Clan	Considered relevant persons under Regulation 11A(1)(d)	Traditional Owner Clan on both Bathurst Island and Melville Island, part of the Tiwi Islands. Relevant when the activity could impact on the coastline, coastal waters and sea country.
Marrikawuyanga Traditional Owner Clan	Considered relevant persons under Regulation 11A(1)(d)	Traditional Owner Clan on Melville Island, part of the Tiwi Islands. Relevant when the activity could impact on the coastline, coastal waters and sea country.
Munupi Traditional Owner Clan	Considered relevant persons under Regulation 11A(1)(d)	Traditional Owner Clan on Melville Island, part of the Tiwi Islands. Applicant in the successful action against NOPSEMA and Santos in the Federal Court. Relevant when the activity could impact on the coastline, coastal waters and sea country.
Northern Australian Indigenous Land & Sea Management Alliance (NAILSMA)	Considered relevant persons under Regulation 11A(1)(d)	NAILSMA is an Indigenous led not-for-profit company operating across northern Australia, working to assist Indigenous people manage their country sustainably for future generations, by providing Indigenous leadership in the delivery of large-scale and complex programs that

Relevant person	Relevance to the Activity	Functions, interest or activities
		meet the environmental, social, cultural, and economic needs of Indigenous people across northern Australia. Relevant when the activity could impact on the coastline, coastal waters and sea country.
Northern Land Council (NLC)	Considered relevant persons under Regulation 11A(1)(d)	The NLC is an independent statutory authority of the Commonwealth, responsible for assisting Aboriginal peoples in the Top End of the Northern Territory to acquire and manage their traditional lands and seas. Relevant when the activity could impact on the coastline, coastal waters and sea country.
Tiwi Land Council (TLC)	Considered relevant persons under Regulation 11A(1)(d)	The Tiwi Land Council represents all Tiwi people in the protection of our land, sea and environment, while at the same time supporting sustainable economic development to improve Tiwi lives through employment, income, education and health opportunities. Relevant when the activity could impact on coastlines, coastal waters and sea country.
Wulirankuwu Traditional Owner Clan	Considered relevant persons under Regulation 11A(1)(d)	Traditional Owner Clan on Melville Island, part of the Tiwi Islands. Relevant when the activity could impact on the coastline, coastal waters and sea country.
Wurankuwu Traditional Owner Clan	Considered relevant persons under Regulation 11A(1)(d)	Traditional Owner Clan on Bathurst Island, part of the Tiwi Islands. Relevant when the activity could impact on the coastline, coastal waters and sea country.
Yimpinari Traditional Owner Clan	Considered relevant persons under Regulation 11A(1)(d)	Traditional Owner Clan on Melville Island, part of the Tiwi Islands. Relevant when the activity could impact on the coastline, coastal waters and sea country.
Port Authorities		
Darwin Port	Considered relevant persons under Regulation 11A(1)(d)	Darwin Port is operated by Darwin Port Operations Pty Ltd which is part of the Landbridge Group. The Landbridge Group is a private company based in Rizhao city in Shandong Province in China, operating businesses in China and Australia. The Darwin Port operates commercial wharf facilities at East Arm Wharf and the cruise ship terminal at Fort Hill Wharf. Relevant when the activity could impact on Port infrastructure and operations.

Relevant person	Relevance to the Activity	Functions, interest or activities
Kimberley Ports Authority	Considered relevant persons under Regulation 11A(1)(d)	Kimberley Port Authority head office is in Broome, and they are responsible for the ports of Derby, Yampi Sound and Wyndham and the Port of Broome. Relevant when the activity could impact on Port infrastructure and operations.
Pilbara Ports Authority	Considered relevant persons under Regulation 11A(1)(d)	Pilbara Port Authority encompasses the Port of Ashburton, Dampier, Port Hedland, and Varanus Island. Relevant when the activity could impact on Port infrastructure and operations.
Wyndham Port (WA Cambridge Gulf Ltd)	Considered relevant persons under Regulation 11A(1)(d)	The Wyndham Port operations and management are currently overseen by Cambridge Gulf Ltd, however the facility is owned by the Department of Transport (WA), who regulates the facility jointly with its transitioning successor, the Kimberley Ports Authority. Principal office in Kununurra. Relevant when the activity could impact on Port operations.
Tourism and Business Associations/ Tour Operators		
Absolute Ocean Charters	Considered relevant persons under Regulation 11A(1)(d)	Absolute Ocean Charters operates from Broome, providing offshore fishing experiences. Relevant when the activity could impact on coastal waters.
Anglers Choice Fishing Safaris	Considered relevant persons under Regulation 11A(1)(d)	Anglers Choice Fishing Safaris operates from Dundee Beach on the Cox Peninsula, providing offshore fishing experiences. Relevant when the activity could impact on coastal waters.
APT Kimberley Coast Cruises	Considered relevant persons under Regulation 11A(1)(d)	APT Kimberley Coast Cruises offer luxury cruises from Broome to Darwin. Relevant when the activity could impact on coastal waters.
Arafura Bluewater Charters	Considered relevant persons under Regulation 11A(1)(d)	Arafura Bluewater Charters operates from Darwin, specialising in bluewater reef and game fishing charters. Relevant when the activity could impact on coastal waters.
Archipelago Adventures	Considered relevant persons under Regulation 11A(1)(d)	Archipelago Adventures operates out of Broome, specialising in catamaran charters off Broome and the Dampier Archipelago. Relevant when the activity could impact on coastal waters.

Relevant person	Relevance to the Activity	Functions, interest or activities
Australia's North West	Considered relevant persons under Regulation 11A(1)(d)	Australia’s North West is the peak tourism body for the Kimberley and Pilbara regions. Relevant when the activity could impact on coastal waters.
Broome Tours	Considered relevant persons under Regulation 11A(1)(d)	Small group tour operator with a powered sailing catamaran, operating out of Broome with a focus on ecotourism. Relevant when the activity could impact on coastal waters.
Broome Visitor Centre	Considered relevant persons under Regulation 11A(1)(d)	Membership-based organisation representing tourism operators in Broome and the broader Kimberley region. Relevant when the activity could impact on coastal waters and coastlines.
Broome Whale Watching	Considered relevant persons under Regulation 11A(1)(d)	Broome Whale Watching operates whale and dolphin watching tours from Broome. Relevant when the activity could impact on coastal waters.
Cannon Charters	Considered relevant persons under Regulation 11A(1)(d)	Cannon Charters operates from Darwin, offering multi-day fishing experiences along the Northern Territory and Kimberley coast. Relevant when the activity could impact on coastal waters.
Clearwater Island Lodge	Considered relevant persons under Regulation 11A(1)(d)	Clearwater Island Lodge is located on Melville Island. Relevant when the activity could impact on the coastline and coastal waters.
Coral Expeditions	Considered relevant persons under Regulation 11A(1)(d)	Coral Expeditions operates from Darwin and Broome providing small ship expeditions. Relevant when the activity could impact on coastal waters.
Darwin Harbour Fishing Charters	Considered relevant persons under Regulation 11A(1)(d)	Darwin Harbour Fishing Charters operates from Darwin, providing offshore and onshore fishing experiences. Relevant when the activity could impact on coastal waters.
Dundee Beach Fishing Charters	Considered relevant persons under Regulation 11A(1)(d)	Dundee Beach Fishing Charters operates from Dundee Beach on the Cox Peninsula, providing offshore fishing experiences. Relevant when the activity could impact on coastal waters.

Relevant person	Relevance to the Activity	Functions, interest or activities
Equinox Fishing Charters	Considered relevant persons under Regulation 11A(1)(d)	Equinox Fishing Charters operates from Darwin, providing offshore fishing experiences. Relevant when the activity could impact on coastline.
Fish Darwin	Considered relevant persons under Regulation 11A(1)(d)	Fish Darwin operates from Darwin, providing offshore fishing experiences. Relevant when the activity could impact on coastal waters.
HeliSpirit Luxury Kimberley Helicopter Safari	Considered relevant persons under Regulation 11A(1)(d)	HeliSpirit Luxury Kimberley Helicopter Safari operate helicopter safaris exploring the Kimberley and NT. Relevant when the activity could impact on coastal waters and coastlines.
Kimberley Cruise Centre	Considered relevant persons under Regulation 11A(1)(d)	Kimberley Cruise Centre arranges Kimberley adventure cruises. Relevant when the activity could impact on coastal waters and coastlines.
Kimberley Expeditions	Considered relevant persons under Regulation 11A(1)(d)	Kimberley Expeditions offers Kimberley cruise expeditions. Relevant when the activity could impact on coastal waters and coastlines.
Kimberley Pearl Cruises	Considered relevant persons under Regulation 11A(1)(d)	Kimberley Pearl Cruises offer boat tours through the Kimberley Coast. Relevant when the activity could impact on coastal waters and coastlines.
Kimberley Quest	Considered relevant persons under Regulation 11A(1)(d)	Kimberley Quest offer luxury cruises through the Kimberley. Relevant when the activity could impact on coastal waters and coastlines.
Kuri Bay Sport Fishing & Adventures	Considered relevant persons under Regulation 11A(1)(d)	Kuri Bay Sport Fishing & Adventures offer fishing expeditions from Kuri Bay, 330km north of Broome. Relevant when the activity could impact on coastal waters and coastlines.
Lady M Luxury Cruises	Considered relevant persons under Regulation 11A(1)(d)	Lady M Luxury Cruises offer cruises of the Kimberley Coast. Relevant when the activity could impact on coastal waters and coastlines.

Relevant person	Relevance to the Activity	Functions, interest or activities
Monsoon Aquatics	Considered relevant persons under Regulation 11A(1)(d)	Monsoon Aquatics are a world leading supplier of premium hand-picked Australian Coral and Marine life. With state-of-the-art facilities in Darwin, Cairns and Bundaberg, collection capability in the North, East and West of Australia and a growing aquaculture program, Monsoon Aquatics supplies an unmatched range of coral to retailers in Australia and wholesalers and public aquaria all around the world. Relevant when the activity could impact on coastal waters.
Ocean Dream Charters	Considered relevant persons under Regulation 11A(1)(d)	Ocean Dream Charters offer cruises of the Kimberley. Relevant when the activity could impact on coastal waters and coastlines.
Offshore Boats Fishing Charters	Considered relevant persons under Regulation 11A(1)(d)	Offshore Boats Fishing Charters operates from Darwin, providing offshore fishing experiences. Relevant when the activity could impact on coastal waters.
One Tide Charters	Considered relevant persons under Regulation 11A(1)(d)	One Tide Charters offer cruises of the Kimberley. Relevant when the activity could impact on coastal waters and coastlines.
Oolin Sunday Island Cultural Tours	Considered relevant persons under Regulation 11A(1)(d)	Oolin Sunday Island Cultural Tours offer tours of Sunday Island and the Kimberley. Relevant when the activity could impact on coastal waters and coastlines.
Ponant Luxury Expeditions	Considered relevant persons under Regulation 11A(1)(d)	Ponant Luxury Expeditions offer sailing tours of the Kimberley. Relevant when the activity could impact on coastal waters and coastlines.
Red Devil Fishing Charters	Considered relevant persons under Regulation 11A(1)(d)	Red Devil Fishing Charters operates from Darwin, providing offshore fishing experiences. Relevant when the activity could impact on coastal waters.
Seafarms Group Ltd Project Sea Dragon	Considered relevant persons under Regulation 11A(1)(d)	As at 23 February 2023 Project Sea Dragon is in Voluntary Administration. Developer of land-based prawn aquaculture project (Sea Dragon) in the Northern Territory. Relevant if the activity could impact on seawater quality.

Relevant person	Relevance to the Activity	Functions, interest or activities
Seaestar Boat Charters	Considered relevant persons under Regulation 11A(1)(d)	Seaestar Boat Charters provides diving and fishing experiences in the Rowley Shoals and Scott Reef. Relevant when the activity could impact on coastal waters.
Silversea Cruises	Considered relevant persons under Regulation 11A(1)(d)	Silversea Cruises offer cruises of the Kimberley. Relevant when the activity could impact on coastal waters and coastlines.
The Great Escape Charter Company	Considered relevant persons under Regulation 11A(1)(d)	The Great Escape Charter Company offer cruises of the Kimberley. Relevant when the activity could impact on coastal waters and coastlines.
Tiwi Island Adventures	Considered relevant persons under Regulation 11A(1)(d)	Tiwi Island Adventures operates from two remote locations on the Tiwi Islands - Melville Island Lodge situated on the shores of Snake Bay and Johnson River Camp situated in the upper reaches of the Johnson River on the east coast of Melville Island. Relevant when the activity could impact on coastal waters and coastlines.
Tourism Top End	Considered relevant persons under Regulation 11A(1)(d)	Regional Tourist Association for the Top End Region of the Northern Territory. Relevant when the activity could impact on coastal waters and coastlines.
True North	Considered relevant persons under Regulation 11A(1)(d)	True North offer cruises of the Kimberley. Relevant when the activity could impact on coastal waters and coastlines.
Willie Pearl Lugger Cruises	Considered relevant persons under Regulation 11A(1)(d)	Willie Pearl Lugger Cruises offer sail cruises of the Kimberley. Relevant when the activity could impact on coastal waters and coastlines.
Yknot Fishing Charters	Considered relevant persons under Regulation 11A(1)(d)	Yknot Fishing Charters operates from Darwin, providing fishing charters to as far as the Tiwi Islands and as far West as the Peron islands. Relevant when the activity could impact on coastal waters.
Environmental Conservation Groups/ eNGOs		
Australian Marine Conservation Society (AMCS)	Considered relevant persons under Regulation 11A(1)(d)	Australian national independent charity dedicated solely to protecting ocean wildlife and working for healthy seas with representation in WA & NT.

Relevant person	Relevance to the Activity	Functions, interest or activities
Conservation Council of Western Australia (CCWA)	Considered relevant persons under Regulation 11A(1)(d)	CCWA is WA's foremost not for profit, non-government conservation and environment organisation. A current active campaign of the CCWA is Say No to Scarborough Gas. Relevant due to in principle opposition to the extraction and use of fossil fuels. Would have the potential to delay but not prevent the Project going ahead.
Environment Centre Northern Territory (ECNT)	Considered relevant persons under Regulation 11A(1)(d)	ECNT is the peak community sector environment organisation in the Northern Territory. ECNT works closely with communities across the Northern Territory to stop environmentally destructive projects, hold government and industry to account, and improve environmental regulation and governance. ECNT has a link on its webpage to the Stop Barossa Gas campaign website which identifies the ECNT as a member of the international alliance opposing the Barossa project. Relevant due to in principle opposition to the extraction and use of fossil fuels. Would have the potential to delay but not prevent the Project from going ahead.
Environs Kimberley	Considered relevant persons under Regulation 11A(1)(d)	Environmental NGO for the Kimberley region, including protecting the Kimberley Coast (and North Kimberley Marine Park)
Greenpeace	Considered relevant persons under Regulation 11A(1)(d)	Independent campaigning organization that uses peaceful protest and creative confrontation to expose global environmental problems and promote solutions that are essential to a green and peaceful future.
Save the Kimberley	Considered relevant persons under Regulation 11A(1)(d)	Independent not for profit awareness organisation run by volunteers made up of a diverse and passionate group of individuals (traditional custodians, local Kimberley community and other committed Australians from all parts).
The Wilderness Society	Considered relevant persons under Regulation 11A(1)(d)	Public company that works to support the living world. They take on transnational corporations, rogue operators, and the armies of lobbyists and politicians who defend them in relation to projects that could affect the environment. They have been active in WA & NT in the past.
World Wildlife Fund	Considered relevant persons under Regulation 11A(1)(d)	Independent conservation organisation for the protection of wildlife in Australia and around the world.
Other Associations		

Relevant person	Relevance to the Activity	Functions, interest or activities
Australian Council of Prawn Fisheries	Considered relevant persons under Regulation 11A(1)(d)	Is made up of membership from local industry bodies and companies that deal with wild prawns or the prawn industry.
Marine Tourism Association of Western Australia (MTWA)	Considered relevant persons under Regulation 11A(1)(d)	Represents the tourism industry in Western Australia (in the context of this project the fishing charter sector). Association currently has one Kimberley member. Relevant when the activity could impact on coastal waters and coastlines.
Northern Territory Chamber of Commerce (NTCA)	Considered relevant persons under Regulation 11A(1)(d)	NTCA is the largest employer association in the Northern Territory. NTCA is an independent, not-for-profit and non-government body whose membership and offices span the Territory.
Thamarrurr Development Corporation (TDC), including the Thamarrurr Rangers	Considered relevant persons under Regulation 11A(1)(d)	TDC is a not-for-profit corporate entity owned by members of the Wangka, Lirrga and Tjanpa peoples. TDC has been established by the 20 clans of the Thamarrurr Region, to represent them in relation to business, socio-economic development, employment and training. Thamarrurr Rangers was established in 2001 by the Traditional Owners of the Thamarrurr Region, who sought to actively address land and sea management issues. Relevant should the activity result in impact on the coastline, coastal waters and sea country.
Academic and Research Organisations		
Australian Institute of Marine Science (AIMS)	Considered relevant persons under Regulation 11A(1)(d)	Organisation concerned with conservation and research outcomes in the area.

6.7 Consultation Methodology

The approach Jadestone is undertaking for consultation in this EP is outlined below:

- Identify relevant persons (as per **Section 6.4**);
- Provide detailed information sheet and area map to commence the consultations via various avenues such as consultation packages and the Jadestone website;
- Provide a table of risks and management measures for those seeking additional information;
- Respond to requests for additional information from relevant persons who have concerns or interests and offer direct consultation with relevant technical staff where applicable;
- Advertise and offer information sessions;
- Allow a reasonable period of time for the relevant person to review and respond to any information provided, at least four weeks;
- Follow up with relevant persons whose functions, interests, or activities may be affected by the activities of the EP, via phone, email/s or in person to ensure they have received the information and verify if they have remaining questions or concerns;
- Ensure relevant persons were informed about the consultation process and how their feedback, questions and concerns were considered in the EP, including the management of sensitive information.

A number of communication methods may be used to exchange information during consultation:

- Written documentation or information provided in person or remotely by methods such as post, email, via website or social media; and/ or
- Verbal communication during telephone calls (pre-emptory or in response/follow up), targeted meetings, focus groups, workshops, information sessions; webinars and/or
- Other means as recommended, particularly in relation to cultural heritage values and sites.

Regardless of the method applied, the information provided to the relevant person has been targeted as much as possible to reduce the information burden on the relevant person, to reduce the possibility of confusion or misinformation, and to improve the likelihood of receiving valuable feedback from the consultation process. The methods Jadestone is using are listed below. The method/s adopted will depend on the nature and scale of an activity and advice on the most appropriate method as advised by each relevant person at the time of the initial consultation.

- Email
- Post
- Phone calls
- Public meetings, including by way of webinars
- For Traditional Owner Clans, presentations face-to-face on country
- Newspaper advertisements
- Social media
- Community noticeboards

- Liaison with other titleholders to reduce stakeholder fatigue

6.8 Follow-up

Jadestone has adopted a number of strategies for following up its invitation for consultation actions.

6.8.1 General

Jadestone has developed a procedure (Figure 6-2) for follow-up with Commonwealth and State/Territory Government Departments, agencies and authorities, with Local Governments, with representative peak industry bodies, with other petroleum title holders, and with businesses, including tourism businesses.

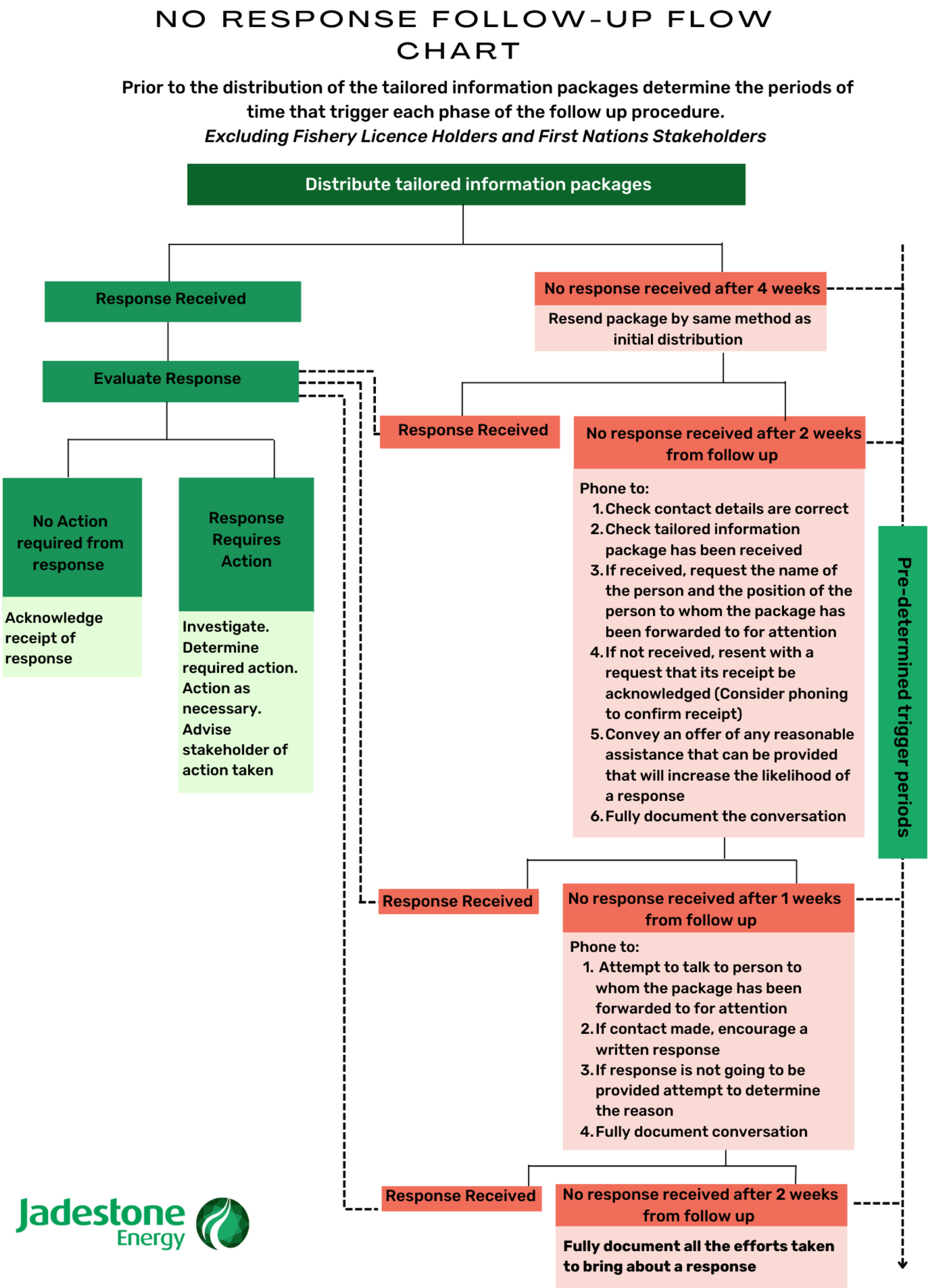


Figure 6-2 No response follow-up flow chart

6.8.2 Commercial Fishery Licence Holders

Initially, all 341 licence holders in the relevant Commonwealth, Western Australian and Northern Territory commercial fisheries were consulted by a mailout with Invitation for Consultation document, noting that the number of individual licence holders is significant, but the designated zones of many of the fisheries extend over large areas of the Australian coast. A review of the postal addresses of the individual licence holders suggests that many of those licence holders do not fish at any time within the EMBA. The initial consultation included a request that those licence holders that do fish within the EMBA indicate that in return correspondence.

The details of the no responders to the initial mailout are to be referred to the Western Australian Fishing Industry Council (WAFIC), the Northern Territory Seafood Council (NTSC) and the Southern Bluefin Tuna Industry Association (ASBTIA), with a request for assistance in identifying those licence holders that are known or believed not to fish in the portion of the fishing zone within or adjacent to the project EMBA.

A search is currently being undertaken to identify an email address for each licence holder.

Based on analysis of the addresses of licence holders, and the advice of WAFIC, NTSC and SBFTIA, follow-up correspondence (mailout or email) will be sent to all no responders that are known or believed to fish in the portion of the fishing zone within or adjacent to the project EMBA.

Jadestone anticipates that analysis of the responses including, as appropriate, through follow up communication, future consultation activities to be with only those licence holders that have been identified as relevant persons.

6.8.3 Newspaper Adverts

To assist relevant persons to self-identify display adverts inviting consultation will be placed in:

- The Australian
- West Australian
- NT News
- Koori Mail
- Kimberley Echo

It is anticipated that the notice inviting consultation will be published in the newspapers mentioned above in the first few weeks of March 2023.

6.9 Provision of Information

The OPGGS(E) requires titleholders to give each relevant person sufficient information to allow the relevant person to make an informed assessment of potential effects on their functions, interests or activities from the activities in the EP. Provision of information is responsive and adaptive to the individual needs and circumstances of the relevant person seeking the information.
Updates on the Montara project, and advice about future activities have been provided via email and posted on the Jadestone website. Copies of these emails (and responses from relevant persons) have been previously provided to NOPSEMA as a Sensitive Information Appendix under Regulation 9(8) of the OPGGS(E) and consultation specific to this EP revision has been included in Appendix G and the Sensitive Information Report submitted to NOPSEMA.

6.10 Management of Objections and Claims

If any objections or claims are raised during ongoing consultation, these will be substantiated by evidence such as publicly available credible information and / or scientific data, including fishing data. Where the objection or claim is substantiated, where applicable it will be assessed as per the Jadestone risk assessment process and controls applied where appropriate to manage impacts and risks to ALARP and an acceptable level. Relevant persons will be provided with feedback as to how their objection or claim has been assessed and if any controls were put in place to manage the risk or impact or risk to ALARP and an acceptable level. If the objection or claim is raised after the EP is accepted and triggers a revision of the EP this will be managed in accordance with Jadestone's Management of Change processes and the relevant person will be advised of the process.

6.11 Ongoing Consultation with Relevant Persons

Jadestone will continue to consult with relevant persons to provide project updates and keep them informed as information becomes available. This will be done via ongoing consultation, including updates in relation to specific activities and broader project information via emails and the provision of relevant information on the Jadestone website. **Table 6-3**: Standard Consultation Actions

outlines the ongoing consultation (and timing) requirements for the activity. Records of ongoing relevant person engagement are maintained in Jadestone's electronic document Management System (eDMS).

Table 6-3: Standard Consultation Actions

Activity	Frequency and method	Responsibility
Provisions of updates on activity progress	Updates to Jadestone website on the Montara Operations activity provided as needed	HSE Manager
Notification of Australian Hydrographic Office	No less than four weeks prior to any significant change to operations commencing email AHO (datacentre@hydro.gov.au) for the promulgation of related notices to mariners.	HSE Manager
Notification of AMSA Joint Rescue Coordination Centre (JRCC)	To notify AMSA's JRCC (rccaus@amsa.gov.au Ph 1800 641 792) 24-48 hrs prior to operations commencing with following details regarding the unit: • Name • Call sign • Maritime mobile service identity (MMSI) • Satellite communications details (including INMARSAT-C and satellite telephone • Area of operation • Requested clearance from other vessels • Operations start and end.	HSE Manager
Notification of DPIRD (Fisheries)	No less than 4 weeks prior to a significant change in operations commencing notify DPIRD (Fisheries) of actual commencement date and any change to proposal.	HSE Manager

Activity	Frequency and method	Responsibility
Notification of Director National Parks	No less than 4 weeks to a significant change in operations commencing notify DNP of actual commencement date and any change to proposal.	HSE Manager
Close out of communication commitments made during pre-start consultation including: • Notification of NOPSEMA EP approval to stakeholders that have requested	Email stakeholder contact within 3 months of EP approval	HSE Manager
Review of relevant persons list	Annually unless triggered earlier	General Manager
Provide response organisations with a copy of the OPEP	Email response organisations within 3 months of OPEP acceptance	ER Lead
Notification of commencement activity to NOPSEMA	Acceptance of the EP is taken to be the notification of commencement of the activity	Environment Lead
Notification of updates to AHO and JRCC on progress and changes to intended operations	Notification as required	Environment Lead

Any new relevant persons or changes to existing relevant persons will be identified through ongoing consultation through the EP review. Where new relevant persons are identified, they will be contacted and provided information about the activity relevant to their functions, interests or activities. Any objections or claims will be managed as per **Section 6.10**.

Jadestone will undertake additional triggered consultation as outlined below, should an unplanned event occur (**Table 6-4**: Triggered Consultation Actions
).

Table 6-4: Triggered Consultation Actions

Trigger	Action	Responsibility
Feedback received from relevant person	Follow consultative process outlined in of the Stakeholder Management Plan	General Manager
Deviation to Montara operations from those originally provided in consultation	Notification to relevant persons via email	General Manager
Change to risk profile in operational area	Notification to relevant persons via email Re-engage for consultation if quantum of risk change is significant	General Manager
Change to risk profile in EMBA	Notification to relevant persons via email	General Manager

Trigger	Action	Responsibility
Loss of Well Control event	Trigger separate Loss of Well control consultation process Notification to response agencies and government agencies as per OPEP Attempt to electronically notify all relevant persons within 72 hours of spill Notify AMP Director General of spill response activities within AMP (prior to response activities within a MP) 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 Lead
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 Stakeholder Management Plan	HSE Manager
Change to Montara's operating jurisdiction such that other legislative instruments stipulate new or additional consultative requirements	Review of Stakeholder Management Plan	Country Manager
An element of Jadestone's continuous improvement process identifies the procedure needs to be amended	Review of Stakeholder Management Plan	Country 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 Leader
Change to infrastructure that affects exclusion zone	Notify the Australian Hydrographic Service of activities and infrastructure for inclusion in Marine Notices	Operations Manager
SMP activation and termination	Notify relevant persons of SMP commencement 10 days prior to and at the cessation of activities	HSE Manager

6.12 Engagement Process

6.12.1 Historical engagement

Jadestone Energy purchased the existing Montara Operations Activity from PTTEP AA. PTTEP AA had already been in contact with many stakeholders regarding their intended review of the Operations Environment Plan. This included engaging WAFIC to consult with the relevant Western Australian managed commercial fisheries and fishing associations. PTTEP AA passed on issues and information gathered from this consultation. Jadestone has considered any referred information about the intended operation of the Montara facilities, and where appropriate addressed it in this EP (Table 1, Appendix E).

Noting any comments in relation to PTTEP AA's response to the previous spill at the site or compensation from this spill were not considered relevant and have not been included. This summary of response was provided back to stakeholders who had previously commented through the PTEPP consultation to show how JSE were addressing these issues.

Following the purchase of Montara from PTTEP updates on the Montara project, and advice about future activities were provided via email to stakeholders and posted on the Jadestone website. Key notices were issued in October 2018, when an email with factsheet notifying stakeholders of change in Operator and that Jadestone was preparing an EP for ongoing operations over the coming 5 years (general and fisheries package) was sent to relevant persons. A summary log is included in Table 5, Appendix E and associated emails in the Sensitive Information Report.

6.12.2 Additional consultation – Montara 1,2,3 Wellhead Abandonment EP

Additional consultation on the Montara-1, 2, 3 wellheads was conducted as part of the now withdrawn Montara-1, 2, 3 Wellhead Abandonment Environment Plan (TM-70-PLN-I-00003) when the wellheads were planned to be left in situ. However, Jadestone are now committed to removing the wellheads prior to end of field life, and therefore additional consultation was issued to inform stakeholders of this change, and that the information pertaining to the wellheads would be included in an update to this Operations EP. The full text consultation on the wellheads has previously been submitted to NOPSEMA, and under Regulation 31 of the OPGGS(E)R is not included here. However, Jadestone's consultation with stakeholders since the decision to remove the wellheads has been included in this revised EP, in Appendix F and the Sensitive Information Report.

Stakeholders contacted for the Operations EP update were selected based on those relevant for the proposed changes to the EP (i.e. produced water, decommissioning, bird management and GHG) as well as those stakeholders considered relevant to receive an update regarding the wellhead removal. A full list of those contacted and full text consultation is provided in the SIR to NOPSEMA. Given the minor changes to ongoing operations, no further consultation is proposed.

Consultation with DCCEEW was undertaken specifically around withdrawing the sea dumping permit for the originally proposed wellhead abandonment and with NOPSEMA for withdrawing the Montara-1,2,3 Wellhead Abandonment EP itself. Additional consultation was also conducted specifically with the DCCEEW to obtain advice on EPBC permits required in relation to proposed bird management measures. A summary of this consultation is provided in **Error! Reference source not found.**.

In a future EP that includes removal of the wellheads or any other infrastructure, all stakeholders will be re-assessed for that activity and for the purposes of consultation to ensure all relevant persons are kept informed of the proposal.

6.12.3 Additional consultation – Current

Table 6-5: Information provided to relevant persons

provides a summary of consultation undertaken to date for this revision of the EP.

Table 6-5: Information provided to relevant persons

Format	Description
Consultation document	An Invitation for Consultation document was prepared and distributed. The document was prepared with sub-regulation 11A(2) and associated guidance in mind to ensure it

	adequately described the activity, including the risks associated with the activities. The document can be found in Appendix G.
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.
Mail-outs, emails and phone calls	Mailouts, emails and phone calls were used to consult with relevant persons as part of the development of the EP. The sensitive information report contains all of the mail-out correspondence, emails and phone call details, captured as part of relevant person consultation.

6.12.4 Current status of consultation (February 2023)

Stakeholder	Key dates and information	Next steps
All relevant persons excluding commercial fishing licence holders and first nations peoples	19 December 2023 – information package emailed 8 February 2023 – Follow up email sent Week commencing 22 February 2023 - follow up phone calls commenced and ongoing	If two weeks later no response had been received, Jadestone commenced follow up phone calls to determine if the contact details were correct and if the information package had been received. If not received, the information package was sent to the contact details provided on the call. This process is still being undertaken and evidence is detailed in the stakeholder log, Appendix G. Emails and correspondence received after 23/02/2023 are still being processed and Jadestone will respond as promptly as possible.
Commercial fishing licence holders Details of licence holders consulted as part of the initial mailout are provided the Sensitive Information Report	9 January 2023 – Hard copy information package posted To date of the 341 letters mailed out 9 have been returned to sender and no responses have been received.	Jadestone are currently working through the follow-up approach detailed in Section 6.8.2 and will then conduct follow up mail out including attempts to confirm incorrect addresses.
First nations peoples: Northern Land Council, Kimberley Land Council and Tiwi Land Council	7-10 March 2023	Meet on-country to obtain details of Traditional Owner Clans within the EMBA and seek guidance on the most appropriate and effective ways of consulting directly with these Clans

6.13 Reasonable period

Recipients of the Invitation for Consultation document were encouraged to provide comment within a six-week period. Comments provided outside of this time were still considered and incorporated into the approvals process wherever practicable.

The Montara EP includes emergency response plans. Pursuant to the environment regulations, Commonwealth, and State and Territory Government departments, agencies and authorities have been, and will continue to be, consulted on response preparedness for an uncontrolled discharge of oil from vessels or the well.

6.14 Assessment of Relevant Persons Objections and Claims

Prior to engaging with relevant persons, Jadestone reviewed the comments, objections and claims raised through the previous Montara Operations EPs.

For all responses received by Jadestone during the engagement, the merit of each of these responses was assessed. Historical Assessment of merit is detailed in Appendix E. Assessment of merit for historical Montara 1,2,3 wellheads EP is found in **Error! Reference source not found.** and the a ssessment of merit for current consultation (post-Tipakalippa decision) in **Error! Reference source not found.**.

The summary provides details of the information sent to relevant persons and others, and any responses received. It also details the assessment undertaken of any objection or claims. Consultation undertaken prior to this time has been reported in other EPs prepared for the Montara Project, along with all of Jadestone's and previous Montara titleholders accepted EPs and can be viewed on the NOPSEMA website.

Where an objection or claim was raised by relevant person, they were provided feedback as to whether the objection or claim was substantiated, how it was assessed and if any additional controls were required to manage the impact or risk to ALARP and an acceptable level. Where an objection or claim was substantiated by evidence such as publicly available credible information and/or scientific data, including fishing data, this was assessed as per the risk assessment process detail in Chapter 6 and controls applied where appropriate to ensure impacts and risks are mismanaged to ALARP and an acceptable level.

Copies of the full text of any responses by relevant person have been provided to NOPSEMA as a Sensitive Information Appendix under regulation 9(8) of the OPGGS(E).

Table 6-6: Assessment of Merit of Concerns – historical Montara 1,2,3 wellheads

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
Department of Transport	What will be the timing of EP submission to DoT? Ongoing communications with DoT. JSE requested clarification of the DoT focus of OPEP review.	***No objection, concern or claim.*** ***Request only:*** DoT is the key regulatory agency for the management of WA Oil Spill Response and provides significant input for EP consideration.	• Jadestone will submit the OPEP and supporting documents to DoT as per the IGN upon submission of the Montara EP to NOPSEMA • Jadestone will set up regular meetings with DoT to provide an update on the transitional process • DoT review focus for the OPEP is to ensure that Jadestone has the response arrangements in place to allow DoT to use and is aligned with the IGN
	Submission of 'Montara Ops EP Specific Information for DoT' with relevant EP and OPEP sections highlighted, in addition to an initial meeting, enabled a smooth review process. Documents refer to DoT Industry Guidance Note December 2017. Please refer to most recent version – July 2020. This version refers to the new 'State Hazard Plan - Maritime Environmental Emergency', WestPlan-MOP has been superseded. OSR Arrangements Table 8.1 information on Control Agency is incorrect.	Information noted and where appropriate OPEP updated	• DoT satisfaction with engagement and format noted • OPEP updated based on 'State Hazard Plan - Maritime Environmental Emergency' July 2020 • OSR arrangement Table 8.1 has been updated
	Known or indicative oil type/properties - OPEP Appendices A3, A4 and A5 not provided.	JSE considers these comments have merit and have incorporated these into the OPEP.	• Oil assay information provided in Jadestone IMT Response Plan (Appendix C)

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
	Potential Incident Control Centre arrangements – inadequate detail. OSR Arrangements does not give details of ICC location or facilities. Section 11 states that IMT will be established in Perth, however no information given on: what facilities are required for the ICC will ICC will be established at Jadestone offices, or if alternate ICC locations have been identified.	JSE considers these comments have merit and have incorporated these into the OPEP.	• Jadestone ICC arrangements (Primary and alternative) detailed within IMT Response Plan sections 5.6 and 6.6 – 6.7
	Potential staging areas/ Forward Operating Base - OSR Arrangements focusses on North West Shelf activities: Section 11 refers to Dampier, Stag, Exmouth and North West Shelf. Lack of detail around Montara requirements in Kimberley region.	JSE considers these comments have merit and have incorporated these into the OPEP.	• Jadestone FOB arrangements detailed within IMT Response Plan sections 5.7 – 5.8
	Details on proposed IMT structure – OSR Arrangements Figure 5.1 shows Jadestone IMT Structure. In the event of a cross jurisdictional response as per the Montara scenario please show how the DoT IMT would interact with the Jadestone IMT. Include detail on IMT structures relevant to this specific scenario. For example, how Version: 1 Approved Date: N Owner: OSRC Objective ID: A2492301 Page 2 of 2 would Northern Territory oil spill response arrangements interact with these structures?		• Jadestone IMT Structure detailed within IMT Response Plan sections 5.5 and Appendix A (OSRA) section 3.2 (WA) and 3.3 (NT)
	Details of exercise and testing arrangements of OPEP/OSCP – OSR Arrangements Section 12.2 focuses on Stag. No detail given around Montara. As stated in the Industry Guidance	JSE considers these comments have merit and have incorporated these into the OPEP.	• Jadestone Test/Exercising arrangements detailed within IMT Response Plan section 10 (Administration)

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
	Note, DoT has capacity for involvement in Petroleum Titleholder exercises, subject to availability of DoT resources.		
	Confirmation that the Petroleum Titleholder has access to staff for the Initial Personnel Requirements as outlined in Annex 2 of the IGN – OSR Arrangements Section 4.2 confirms the initial personnel requirement. Please also note that as per the IGN, the Deputy Planning Officer and the Deputy Logistics Officer must have intimate knowledge of Jadestone processes.	JSE considers these comments have merit and have incorporated these into the OPEP.	• Jadestone arrangements detailed within IMT Response Plan Appendix A (OSRA) section 3.2 (WA)
Australian Maritime Safety Authority	Shipping traffic plot shows area clear of major international shipping routes but noting that some heavy vessels following the charted Osborn Passage will pass through both permits to the north of the Montara Venture FPSO. The AIS also shows support vessels in the area of activity.	Information noted and risk assessment updated.	• Considered during ENVID. Refer to Interference with other users – Section 7.7
	To notify AMSA's JRCC (rccaus@amsa.gov.au, Ph 1800 641 792) 24-48 hrs prior to operations commencing.	JSE considers these comments have merit and have incorporated these into the EP.	• Item included in implementation section of EP to ensure notification 48 hrs prior to operations commencing
	Australian Hydrographic Office (datacentre@hydro.gov.au) to be contacted no less than 4 weeks prior to operations commencing for the promulgation of related notices to mariners.	Action to be taken	• Item included in implementation section of EP to ensure notification 4 weeks prior to commencement
DPIRD (Fisheries)	Key items raised by DPIRD (Fisheries) regarding Montara operation were:	DPRID (Fisheries) is the key regulatory agency for the management of State fisheries and provides significant input for EP consideration.	

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
	Consultation Request for JSE to consult with: • WAFIC, PPA and Recfishwest • Commercial fishers	JSE agrees with DoF comments and has undertaken consultation with the representative bodies requested.	• Consultation undertaken with WAFIC, PPA, Recfishwest and Commercial fishers using current datasets which fulfils Fisheries request
	Timeframes • Advice provided valid for duration of activity commencing within six months of the date this letter is signed. • Request to be advised of actual commencement date and any changes to this proposal as soon as practicable prior to the commencement of any activity. Response to any updated advice provided at this time required.	JSE considers these comments have merit and have incorporated these into the EP.	• Timeline for validity of advice noted • Item included in implementation section of EP to ensure notification 4 weeks prior to commencement
	Pollution Emergency Plans • Request that when developing OPEP JSE collects baseline marine data to compare against post spill monitoring. Baseline data should be made available to the Department. • Consideration of spawning grounds and nursery areas should be included in OPEP.	JSE considers these comments have merit and have incorporated these into the EP.	• Baseline sampling was undertaken by PTEPP (Montara Environmental monitoring: Produced Formation Water Chemical Characterisation and Potential effects on the receiving Environment, 2018). These reports can be made available to the DPIRD Fish spawning is addressed in Section 5.5.3 including **Table 5-2**
	Biosecurity • JSE must take reasonable measures to minimise the biosecurity risk. Recommend using the Departments Vessel Check tool. • Request that any suspected marine pest or disease be reported within 24 hours.	JSE considers these comments have merit and have incorporated these into the EP.	• ALARP assessment of biosecurity risk included in Section 8.2, including management of residual risks. This includes a performance standard (Section 8.2.3) that all vessels sourced from outside WA must use the Vessel check process and for this assessment to indicate low/acceptable

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
			risk rating. Vessels mobilised from international waters will have DoA approval and Ballast Management Plans and Ballast Record Books • Item included in implementation section of EP to ensure notification within 24 hrs of biosecurity incident
	Implementation Ensure all vessel and asset operators associated with the project are aware of IMS risk and management methods.	JSE considers these comments have merit and have incorporated these into the EP.	• A JSE IMS management plan has been developed to ensure implementation of appropriate standards across the company, including contractors
WAFIC	Response requesting consideration of more detailed response to previous queries raised with PTEPP.	JSE considers these comments have merit and actioned them during consultation process.	• JSE responded 14.11.18. Response to PTEPP issues included in package sent to previous fisheries responders
	Response in relation to PTEPP news article seeking clarification of safety, maintenance and risk reduction and existing issues leading to another oil spill.	JSE considers merit in providing further information to address their concerns.	• 20.11.18- response to WAFIC outlining JSE position and commitments. This was forwarded by WAFIC to fishers on 20.11.18. Refer to Appendix G and SIR for full text of response. No further issues raised following response
	Additional consultation with WAFIC to discuss removal of wellheads and WAFIC's position on decommissioning in the future and future engagement considerations.	***No objection, concern or claim.*** Information noted and where appropriate Appendix G updated	• Refer to Appendix G and SIR for full text of response
DCCEEW	Additional consultation to withdraw permit application for sea dumping. Additional consultation with DCCEEW on bird management on the Montara facility and confirmation on regulatory permitting associated with this.	***No objection, concern or claim.*** Information noted and where appropriate Appendix G updated.	• No further information required to action the withdrawal of the permit application • Confirmation that a Part 13 permit under the EPBC Act is not applicable for the Montara FPSO

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
			• Refer to Appendix G for full text of response
NOPSEMA	Additional consultation to withdraw the Montara 1,2,3 Wellhead Abandonment Environment Plan.	No objection, concern or claim. Information noted and where appropriate Appendix G updated.	• Refer to Appendix G for full text of response

Table 6-7: Assessment of Merit of Concerns – Current consultation (post-Tipakalippa decision)

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
Australian Fisheries Management Authority (AFMA)	***No objection, concern or claim*** Noted the importance of consulting with all fishers who have entitlements to fish within proposed area, either through the relevant fishing industry associations or directly with fishers	Comment has merit and has been actioned.	In accordance with this guidance, as part of Jadestone's standard approach to consultation the relevant fishing industry associations and/or individual fishers have been engaged with during the development of the EP.
Australian Hydrographic Office (AHO)	***No objection, concern or claim*** Acknowledged and noted will be included in charting information.	Noted	No further action required.

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
Australian Maritime Safety Authority (AMSA)	***No objection, concern or claim*** Stakeholder Engagement * 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. *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. * Plan to provide updates to both the Australian Hydrographic Office and the JRCC on progress and, importantly, any changes to the intended operations.	JSE considers these comments have merit and have incorporated these into the EP.	*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 48 hrs prior to operations commencing and at cessation. * Item included in implementation section of EP (Table 8-1) to ensure notification to AHO and JRCC.
Australian Bluefin Tuna	***No objection, concern or claim*** Jadestone have contacted ASBTIA to request assistance in identifying Southern Bluefin Tuna licence holders that are known or believed not to fish in the portion of the fishing zone within or adjacent to the project EMBA.	Noted	No action required
Broome Visitor Centre (BVC)	***No objection, concern or claim*** Asked Jadestone to call BVC to discuss further.	Comment has merit and has been actioned.	Jadestone to meet with BVC on-country in March 2023
Cambridge Gulf Limited	***No objection, concern or claim*** No concern to shipping operations resulting from proposed activities. Offered logistical report if required	Noted	No action required
Carnarvon Energy	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
Chamber of Commerce (NT)	***No objection, concern or claim*** No concern to shipping operations resulting from proposed activities. Offered logistical report if required	Noted	No action required
Commonwealth Fisheries Association (CFA)	***No objection, concern or claim*** CFA are not resourced to give feedback. Advised to direct enquiries to the associations that represent the directly affected fisheries/fishers. May need to engage on a fee for service basis.	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.
Department of Agriculture, Fisheries and Forestry (DAFF) Marine Biosecurity Unit	***No objection, concern or claim*** Provided information on general biofouling management requirements	Comment has merit and has been actioned.	Biofouling management is covered under Jadestone's Biosecurity Manual and has been included in the EP (Section 8.2 Marine Pest Introduction).
Department of Biodiversity, Conservation and Attractions (DBCA) (WA)	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required
Department of Foreign Affairs and Trade (DFAT)	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required
Department of Industry Tourism and Trade (DITT) (NT)	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required
WA Department Transport (DoT)	***No objection, concern or claim*** Provided guidance note	Noted	No action required

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
Director of National Parks (DNP)	***No objection, concern or claim*** Stakeholder Engagement * Confirmed no authorisation required as outside AMP and no objections or claims at this time * Link to guidance note on Marine Parks provided *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 * Notification details in the event of an incident provided * 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 0419 293 465. Notification should include: - Titleholder details - Time and location of the incident (including name of marine park likely to be effected) - 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	Jadestone considers these comments to have merit and they have been addressed in the EP.	* Guidance note is reference in EP (Table 2-2) *EP has been drafted to include information on the AMPs in Section 5.4.4). With no AMP in the operational area there is not expected to be any impact from planned activities on any AMPs. *Triggered consultation item included to notify AMP DG if any change to planned activity that results in change in risk to AMP (Table 9-2). * Item included in Implementation section of the EP (Table 9-2) to ensure DNP notification in event of an oil/gas pollution incident

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
Department of Defence (DOD)	***No objection, concern or claim*** *Activity is located outside any Defence Training Areas and restricted airspace. *Advised of risk of UXOs. *Continued liaison with AHS for Notice to Mariners required	Jadestone considers these comments to have merit and they have been addressed in the EP. JSE considers this comment to have merit and have incorporated these into the EP.	*Item included in Implementation section of the EP (Table 9-2) to ensure AHS notification three weeks prior to commencement of activities.
Department of Environment, Parks& Water Security (DEPWS) (NT)	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required
Department of Planning, Lands & Heritage (DPLH) (WA)	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required
Department of Water and Environmental Regulation (DWER) (WA)	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required
Kimberley Port Authority (KPA)	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required
National Offshore Petroleum Titles Administrator (NOPTA)	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required
Northern Prawn Fishery (NPF)	NPF have requested project EMBA shapefile to be able to provide advice on impacts on the NPF	Noted	Jadestone are getting the shapefile information in the right format to provide
Oil Spill Response Limited (OSRL)	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
Recfishwest	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required
Shell	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required
Victoria Daly Regional Council	***No objection, concern or claim*** No comments on the proposed activity	Noted	No action required
WAFIC	***No objection, concern or claim*** Jadestone have contacted WAFIC to request assistance in identifying commercial fishing licence holders that are known or believed not to fish in the portion of the fishing zone within or adjacent to the project EMBA.	Noted	No action required

6.15 Environmental Performance

Hazard		**Stakeholder consultation**		
Performance outcome		**Relevant persons are kept informed of activities**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
001	Stakeholder Management Plan (JS-70-PR-I-00034)	Relevant persons identified according to current Regulatory requirements	Consultation records	General Manager
002		Relevant persons provided a minimum 4-week period to respond to stakeholder information issued on the proposed planned activities and followed up in accordance with the plan		
003		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		

7. ASSESSMENT – PLANNED ACTIVITIES

7.1 Light emissions

7.1.1 Description of aspect

Artificial light	During the Activity, safety lighting on the FPSO, WHP and support vessels will generate light emissions that may potentially affect marine fauna behaviour. Lighting typically consists of bright white (metal halide, halogen, fluorescent) lights. Direct light spill on surface waters will be limited to the area directly adjacent to the facility and support vessels as they operate within the Operational Area. In addition to the light emitted from navigational and safety lighting, continuous flaring occurs during operations. The flare system is located on the FPSO. Flaring of gases may occur during routine operations, unplanned maintenance shutdowns, process upset conditions and events that for safety reasons require hydrocarbon inventory to be released to the flare.

7.1.2 Impacts

Artificial lighting has the potential to affect marine fauna that use visual cues for orientation, navigation, or other purposes, resulting in behavioural responses which can alter foraging and breeding activity in marine reptiles, seabirds, fish and dolphins, create competitive advantage to some species and reduce reproductive success and/ or survival in others.

Potential impacts to marine fauna from artificial lighting associated with the Montara operations infrastructure 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 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
- Sensitivity and resilience of the fauna populations that are affected.

Sensitive Receptor	Impact description
Plankton; Fish, Sharks and Rays	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 and flaring. However, as the Operational area does not contain any significant feeding, breeding or aggregation areas for fish it is more likely there will individuals traversing the area then large groups of species. Light associated with the Operations will affect a small portion of the vast biologically important foraging area for whale sharks. However, impacts at a population level are not expected. Light impacts to plankton, fish, sharks (including whale sharks) are considered ***negligible.***

Sensitive Receptor	Impact description	
Marine reptiles	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 most significant risk posed to marine turtles from artificial lighting is the potential disorientation of hatchlings following their emergence from nests. Hatchlings use the light of the oceanic horizon to orientate themselves towards the sea when making their way into the water for the first time; the oceanic horizon is almost always brighter than the elevated landward horizon (EPA 2010). Hatchling behaviour may therefore be affected when exposed to an artificial light source at certain intensities and distributions, potentially leading to disorientation when attempting to migrate to the ocean. 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 closest turtle nesting habitat to the Operational Area is significantly beyond this distance as Cartier Island is approximately 84 km north-west of the FPSO. The nearest BIA boundary for marine reptiles (green turtle) is 64 km west of the Operational area. As a result, impacts to adults and hatchlings are expected to be ***negligible***. Light generated by flaring events may not affect hatchlings as much as other light sources. With the most disruptive wavelengths to marine turtle hatchlings to be in the range of 300 to 500 nm, spectral analysis of flares on Thevenard Island on the North-West Shelf (Pendoley, 2000) suggests that flare light does not contain a high proportion of light wavelengths within this range. Due to the paucity of information, the direct effect of artificial light on sea snakes is largely unknown. Sea snakes may experience indirect effects such as changes in predator-prey relationships and disorientation, attraction or repulsion may occur. Sea snakes are thought to occur more commonly on reef habitats that are not present in the Operational area. It is recognised that some pelagic sea snake individuals may occur and be attracted to the light from the infrastructure. However, while such individuals may come to investigate the light source it is considered unlikely that they will stay within the area. As such impacts to sea snakes are considered ***negligible.***	
Seabirds.	It is broadly accepted that seabirds do aggregate around offshore production facilities in above average numbers (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). The light from the operating production facilities and the flare may also 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). Given that the Operational area is outside a flyway, and the nearest migratory bird breeding/ roosting site is Cartier Island which is located approximately 80 km north-west of the FPSO only a small number of seabirds are expected to be affected by artificial light emissions whilst in transit, any behavioural disturbances such as disorientation and attraction would be a *Slight effect; recovery in days to week*. As such impacts to seabirds are considered ***negligible.***	
Other species	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 Montara operations is not considered to have an impact on marine mammal behaviour.	
Consequence		**Ranking**
Negligible		Acceptable

7.1.3 Environmental performance

Aspect		**Light**		
Performance outcome		**Activity lighting managed in accordance with OHS requirements**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
001	Performance Standards Report (MV-70-REP-F-00002) ensures navigation aids and equipment meet regulatory and safety requirements	Vessel navigation lights are visible as per COLREGs requirements.	CMMS confirms navigational lighting is maintained as per COLREGs	Maintenance Supervisor
002	Performance Standards Report (MV-70-REP-F-00002) ensures lights are present and working	Aircraft warning lights mark tall objects that may be an obstruction to a helicopter approach to the helideck. Lights are positioned on infrastructure such that at least one light is visible to a vessel approaching from any direction.	Formal inspection confirms lights present and functioning, recorded in CMMS	OIM

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 light emissions to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are 'tolerable' as they are within the green category (negligible impacts). No further controls are required (see below) and therefore ALARP has been demonstrated.

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 significant costs and loss of production. Light from the FPSO, WHP 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
Steam facilitating low opacity emissions currently there is no steam line running to the flare tip because the original engineering design did not include this feature. A steam system would need to be supplied with steam 24 hours per day in the event it was required for combustion emission management (i.e. it needs to be instantaneously operable when required). This would place an operational load on the boiler which is the equipment that would supply steam. The boiler system may need to be redesigned to enable the steam supply function to the flare tip (the cost for re-engineering the boiler has not been considered in this assessment). The cost for design, installation and commissioning is estimated to be approx. $0.5M cost.	Engineering	Yes	No	No parties (e.g. air force, navy, border force, local users) have complained or reported dark emissions at Montara. The cost for the improvement versus the benefit that would be achieved is not ALARP.
High pressure water cleaning to create white smoke: as for the steam cleaning system, the flare system at Montara has not included this function within the original design of the facility. The cost that would be incurred due to engineering design, construction and commissioning of a high-pressure water cleaning system at the flare tip is estimated at approx. $0.3M.	Engineering	Yes	No	No parties (e.g. air force, navy, border force, local users) have complained or reported dark emissions at Montara. The cost for the improvement versus the benefit that would be achieved is not ALARP.
Increased flaring: another option is to increase flaring in the event of dark smoke emissions due to lack of oxygen at the flare tip. Increased flaring results in better combustion at the flare tip due to the sonic design of flare and thereby a reduction in the opacity of emissions.	Administrative	Yes	Yes	Not adopted – the increased flaring would be contrary to the intent of the environmental performance outcome of planned flaring operations

7.1.5 Acceptability Assessment

The potential impacts due to light emissions are considered acceptable in accordance with Section 4.4, 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 would compromise personnel health and safety, and the environmental consequence is considered negligible.	
Policy & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for the activities.
Stakeholders & reputation	Stakeholder consultation has been undertaken (see **Section 6**), and no stakeholder concerns have been raised with regards to impacts from lighting on sensitive receptors.
Environmental context & ESD	While there is direct light spill to sea surface immediately around the FPSO and WHP and support vessels, the impact and risk assessment process indicates that the light spill will not cause significant effects to adult turtles or birds that may transit 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. Jadestone has had regard to the representative values of the protected areas within the adjacent 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 (**Appendix C**) and considered acceptable.

7.2 Noise Emissions

7.2.1 Description of aspect

Noise emissions	Noise will be generated during Montara operations from a number of sources, in particular: • Machinery operated on the decks and working areas of the Montara FPSO and WHP; • Operational noise from wellheads and flowlines; • Vessel engines, and propeller rotations and cavitation; • Equipment operated on the decks and working areas of support vessels that radiate through the vessel hulls; • Helicopter operations, which typically occur twice a week for crew changes and personnel transfers; and • Side scan sonar during ROV surveys. Marine operations conducted on the decks and working areas of a vessel introduce sounds of varying characteristics into the water column, largely at low frequencies. A large proportion of the sound generated will be from above the water surface rather than through the water. A significant proportion of the sound will be reflected at the air-water interface and would not penetrate the water column. The sound produced by facilities and vessels will generally be 'continuous' (i.e. non-impulsive) in nature and will fluctuate depending on the number of vessels operating around the facilities at any one time.

	It is recognised that noise may occasionally be generated from a range of other operations activities and sources, though such noise is considered to be incidental relative to other key noise sources. For example, inspection, maintenance and repair works on subsea equipment, such as flowline span correction (e.g. rock/ cement bag/ concrete mattress placement) has previously been recorded and found not to result in a noticeable increase in noise levels over and above the noise generated from the dynamic positioning system thrusters of the vessels undertaking the work (Nedwell and Edwards 2004; Jiménez-Arranz et al. 2017). Water jetting to remove marine growth from infrastructure will also result in low level noise. Facility Operations and Vessel Noise Underwater noise generated during operations, will primarily consist of non-impulsive noise sources from the *Montara Venture* FPSO and WHP. Vessel noise will also contribute to the sound profile of the operations with increased noise levels during loading and unloading activities where dynamic positioning thrusters are used to maintain position. Some continuous noise will also be generated at the seabed by valves on the wellheads, manifolds and flowlines. Operational FPSO noise has been reported to be in the order of 180 dB re 1µPa@1 m (SPL) (Erbe et al. 2013) and production platforms have been reported to produce sound up to 196 dB re 1µPa@1 m (SPL), rapidly reducing to approximately 135 dB re 1µPa at a distance of 500 m (Nedwell et al. 2003). Wellhead noise was modelled for the Browse LNG project (Woodside 2015) and sound levels were predicted to fall below 120 dB re 1µPa within 1 km and so noise from subsea infrastructure is not expected to contribute significantly to the sound field during operations. Vessel noise varies with the size, age, speed, and engine type and the activity being undertaken. Noise levels for a range of support vessels have been measured at 150-189 dB re µPa at 1 m, while large tankers have been measured at 175-190 dB re µPa at 1 m (Jiménez-Arranz et al. 2017). Vessel noise is expected to decrease rapidly with distance from the source. For example, measured noise from tankers has been found to reduce to less than 115 dB re µPa over distances of approximately 3 km and measured noise from support vessels has been found to reduce to approximately 120 dB re µPa within approximately 1 km (Jiménez-Arranz et al. 2017). Modelling of noise from an FPSO and vessels in the Barossa field (ConocoPhillips 2017) predicted that noise would fall to 120 dB re 1µPa within 1.4 km during normal operations, and within 11.4 km during offtake activities. For comparison, modelling of operational noise produced by the Browse floating LNG (FLNG) facility, which has a significantly larger sound profile than the Montara FPSO, predicted that sound levels would fall to 120 dB re 1µPa within 4 km during average operational conditions and within a maximum of 14 km during maximum operational and offloading conditions. Therefore, operational noise combined with associated vessel noise may result in sound that is detectable above ambient noise levels over several kilometres from the FPSO, WHP and vessels, but will be most evident within closer proximity, potentially causing a range of behavioural response from different marine fauna species. Side-scan sonar (SSS) is an activity that may be used during inspection, maintenance and repair work, likely to be applied for several days at a time every few years. Sidescan transducers may be mounted on AUV systems, vessel hulls or more commonly using a towfish. The towfish is towed behind the vessel at a pre-determined speed (approximately 4–10 knots depending on equipment specification). Towfish are generally towed at 10-20 % of the swath width above the seabed. The technique uses pulses of sound at perpendicular angles to the side scan sonar system. They transmit and receive sensors are both contained within the same unit. When the return acoustic pulses is processed they provide information on the amplitude of the return pulse, which in turn provides information on the composition of the seabed. Side scan sonar systems are generally high frequency (100-500 kHz) and high sound source (220–226 dB re 1 µPa @ 1 m) (Department of Energy and Climate Change 2011). The extent of helicopter noise impacts is limited to take off and landing at the facilities 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 travelling from a source in the air (e.g. 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. The received level underwater depends on source altitude and lateral distance, receiver depth, water depth, and other variables. The angle at which the line from the aircraft and receiver intersects the water surface is important. In calm conditions, at angles greater than 13° from vertical, much of the sound is reflected and does not penetrate into the water (Richardson et al., 1995; NRC, 2003). Therefore, strong underwater sounds are detectable for a period roughly corresponding to the time the helicopter is within a 26° cone above the receiver (BHPB, 2005). A summary of anthropogenic noise sources associated with the operations, and natural underwater noise sources, are provided in **Table 7-1** below.

Table 7-1: Summary of anthropogenic and natural underwater noise sources

Source	Sound Intensity (dB re 1 µPa)	Dominant Frequency (Hz)
Natural Noises		
Ambient sea sound [1, 2]	80 – 120	Varied
Undersea earthquake [2]	272	50
Seafloor volcanic eruption [2]	255+	Varied
Lightning strike on sea surface [2]	250	Varied
Breaching whale [2]	200	10-100
Bottlenose dolphin click [2]	Up to 229	Up to 120,000
Humpback whales (tail fluke, fin slaps) [3]	192	30 – 1,200
Humpback whale song [4]	179	50 – 10,000
Sperm whale clicks [2]	Up to 235	100 – 30,000
Blue whale vocalisations [2]	190	12 – 400
Anthropogenic Noise Sources Expected from the MDP		
FPSO noise (production operations) [5, 6]	170-185 dB re 1µPa@1 m (route-mean-square sound pressure level; SPL)	Non-impulsive, predominantly low frequency (<500 Hz).
WHP noise (fixed platform production noise) [5, 7]	129-196 dB re 1µPa@1 m (SPL)	Non-impulsive, predominantly low frequency (<500 Hz).
Wellheads and flowlines [8, 9]	Approx. 159 dB re 1 µPa @1 m (SPL)	Non-impulsive, predominantly between 100 Hz and 2.5 kHz.
Support vessels (<100 m length) [5]	150 – 189 (SPL), depending on size, age, speed and engine characteristics	Non-impulsive, modulated by propeller cavitation and dynamic positioning. Tonal and broadband noise up to 100 kHz, dominant at low frequency (50-150 Hz).

Source	Sound Intensity (dB re 1 µPa)	Dominant Frequency (Hz)
Tankers (>100 m length) [5]	175 – 190 (SPL), depending on size, age, speed and engine characteristics	Non-impulsive, modulated by propeller cavitation. Tonal and broadband noise up to 10 kHz, dominant at low frequency (<100 Hz).
Helicopter flyover [5, 9]	Depends on type and size of helicopter and height above sea level. E.g. from 101 to 109 dB re 1 uPa measured at 3 m water depth for a helicopter at altitudes of 610 m and 152 m respectively.	Most acoustic energy is low frequency (<500 Hz).
Side Scan Sonar	Typically, 220-226 dB re 1 µPa @ 1 m	100,000 Hz – 500,000Hz (100-500 kHz)

7.2.2 Impacts

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)) or permanent (permanent threshold shift (PTS));
- 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.

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 plan for a number of the EPBC species that may occur in the operational area.

Sensitive Receptor	Impact description
Marine Mammals	Whales are low-frequency hearing cetaceans with an estimated functional hearing frequency range of 7–22 kHz (Southall *et. al.*2007). The thresholds of recommended root square mean sound pressure level (ms SPL) that could result in behavioural response for cetaceans is expected to be: • 120 dB (ms SPL) for continuous noise sources; and • 160 dB RMS SPL for impulsive noise sources. More permanent injury would be expected to occur at 230 dB re 1 µPa (peak) (Parvin et al., 2007, Gomez *et al.* 2016). 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). Cetaceans approaching the MDP facilities will be gradually exposed to increasing noise levels and,

Sensitive Receptor	Impact description
	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 facilities and vessels. Sound levels are expected to approach ambient levels over several kilometres. 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. Modelling has previously been undertaken to determine the sound levels at increasing horizontal distance away from the source array for two geophysical sparker sound sources (Squid 2000 and Squid 500). The peak source level for the Squid 2000 and the Squid 500 were 222 dB re 1 µPa and 216 dB re 1 µPa respectively at 1 m from the array (0.5-300kHz). In the four cases that were modelled, the received sound exposure levels are predicted to have dropped below 160 dB re 1 µPa2s within 20 m of the source for Squid 500 and within 40 m of the source for the Squid 2000 (Duncan and Salgado-Kent 2011). As side can sonar equipment generates similar sound pulses at or above the low frequency limit of the low range of the squid sparkers (0.5 kHz), it is expected sound levels will dissipate within (or far more rapidly) a similar distance to the modelling described. For example, as the side scan sonar generates sound pulses of a higher frequency, but similar sound source, the sound pressure level from the side scan sonar is expected to attenuate more quickly with increasing distance from the source array. Although there are likely to be transient whales passing through the Operational area (refer **Section 5.5.5**), it does not contain any significant feeding, breeding or aggregation areas for marine mammals. The nearest BIA for cetaceans is the pygmy blue whale migration BIA, which is located 80 km from the Operational area and is therefore not expected to be impacted by noise from the facility. Impacts to cetaceans from underwater noise generated by Operations is considered ***negligible.***
Marine reptiles	The auditory sensitivity of marine turtles is reported to be centred in the 400–1,000 Hz range, with a rapid drop-off in noise perception on either side of this range (Richardson *et al.* 1995). 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). No absolute thresholds are known for the sensitivity of turtles to underwater noise, or the levels required causing pathological damage. However, Popper *et al.* (2014), a working group of leading experts, suggested that behavioural responses 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. Sidescan sonar frequencies are outside of the hearing range that turtles are sensitive to, and consequently, it is not considered credible that auditory impairment to turtles could occur from side scan sonar surveys. The Operational area does not intersect any known internesting areas and is 84 km from nearest BIA and key nesting sites (Cartier Island). As such, it is more likely that a transient individual might be affected by noise. However, any impacts are expected to be limited to behavioural impacts, with recovery in days to weeks (***negligible***).

Sensitive Receptor	Impact description
	Sea snakes may also be affected by noise, although as they generally associated with reef systems including at submerged shoals (the closest are approximately 30 km away from the operational area), it is considered unlikely they will frequent the area of operations.
Fish, Sharks and Rays	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 (Gordon 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 to turtles and fish are expected to be limited and highly localised. There are also no known key feeding/ breeding areas occur within the Operational area, however fish will likely transit the area. Scientific literature indicates that behavioural affects due to artificial noise may include changes to schooling behaviour and avoidance of noise sources. A number of shark species may also occur in the region, including the EPBC Act listed whale shark as a BIA overlaps the area. 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). Sidescan sonar frequencies are outside of the hearing range that fish are sensitive to, and consequently, it is not considered credible that auditory impairment to fish could occur from side scan sonar surveys As such any impacts to fish, sharks or rays are expected to be ***negligible.***
Seabirds	Birds generally hear at a narrower frequency range than mammals, with best hearing at frequencies between 1 and 5 kHz (Dooling & Popper 2007). However, there is little information available specific to seabird and shorebird hearing and thresholds for disturbance. It is not expected that noise generated from activities will greatly affect seabirds and shorebirds that may overfly or land on the facility. Therefore, any impacts are expected to be limited to behavioural impacts, with recovery in days to weeks (***negligible***).

Consequence	Ranking
Negligible	Acceptable

7.2.3 Environmental performance

Aspect		Noise		
Performance outcome		**Controls implemented to minimise potential harmful impacts to marine fauna from noise**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
003	Support vessels will comply with EPBC Regulations 8.05 and 8.06 as per Montara Marine Facility Operating Manual (MV-90-PR-H-00001)	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.	Vessel Masters provided and required to operate in accordance with the Montara Marine Facility Operating Manual (MV-90-PR-H-00001) – 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)	Logistics Lead
004	Helicopters will comply with EPBC Regulations 8.07 as per Aviation Operations Procedure (MV-90-PR-G-00004)	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 provided Jadestone's Aviation Operations Procedure (MV-90-PR-G-00004) - Sign-off sheet completed by Helicopter contract. Incident reports record non-compliances with EPBC Regulations 2000 – Part 8 Division 8.1 (interacting with cetaceans) Incidents of bird strike are reported as per Table 10-1	Logistics Lead
005	FPSO & WHP machinery is certified and maintained	FPSO & WHP machinery is maintained in accordance with CMMS.	CMMS shows maintenance has been satisfactorily completed as scheduled	OIM

7.2.4 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 to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Tolerable as they are within the green category (negligible impacts). No further controls are required and therefore ALARP has been demonstrated.

Rejected Control	Hierarchy	Practicable	Cost-effective	Justification
Remove machinery that emits noise	Eliminate	No	N/a	Noise from the FPSO, vessels, ROVs, 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 times/ areas of sensitivity	Isolation	No	N/a	The activities are located at distance from sensitive receptors and the coastline. Other fauna in the vicinity may experience short term behavioural effects only.
Additional activity specific noise emissions procedures for assets	Administrative	No	No	Through the application of EPBC Regulation 8 for helicopter and vessel marine fauna interaction procedures, and application of machinery maintenance, potential impacts are reduced. No further procedures are considered necessary.

7.2.5 Acceptability Assessment

The impacts due to machinery, FPSO, helicopter and vessel noise are considered acceptable in accordance with Section 4.4, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes, and the environmental consequence is considered negligible.

Policy & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for the proposed drilling activities.
Stakeholders & reputation	Stakeholder consultation has been undertaken (see **Section 6**), and no stakeholder concerns have been raised with regards to impacts from noise on sensitive receptors.
Environmental context & ESD	While there are noise emissions expected, the impact and risk assessment process indicate that noise will not result in death, injury or significant behavioural effects to marine fauna 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 in: • The Recovery Plan for Marine Turtles in Australia (2003) • The Conservation Management Plan (Recovery Plan) for the Blue Whale (B. musculus) (DoE 2015) Jadestone has had regard to the representative values of the protected areas within the 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 marine parks. This is consistent with the objectives of the protected area management plans (**Appendix C**), and considered acceptable. EPBC Regulation 8 and the Australian National Guidelines for Whale and Dolphin Watching 2017 (Commonwealth of Australia 2017). Noise is not identified as a risk in the Whale Shark Management Plan.

7.3 Atmospheric Emissions

7.3.1 Description of aspect

Emissions	The main sources of atmospheric emissions during operational activities are: • Flaring of gases encountered from the oil extraction process on board the FPSO, including increased flaring during commissioning, shutdown and upset and emergency conditions; • Fuel gas combustion for power generation for gas turbines and compressors; and • Diesel combustion for mobile and fixed plant. Flaring of gases encountered from the production process on board the FPSO, includes: • • Flaring during unplanned maintenance shutdowns of the reinjection system (Compressor and injection well); • Flaring during unplanned maintenance shutdowns of other sections of the process that results in increased flaring; • Process upset conditions that result in gas, over and above the purge, pilot and routine flaring from the second and third stage separators (estimated as a total of 4 mmscf/d) as being routed to the flare; and • Events that for safety reasons require hydrocarbon inventory to be released to the flare. In addition, the below sources contribute to emissions, albeit making a less material contribution compared to the main sources above: • Fugitive emissions from infrastructure including losses during loading, product storage, offtake and upset and emergency conditions; and • Use of refrigerants for air conditioning and refrigeration on board the FPSO. These processes 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). Vessels may use ozone-depleting substances (ODS) in closed-system rechargeable refrigeration systems. Unplanned flaring is considered in **Section 8.1**. •

As per the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (2015), GHG emissions are categorised as:

- Scope 1: GHG emissions are direct emissions from sources owned or controlled by the company.
- Scope 2: GHG emissions are indirect emissions from the consumption of purchased electricity.
- Scope 3: GHG emissions are indirect emissions that are a consequence of the activities of the company, but occur from sources not owned or controlled by the company

In relation to the Montara facility, scope 1 and scope 3 emissions are relevant, but scope 2 emissions are not as electricity purchased from the grid is not used on the facility.

Scope 1 Emissions

A summary of the carbon dioxide equivalent emissions at the Montara facility in 2021 is provided in Figure 7-1. Annual emissions that have been forecasted for the remaining field life range from 273,000 to 291,000 tonnes of CO_2 equivalent (including CO_2, N_2O and CH_4). GHG forecast estimates have focused on material GHG sources only and are based on current business plans which may be subject to change. The profile has been modelled using business-as-usual flaring, gas as fuel and diesel consumption forecasts, that will inevitably carry a margin of error.

GHG emissions from the Montara facility come from associated gas (either flared or used as fuel gas) and diesel combustion. Associated gases are routed from the separation process to the reinjection gas compression system. This gas stream is compressed, dehydrated and cooled prior to being used as fuel gas at the FPSO, and lift gas at each well, with the surplus reinjected into the Montara reservoir through the reinjection system. In 2021, approximately 24% of associated gas was routed to the facility and 76% was reinjected. The FPSO generally operates on fuel gas, with main electrical power being supplied by two gas turbine generators and compressors that use approximately 9% of associated gas. The gas turbines and compressors normally operate on fuel gas but can also operate on diesel if required.

The remaining 15% of associated gas is flared. This routine operational flaring (when the reinjection system is operational) is expected to be below 4 MMscf/d. Up to 3.5 MMscf/d is from the separators. Other small continuous loads are from the flare header purge and pilot gas, which contribute approximately 0.5 MMscf/d. The actual annual total volume will be larger than this estimate given there will be planned maintenance undertaken on the reinjection system and unplanned down-time.

Diesel is used onboard the FPSO for turbines, generators (including back-up generators), crane, boilers, back up compressor and fire pumps. GHG emissions are produced when the diesel is combusted. The boiler exhaust gas is the source of inert gas used to inert the cargo tanks. In 2021 diesel use represented approximately 5% of combustion emissions.

Minor amounts of fugitive GHG emissions occur on the facility. Fugitive emissions at Montara have been calculated as 1,072 tCO_2e (2020); 1,289 tCO_2e (2021) and 739 tCO_2e (2022). The main driver for the reduction in 2022 was the change to the NGER Determination for crude oil facilities. Fugitive emissions calculations are related to the handling of crude (vaporisation of crude during transfers and fugitives associated with the oil component of produced formation water) and no longer include fugitives associated with natural gas to avoid double-counting by crude oil facilities.

Fugitives are released from storage tanks and equipment as Volatile Organic Compounds (VOCs) when lighter hydrocarbons in the crude vaporise. Emissions of fugitive VOCs are minimised by pumping blanket gas (inert gas from the boiler flue gas) into cargo tanks of the third-party tanker. As these tanks are filled, VOCs may be vented to atmosphere as they are displaced by the inert gas. Fugitive emissions are also associated with small amount of crude that are discharged into the marine environment as PFW..

Scope 1 emissions are reported to the Clean Energy Regulator as part of the statutory annual National Greenhouse and Energy Reporting Act 2007 (NGER Act). NGER reporting includes direct emissions from fuel use, venting and fugitive emissions associated with the facilities but does not include indirect emissions associated with helicopters transfers and vessels used.

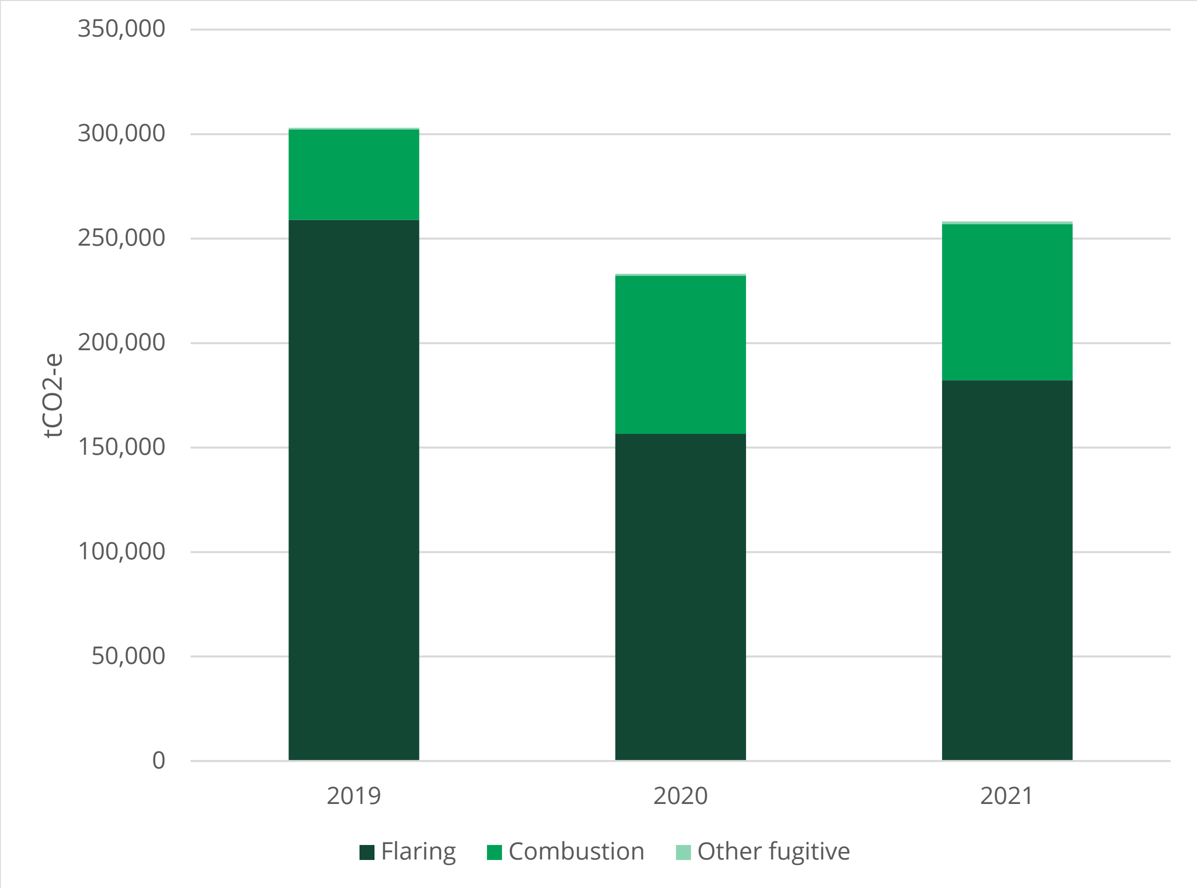


Figure 7-1: GHG emissions due to combustion sources at Montara Facility in 2021

<u>Scope 3 GHG Emissions</u>

Scope 3 emissions are defined as all indirect GHG emissions (not included in scope 1 or 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions. Scope 3 GHG emissions can be considered indirect consequences of the activity and therefore have impacts (EPBC Act 1999 in Section 527E). Scope 3 GHG emissions are not reported under the NGER Scheme and have been estimated using the most appropriate emission factors available.

Jadestone has engaged a specialist third-party to undertake a review of its scope 3 emissions relating to Stag operations. When defining its approach, the Greenhouse Gas Protocol and relevant sector guidance have been consulted, which included:

- GHG Protocol: Corporate Accounting and Reporting Standard
- GHG Protocol: Corporate Value Chain Accounting and Reporting Standard
- IPIECA: Estimating petroleum industry value chain (scope 3) greenhouse gas emissions

As a first step, Group reporting boundaries were defined and a consolidation approach for direct GHG emissions selected. As Jadestone reports its GHG direct emissions based on the operational control principle, the scope 1 boundary is clearly delineated from the relevant value chain activities falling within scope 3 categories.

Subsequently, in order to establish a view of the likely material scope 3 emission categories, benchmarking of relevant E&P operators was undertaken. Materiality of value chain categories is dependent on the type of business operations and there is no uniform approach to scope 3 across the industry, however key scope 3 trends have been established through the benchmarking exercise.

As a next step, Jadestone has undertaken a detailed review of the value chain activities pertaining to Montara operations, considering all 15 categories defined by the GHG Protocol. Factors such as relevance to Jadestone business operations, materiality threshold as well as availability of data were taken into account, with the following categories shortlisted:

- Category 3: Fuel and energy related activities
- Category 9: Downstream transportation and distribution
- Category 10: Processing of sold products
- Category 11: Use of sold products

Table 7-2 provides an overview of the assumptions and methods applied for quantifying the value chain emissions for Montara.

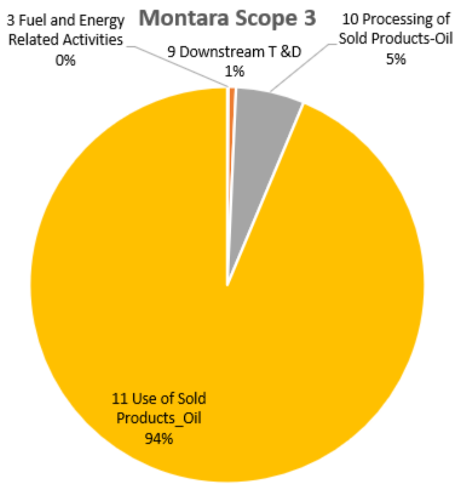
Table 7-2: Overview of the assumptions and methods applied for quantifying the value chain emissions for Montara

Category	Assumptions	Method of quantification
3: Fuel and energy related activities	Includes all upstream (i.e. cradle-to-gate) emissions from the extraction, production and transportation of diesel, being the only fuel type consumed in the generation of power at the Montara facilities, that was acquired by Jadestone in the reporting year and was not included in scope 1 or scope 2.	Jadestone determined the quantity of diesel purchased and utilised at Montara operations and then applied cradle-to-gate emission factors
9: Downstream transportation and distribution	All transportation of crude is by vessel hired by Jadestone Energy from Damier WA to Jurong Singapore, emissions only counted for one way trip.	The monetary amount spent for an offtake tanker by Jadestone in the reporting year was multiplied by the relevant emission factor
10: Processing of sold products	Fuels used by refinery are not derived from the crude oil feedstock provided by Jadestone Energy. This is a conservative estimate as it is possible that the refinery is using fuels derived from Jadestone feedstock.	Crude oil refining emission factors had been applied
11: Use of sold products	As Montara's crude is stock-standard crude, it is assumed that 87% of the refined product is used as fuel based on EIA data. This is a reasonable estimate, as it is possible that some by products are used as petrochemical feedstock and therefore not combusted for energy.	Sales volumes for each reporting year were converted into emissions by applying IPCC emission factors for diesel

Table 7-3: Summary of Scope 3 GHG Emissions in 2022

Scope 3 Category	Total Emissions (tCO2e)	% Coverage
3 Fuel and Energy Related Activities	923	0.09
9 Downstream transportation and distribution	6,268	0.62

10 Processing of Sold Products-Oil	56,856	5.61
11 Use of Sold Products-Oil	948,848	93.68
Scope 3 Total	1,014,895	100



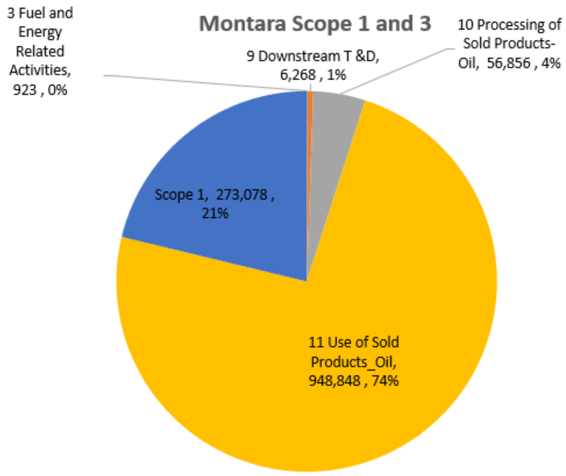


Figure 7-2: Scope 3 emissions in 2022 (top) and including scope 1 (bottom)

In 2022, the majority of scope 3 emissions came from Use of Products (category 11) (94% of quantified scope 3 emissions) (Figure 7-2). This category covers the use of refined products by the consumer. Processing emissions (category 10) comprise 6%, downstream transport and distribution (category 4) comprise 0.62% and upstream emissions of diesel use (category 3) comprise 0.09% of quantified scope 3 emissions. Scope 1 emissions are approximately 27% of the total direct and indirect emissions (scope 1 and 3) associated with the Montara facility.

Over the remaining 10 years of field life, when considering a business-as-usual scenario, scope 1 emissions are forecasted to remain relatively flat, whilst scope 3 emissions are expected to decrease along with the decline in production (**Figure 7-3**). Cumulative scope 3 emissions (extrapolated from those quantified here) are expected to be approximately 5,237,199 tCO_2e over the remaining life of the field.

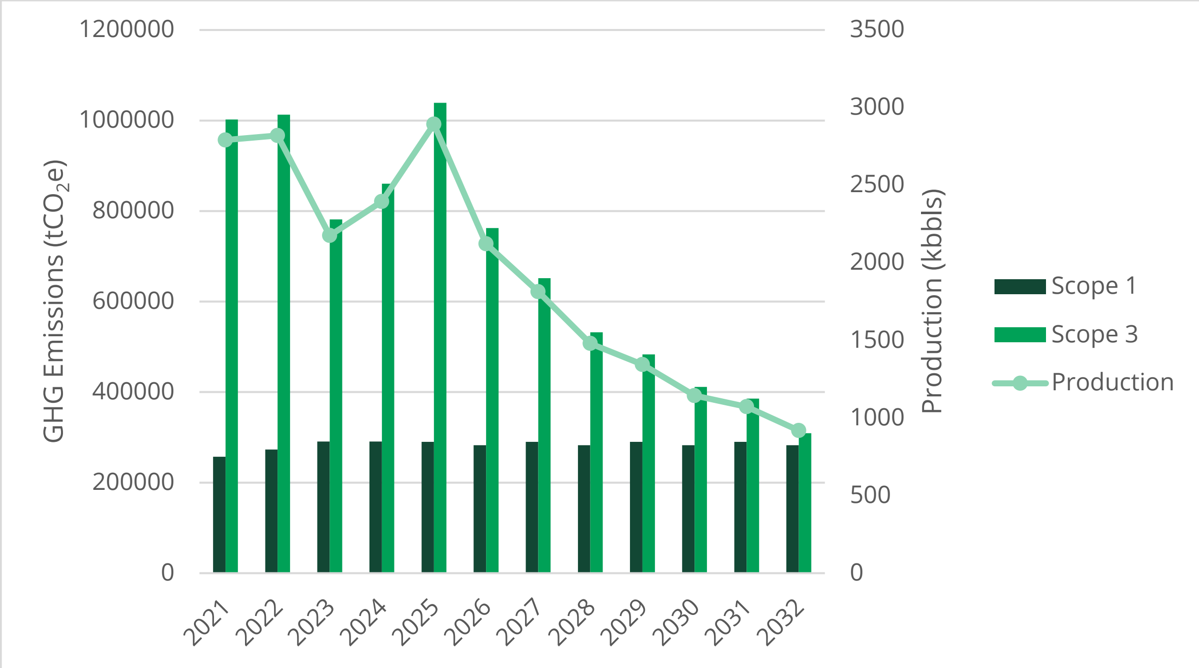


Figure 7-3: Business-as-usual forecast scope 1 and scope 3 emissions over the remaining lifespan of the Montara facility. The secondary axis shows anticipated production.

7.3.2 Impacts

Emissions can reduce air quality in the immediate vicinity of the Facility. Under normal circumstances, the gaseous emissions will quickly dissipate into the surrounding atmosphere in the immediate vicinity of the facility. As Montara Facility operations 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 Crux facility operated by Shell (approximately 30 km south) are not expected.

Greenhouse gases are persistent by nature and the key impact of these emissions is that they accumulate in the atmosphere. Upon release from a facility, CO_2 persists for thousands of years in the atmosphere, nitrous oxides persists for hundreds of years and methane persists for a least a decade (EPA, 2022). Whilst CO_2 is cycled out of the atmosphere by various carbon sinks (vegetation and the ocean surface in particular) the natural source/sink cycle has been out of balance since the beginning of the industrial revolution, when fossil fuels such as coal first started being combusted, and area of sinks reduced through development resulting in an ever-increasing concentration of greenhouse gases in the atmosphere. This increasing concentration has led to a greenhouse or warming effect resulting in the physical, chemical and biological effects of climate change.

Annually, emissions from Montara represent 0.6% of emissions from energy industries in Western Australia and 0.1% of energy industries nationally (DCCEEW, 2022). Whilst this facility is a relatively low contributor to state and national emissions, due to the persistent nature of greenhouse gases, it is important to acknowledge that all emissions contribute to climate change. Montara has been operational since 2013, however Jadestone only acquired the asset in September 2018. The facility is expected to stay operational until approximately 2032. Over the entire period of Jadestone ownership, total, cumulative Scope 1 emissions associated with Montara are forecast in a business-as-usual scenario to be approximately 3,757,991 tCO_2e.

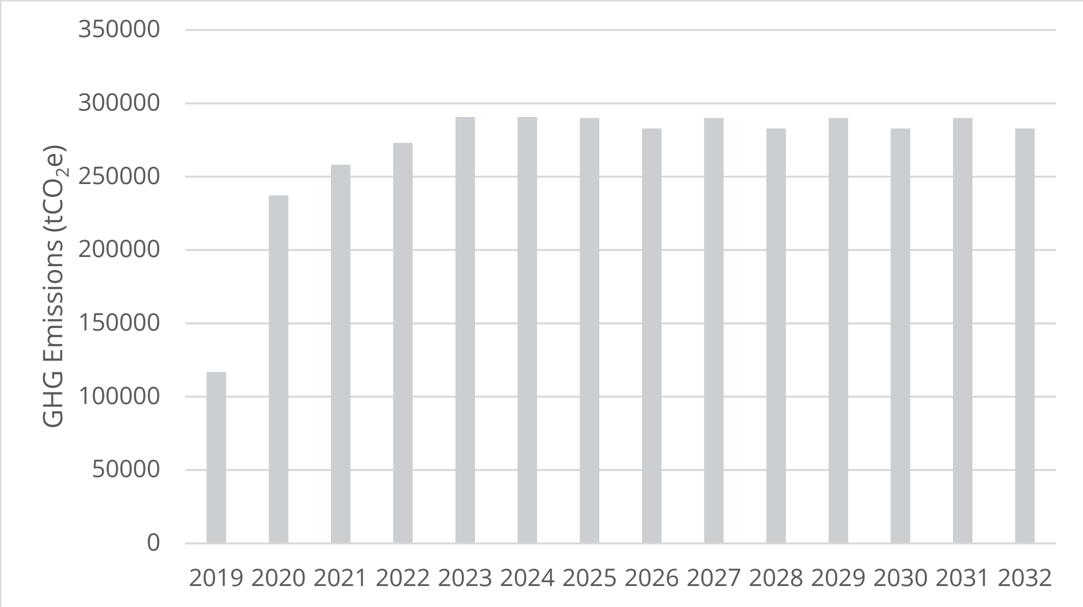


Figure 7-4: Actual (2019–2021) and business-as-usual forecast (2022–2032) scope 1 emissions at Montara

Table 7-4: Comparison of Montara's annual emissions with State and National emissions profiles (Energy Industries category)

Emissions Profile	Annual (2020, in tCO_2-e)
Stag scope 1 emissions	237,299
Western Australia energy industry* emissions*	36,536,000
Australian energy industry emissions*	207,566,000

*Source: Australia's Greenhouse Gas Inventory , 2022

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

The consequence of GHG accumulation in the atmosphere will result in an increase in temperature and will have an adverse effect on ecosystems and threaten biodiversity (IPCC, 2021). Ecosystems that are particularly susceptible to adverse effects of climate change include alpine habitats, coral reefs, wetlands and coastal ecosystems, polar communities, tropical forests, temperate forests and arid and semi-arid environments (DoEE, 2019). Human-induced global warming has already caused multiple observed changes in the climate system including increases in both land and ocean temperatures and an increase in the frequency and duration of heatwaves both on land and in the marine environment (Hoegh-Guldberg et al. 2018).

Extreme weather events such as droughts, floods, storms and fire can affect population dynamics, species boundaries, morphology, reproduction, behaviour, community structure and composition and ecosystem processes. Changes in the frequency and intensity of extreme weather events may have larger impacts on many species and communities than increases in temperature and changes in rainfall patterns (Steffen et al. 2009).

Hoegh-Guldberg et al. (2018) concludes that constraining global warming to 1.5ºC rather than 2ºC has strong benefits for terrestrial wetland ecosystems. Species range losses, increased extinction risks, changes in phenology together with projected increases in extreme weather events all contribute to the disruption of ecosystem functioning and loss of services provided by these ecosystems to humans such as avoidance of desertification, flood control, water and air purification, pollination, nutrient cycling, some sources of food, and recreation.

Impacts on ecosystems from this are spatially variable and species dependent due to the varying degrees of sensitivity to changes in the local and global ecosystem. At the point where global temperature rise, due to climate change, reaches 2°C, increasing numbers of receptor groups suffer impacts which are high to very high, and likely to be irreversible (terrestrial ecosystems, warm-water corals, unique and threatened systems, and arctic regions) (Hoegh-Guldberg et al. 2018).
In Australia, the particular values and sensitivities that have been identified as having a potential to be impacted by climate change include:

- Terrestrial ecosystems: Alpine regions, rainforests, wetlands, grasslands, forests
- Marine ecosystems: coral reefs, mangroves, estuaries and inland waterways

The Australian Natural Resource Management Ministerial Council (NRMMC) recognizes climate change as a key additional threat to the conservation of Australia's biodiversity (Steffen et al., 2009). Impacts to the physical, biological and socioeconomic receptors within these areas could be impacted with predicted impacts highly variable between ecosystems and within on both the ecosystem structure and its flora and fauna. A summary of the potential impacts on each of these is provided in

Table 7-5 below.

Table 7-5: Potential impacts of climate change on identified receptors from greenhouse gas emissions

Receptor	Potential Impacts
Terrestrial Ecosystems	
All terrestrial ecosystems are likely to be impacted by a changing climate (Steffen et al 2009, Hughes 2011, Dunlop et al. 2012, Hoegh-Guldberg et. al. 2018). The predicted impact of climate change on these ecosystems is highly variable, both between ecosystems and within individual ecosystems (Dunlop et al. 2012).	
Tropical Rainforests	Changes in the timing of seasons resulting in longer hot or wet seasons which could result in changes in seasonal responses and alterations to species range and abundance (Hoegh-Guldberg et al., 2018) through the change in patterns of flowering, fruiting or leaf flush. Increased temperatures leading to hotter and potentially more intense fires and cyclones. An increased probability of fires may change the dynamics of the rainforest with a change from fire-sensitive vegetation to fire-tolerant species (McInnes, 2015). Change in rainforest disturbance as cyclones become more intense (Hughes, 2011). Change in vegetation structure or vegetation species dominance due to tolerance/intolerance of increased CO_2 levels (Steffen et al, 2009).
Temperate forests	An increased probability and intensity of fires may change the dynamics of the forest with a change from fire-sensitive vegetation to fire-tolerant species (Steffen et al., 2009) due to a change in structure and species. Increases in temperature and decrease in rainfall may result in reduction in productivity as the soil dries out and reduction in forest cover. Increased rainfall may increase productivity of temperate forest and result in large areas of coverage (Steffen et al., 2009).
Alpine Regions	Alpine and montane areas are considered to be very vulnerable to climate change (Hughes, 2003) due to the increase in temperature reducing the areas covered by snow. Changes in temperature may result in a reduction in species abundance as the available area of ecosystem is reduced (less snow coverage) and there is a subsequent increase in plant establishment. Species that are dependent on snow coverage for stable temperature maintenance (during hibernation), or for protection from predation may be more vulnerable (Hughes, 2003).
Savannahs and grasslands	Increased CO_2 levels may result in a shift in species dominance between woody and grass species due to their tolerance. This will affect herbivores dependent on these species as well as changes in the spatial availability of habitat for fauna associated with the different foliage

Receptor	Potential Impacts
	(Steffen et al., 2009). Increased temperatures leading to hotter and potentially more intense fires that may also increase in frequency and area due to a shift in the vegetation fuelling the fires.
Arid and semi-arid regions	Reduction in patches of fire-sensitive mulga in spinifex grasslands potentially leading to landscape-wide dominance of spinifex. Increased drying due to increase in CO2, with a large shift in vegetation distribution due to changes in annual precipitation. Shifts in the seasonality or intensity of rainfall which can result in enhanced runoff distribution which will intensify vegetation patterning. Reduction in rainfall can result in increased fire frequency and intensity. Dryland salinity could be affected by changes in the timing and intensity of rainfall.
Marine and freshwater ecosystems	
Between 1920 and 2000, sea level is estimated to have risen on average by 1.2 mm per year due to climate change (Church et al. 2006). Ocean currents have also been shown to be affected by a change in temperature and stratospheric ozone depletion with currents increasing in strength (Cai and Cowan, 2006), subsequently resulting in suppression of upwellings (leading to a shift in productivity) and a change in the distribution and productivity of marine ecosystems both spatially and temporally (Steffen et al , 2009). Sea-surface temperatures are projected to continue to increase, with estimates of warming in the Southern Tasman Sea of between 0.6 to 0.9°C and between 0.3 to 0.6°C elsewhere along the Australian coast by 2030 (Church et al. 2006).	
Coral reefs	An increase in sea surface temperatures across the globe has resulted in changes to species abundance, community structure and increased frequency of coral bleaching events (CSIRO, 2017a). Climate change has emerged as a threat to coral reefs, with temperatures of just 1°C above the long term summer maximum for an area over 4–6 weeks being enough to cause mass coral bleaching and mortality (Hoegh-Guldberg 1999, Hughes et al. 2017, Spalding and Brown 2015). An increase in the frequency of bleaching events can result in less time for reefs to recover and therefore remaining in early successional state (unable to support extensive habitat for organisms) or be replaced by ecosystems dominated by macroalgae. Coral mortality or die off following coral bleaching events can stretch across thousands of square kilometres of ocean (Hoegh-Guldberg 1999, Hughes et al. 2017). The impacts associated with a warming ocean, coupled with increasing acidification, are expected to undermine the ability of tropical coral reefs to provide habitat for fish and invertebrates, which together provide a range of ecosystem services (e.g., food, livelihoods, coastal protection) (Hoegh-Guldberg et al. 2018). As CO_2 is gradually absorbed by oceans and fresh water, the water becomes more acidic, which increases the solubility of calcium carbonate, the principal component of the skeletal material in aquatic organisms (Steffen et al. 2009) reducing the capacity for corals to build and maintain skeletons. Coral reefs are likely to degrade over the next 20 years, presenting fundamental challenges for those who derive food, income or coastal protection from coral reefs (Hoegh-Guldberg et al. 2017).
Saltmarsh and coastal freshwater wetlands	Sea levels are predicted to increase by 18 to 59 cm by 2100 in response to both thermal expansion and melting of ice-sheets (Solomon et al. 2007). This will lead to some coastal inundation affecting mangroves, salt marshes and coastal freshwater wetlands. Changes to the upstream freshwater habitats will result in changes to the spatial distribution of saltwater intolerant species further upstream with freshwater swamps and groundwater affected and areas of riparian vegetation being replaced by mangroves over time (Steffen et al., 2009). Further inland, reduction in rainfall may result in reduced river flows and changes in seasonality of flows and drought frequency and intensity increasing. Changes in water quality including nutrient flows, sediment loading, O2 and CO2 concentration can result in increased intensity, duration and frequency of eutrophication (Steffen et al., 2009).

Receptor	Potential Impacts
	Rocky shore and saltmarsh species in areas of low topographic relief will be vulnerable to complete loss of habitat, especially when bounded by cliff lines or coastal development (Steffen et al, 2009).
Mangroves	Mangrove ecosystems in Australia will face higher temperatures, increased evaporation rates and warmer oceans (McInnes 2015) as well as an associated sea-level rise (Hoegh-Guldberg et al. 2018). Mangrove range may increase their southern range as temperatures increase in the region, but the higher temperatures, ocean acidification and sea level rise may also result in a decrease in mangrove abundance (Duke et al., 2017). There is some evidence to suggest that sea level rise may not affect mangroves in such a negative way as they can accumulate more peat or mud to constantly adjust to the gradual sea level rise (Field, 1995).
Flora and Fauna	
Changes occur in species interactions as responses to environmental change, and usually have knock-on effects to whole communities and ecosystems. These higher order changes range from direct species–species interactions – such as mutualism, competition and predation – to changes in the ways in which species influence the structure and functioning of ecosystems, including cascading impacts through ecosystems, and the formation of novel communities and ecosystems (Steffen et al, 2009) including invasion of species.	
Mammals	Terrestrial mammals may be affected by a change in fire regime and extreme weather events resulting in drought, vegetation loss and starvation. Removal or addition of key species in the food web can also result in ecological cascades. Narrow-ranged endemics (particularly in montane regions) are susceptible to rapid climate change in situ (Williams et al. 2003). Changes in ocean temperatures, upwellings, ocean acidification and melting of Antarctic sea ice may impact krill availability, the major food source for blue whales (DoE 2015). It is predicted that cetaceans limited to warmer areas such as pygmy blue whales will experience a southward shift in distribution as ocean temperature increases. There is evidence of these changes already occurring in other marine mammal species, but such changes are difficult to detect for whales due to the complexity of ecological systems and the lack of long-term records (DoE 2015).
Birds	Impacts to birds can include (Steffen et al. 2009): - Changes in phenology of migration and egg laying (Chambers et al. 2005); - Increased competition of resident species with migratory species as the latter species stay at breeding grounds for longer periods; - Reduced breeding of waterbirds susceptible to reduction of freshwater flows into wetlands; - Changes in food supply as a result of ocean warming (Smithers et al. 2003); - Rising sea levels will affect birds that nest on or burrow in sandy and muddy shores, salt marshes, inter-tidal zones, coastal wetlands and low-lying islands; - Saltwater intrusion into freshwater wetlands, especially in northern Australia, will affect breeding habitat (Williams et al. 1995)
Reptiles	Warming temperatures may alter sex ratios of species with environmental sex determination (ESD) such as crocodiles and turtles (some species likely to modify use of microhabitats to cope with warming in situ) (Steffen et al., 2009) Climate change is likely to have impacts on marine turtles and seasnakes across their entire range and at all life stages. Climate change is expected to cause changes in dispersal patterns, food webs (e.g. seagrass dieoff), species range, primary sex ratios, habitat availability (e.g. loss of nesting beaches due to sea level rise), reproductive success and survivorship. Impacts will differ based on the ability of a stock to adapt to changes in suitable nesting beaches and food availability (DEE 2017a). Sea level rise presents a risk of nests flooding which may complicate turtle hatchling success. The magnitude of sea level rise is expected to be greater at more southerly latitudes, particularly for WA.

Receptor	Potential Impacts
Amphibians	Increased drying in bog and swamp areas will limit the range of habitat available to frogs and toads. Threatened alpine species (such as the southern corroboree frog *Pseudophryne corroboree*) at risk from changes to their breeding sites as snow coverage is reduced and areas dry out (Steffen et al, 2009). Increased outbreaks of pathogenic chytrid fungus in frogs as high temperatures provide optimum growth conditions (Laurance, 2008). Cane toad distribution may increase resulting in increased predation and competition as their range expands with warming.
Invertebrates	Invertebrates are expected to be more responsive than vertebrates due to short generation times, high reproduction rates and sensitivity to climatic variables. Flying insects such as butterflies may be able to adapt by shifting ranges, as long as they are not limited by host plant distributions; non-flying species with narrow ranges are susceptible to rapid change in situ (e.g. Wilson et al. 2005 estimated that 25% of insect diversity in the wet tropics may be threatened this century). Invertebrate herbivores may also be affected by reduced foliar quality under elevated CO_2 and changes in rainfall and localised ecosystem changes.
Fish and plankton	Many marine fauna are sensitive to average temperature changes, even by less than 3 degrees, resulting in effects on dispersal, growth rates, reproduction, susceptibility to disease and survival; this includes impacts throughout the food web starting with phytoplankton production and secondary production in benthic communities. Changes in seasonal cycles of plankton abundance, with potential for mismatch between phytoplankton blooms and zooplankton growth, leading to cascading effects to the rest of the marine food chain (Hays et al. 2005). Freshwater species are vulnerable to changes in water flow and quality with limited capacity for species to move to new waterways. Many marine organisms are highly sensitive to changes in temperature, leading to effects on growth rates, survival, dispersal, reproduction and susceptibility to disease. Increasing temperatures may reduce larval development time, potentially reducing dispersal distances and warm-water assemblages may replace cool-water communities.
Plants	Longer-lived plants such as trees may be highly vulnerable if climate change 'moves' suitable establishment sites for seedlings beyond seed dispersal distance at a rate exceeding generation time. Narrow-ranged endemic plants requiring a very specific set of environmental characteristics (such as specific soil types) will have limited capacity to disperse to similar, rare sites. Elevated CO_2 will increase photosynthetic rates as long as other factors, such as water and nutrients, are not limiting (Steffen et al, 2009). There is potential for productivity to be boosted in some regions by a combination of increased CO_2 and longer growing seasons (e.g. Dunlop and Brown 2008). This effect, however, may not occur in regions where drying occurs. Increasing CO_2 will increase water use efficiency at an individual plant level. But at an ecosystem level, total water use may not necessarily decrease, due to decreased total leaf area and increased evaporation from soil as a consequence of warmer temperatures (Steffen et al, 2009). Any changes in productivity and foliar nutrients will have flow-on effects to herbivores. Changes to fire regimes will have significant impacts on vegetation; increases in frequency and intensity of fires may disadvantage obligate seeders relative to vegetative resprouters. Changes in the timing of plant phenology and insect life cycles will affect pollination and some forms of dispersal.
Socioeconomic factors	Socioeconomic impacts resulting from climate change include impacts on the functions, interests or activities of other users which rely on these ecological values, including commercial and recreational fisheries and aquaculture. There may also be impacts to cultural heritage sites and places of spiritual importance in coastal locations due to sea level rises.

Table 7-6: Potential impacts of atmospheric emissions on identified receptors within the operational area**Sensitive Receptor**	**Impact description within the operational area**
Air quality	Emissions can reduce air quality in the immediate vicinity of the Facility in the Operational Area. The quantities of gaseous emissions are relatively small, and will under normal circumstances, quickly dissipate into the surrounding atmosphere. As the facility operations 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 any other nearby petroleum activities are not expected. As such impacts to air emissions are considered ***negligible.***
Birds	A reduction in air quality may have a temporary effect on transient bird species passing through the operational area. As described in Section 5, no avifauna BIAs overlap the Operational area, however, eleven threatened and/or migratory seabirds were identified as potentially occurring within, or having habitat potentially occurring within the EMBA. These species may be impacted by deterioration in air quality if they are transiting the immediate area of the FPSO and vessel exhaust release points. Symptoms of exposure could include irritation of eyes and respiratory tissues or breathing difficulties. Given that the Operational area is outside a flyway, and the nearest migratory bird breeding/ roosting site is Cartier Island which is located approximately 84 km north-west of the FPSO 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.***
Social receptors	As Montara Facility operations 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. No impacts are therefore expected.

Consequence	**Ranking**
Negligible	Acceptable

7.3.3 Environmental performance

Aspect		Atmospheric emissions		
Performance outcome		**No unplanned emissions to the atmosphere; Emissions to air meet regulatory requirements**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
006	CMMS requires equipment certification and maintenance	All engines, compressors and machinery on the FPSO and WHP are maintained via the CMMS	CMMS records maintenance has been satisfactorily completed as scheduled	OIM
007	International Air Pollution Prevention (IAPP) Certificate valid	FPSO and vessels (as appropriate to vessel class) will maintain a current International Air Pollution Prevention (IAPP) Certificate or equivalent which confirms that the following measures during the activity are in place: prevent ozone-depleting substance (ODS) emissions; and reduce NOx, SOx	Valid and current IAPP	OIM
008	FPSO and vessels compliant with Marine Order 97	FPSO and vessels (as appropriate to vessel class) will comply with Marine Order 97 (Marine pollution prevention – air pollution), which requires vessels to have a valid IAPP Certificate (for vessels > 400 tonnage) and use of low sulphur diesel, when possible (required to be less than 0.50% m/m as of 1 March 2020)	Valid and current IAPP	OIM
–	Gas compressor	Refer to performance standards in **Section 8.1.3**		

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 atmospheric emissions from production and operations equipment, as well as vessels to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Tolerable as they are within the green category (negligible impacts). No further controls are required and therefore ALARP has been demonstrated. Jadestone continues to review control options periodically and is currently investigating an alternative, mitigated GHG forecast for the site, subject to techno-economic analysis.				
Rejected control	**Hierarchy**	**Practicable**	**Cost effective**	**Justification**
All emissions producing equipment is removed	Eliminate	No	N/a	Atmospheric emissions from production and operating equipment is required to undertake the Activity. 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. The facility is modified to reduce air emissions e.g. new well for reinjection, scrubbers	Engineering	Yes	No	Risk and impact reduction are achieved through planned maintenance ensuring clean and efficient running of engines.
None identified	Isolation	N/a	N/a	The Activity is located at distance from sensitive receptors and the coastline.
None identified	Administrative	N/a	N/a	Compliance with relevant and appropriate MARPOL requirements

7.3.4.1 Mitigations

Jadestone is committed to achieve Net Zero (scope 1 and 2) GHG emissions for its operated assets by no later than 2040. Jadestone defines Net Zero as the state reached when its GHG emissions are reduced in line with the goals of the Paris agreement, and any remaining emissions that cannot be reduced further, are fully neutralised by like-for-like permanent removals. For those emissions that are economically or technically difficult to eliminate, Jadestone will employ nature-based solutions and offsets to mitigate. Jadestone is currently developing a Net Zero Plan which will be finalized and published end of 2023. The use of offsets to mitigate hard to abate emissions is the least preferred option in the mitigation hierarchy and Jadestone will continue to assess reduction options over the life span of the facility. Where offsets are used, Jadestone will ensure they are properly measured, verified, and represent permanent removal of carbon from the atmosphere.

A listing of current priorities applied to flaring management is provided below:

- Improving process stability – focus on process optimisation: reducing pressure fluctuations reduces the necessity to flare operational gas for short repetitive periods.
- Reinjecting gas – strong focus on increasing gas reinjection capacity to avoid GHG emissions, enhance oil recovery and preserve reservoir pressure.

- Gas as fuel source – produced gas is used to fuel gas turbines, which in turn provide power to the facility, thus reducing the need to purchase and supply diesel for the operation of plant and equipment.

Anticipated changed to the National Safeguard Mechanism

- The National Safeguard Mechanism is currently being reviewed. The anticipated changed are likely to mirror Jadestone's Net Zero plans, specifically around reducing emissions in line with a 1.5C target and trading or purchasing offsets where emissions are hard to abate

7.3.5 Acceptability Assessment

The potential impacts of atmospheric emissions are considered acceptable in accordance with **Section 4.4**, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes, and the environmental consequence is considered negligible.	
Policy & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for the activities.
Stakeholders & reputation	Stakeholder consultation has been undertaken (see **Section 6**), and no stakeholder concerns have been raised with regards to impacts from atmospheric emissions on sensitive receptors.
Environmental context & ESD	While there are atmospheric emissions to the airshed immediately around the facility 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. Whilst direct impacts to localised receptors is considered negligible, the cumulative impact of Montara's annual emissions does contribute to climate change. The potential impact is considered acceptable after consideration of: - Remaining project life span - Decreasing emissions - Limited options to reduce actual emissions - Offset hard to abate emissions in line with objectives of Paris Agreement
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 EMBA, 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 marine parks. This is consistent with the objectives of the protected area management plans (Appendix C), and considered acceptable. It is important to acknowledge that climate change impacts cannot be directly attributed to any one activity, as they are the result of global GHG emissions, minus global GHG sinks, that have accumulated in the atmosphere since the industrial revolution began. Therefore, there is no direct link between GHG emissions from the Stag facility operations and climate change impacts to specific ecological receptors.

7.4 Liquid Discharges

7.4.1 Description of Aspect

Liquid discharges	Liquid discharges generated from the FPSO and vessels and routinely discharged to the marine environment include: • Slops water (Deck drainage, bilge water, tank washing) • Cooling water • Desalination Brine • Treated Sewage • Greywater • Putrescible food waste • Guano (water blasted off the facility) A summary of each waste type is provided below. <u>Deck drainage and bilge water</u> Deck drainage from the Montara facilities and support vessels consists primarily of stormwater and deck wash-down water. It may include low levels of detergents, oil and grease, spilt chemicals, used machinery chemicals and general dirt from the deck. The volume of drainage likely to be generated is difficult to determine with accuracy as it depends on the rainfall and frequency of deck washing. As described in Section 3.3.5, the FPSO will have three separate drain facilities; open non-hazardous drains, open hazardous drains and closed hazardous drains. The two drain types that receive hazardous discharge are directed to the dirty slops tank for gravity separation and further transferred to the Produced Water storage tanks for treatment and discharge via the Produced Water treatment system. Deck drainage and bilge water from the FPSO are therefore assessed separately in Section 7.6 (Produced Formation Water). This risk assessment covers the open non-hazardous drains on the FPSO, which flow directly to the Main Deck via the grated process decks, where they can be discharged overboard via the scuppers. This section does not include the management of chemical spills, which is addressed in **Section 8.5**. On vessels, oily water from bilges will be collected and treated via an oil-water separator in accordance with MARPOL requirements (<15 ppm (v) oil-in-water) prior to discharge. Once separated, the oil and grease will be stored in suitable containers ahead of transfer ashore for recycling, and the treated water discharged to sea. <u>Cooling Water and Desalination Brine</u> Cooling water is used as a heat exchange medium to cool machinery; the water is then discharged at a temperature higher than that of the ambient seawater (Black et al. 1994). Seawater will be pumped aboard the Montara FPSO and then circulated through various process and marine heat exchangers prior to discharge back into the ocean. Slipstream of seawater is passed through Marine Growth Prevention System (MGPS) anode treatment tanks where electrodes immersed in the seawater release copper (Cu) and Aluminium (Al) ions into the sea water. Copper and aluminium are anti-fouling agents and are maintained at the trace concentrations of 2 ppb Cu and 0.5 ppb Al. This treated seawater stream is then directed to each inlet sea chest and pump caisson to prevent blockage of marine growth inside pipes and exchangers. Discharge rate of cooling water from the FPSO is up to 65,000 m^3/d (2,200 m^3/h). Freshwater is produced on board the Montara FPSO via desalination. The fresh water makers on board result in discharge of maximum 40 tonnes per day of brine of 50.5ºC and a maximum salinity of 50 ppm. The cooling water discharge system is a segregated system, with no direct contact with hydrocarbons. Cooling water may be treated with biocide to prevent biofouling of pipes.

	Given the Montara FPSO is an existing operating facility in a fixed location with a fairly consistent fresh water and cooling water requirements, operations are well established. GEMS (2003) examined the potential behaviour of cooling water discharge from the Montara FPSO during production using wind and tidal driven currents during the dominant seasons (winter and summer). The report concluded that the zone of impact associated with temperature impact from the discharge of cooling water is predicted to be extremely limited in extent with the plume mixing to within 2ºC of the ambient temperature within 40 m from the point of discharge. A water quality monitoring program conducted in 2017 (Jacobs 2017) confirmed at 100 m from the point of discharge, there was not been greater than 3°C above the ambient water temperature. Sewage, Grey water and Food waste With the maximum persons on board (POB) of the Montara FPSO being 58 personnel (with a lower average number typically on board), the volume of treated sewage and greywater is conservatively estimated to be <35 m^3/d (based on 0.6 m^3/person/d) and putrescible waste of 60 kg/d (based on 1 kg/person/d). These quantities are derived from existing PTTEP AA Montara Operations. Given the Montara FPSO is manned on a continuous basis, discharges of treated sewage, greywater and putrescible food waste is expected to occur daily throughout operations, over all seasons of the year. During planned maintenance periods on the sewage treatment system, sewage will be discharged from the system untreated into the marine environment for a limited amount of time (24–48 hours) at a frequency expected to be approximately 4–6 times annually. In addition to the Montara FPSO, support vessels operating within the permit areas routinely discharge sewage, greywater and putrescible wastes. Given the lower POB of vessels and the intermittent nature of support operations, overall discharge volumes and frequencies are less than that from the FPSO. Guano and water blasting Guano is water-blasted (using seawater) as required to maintain the helideck for safe helicopter landing and the surfaces throughout the facility to maintain personnel health and safety. The guano and water are discharged directly to sea.

7.4.2 Impacts

Sensitive Receptor	**Impact description**
Water Quality	The impacts associated with the discharge of liquids to the marine environment include a potential change to ambient water quality within the direct vicinity of the facilities and support vessels through chemical loading, increased water temperature, eutrophication, and change in salinity. *Deck drainage and bilge water* The potential impact associated with the discharge of treated deck drainage and bilge water is a change to ambient water quality through chemical loading within the direct vicinity of the operational facilities and support vessels. 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. 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 and the consequence was assessed as ***negligible***. *Cooling water and desalination brine* Cooling water discharges to the marine environment will result in a localised and temporary increase in the ambient water temperature of approximately 10ºC. Once discharged into the ocean, the cooling water will initially be subject to mixing due to ocean turbulence and some heat will be transferred to the surrounding waters. The plume will then disperse and rise to the ocean surface, where further loss of heat and dilution will occur (Black et al. 1994). The volume of water discharged will be small compared to the receiving waters, the environmental effects of the elevated temperature of discharged waters is therefore predicted to be insignificant due to the large buffering

Sensitive Receptor	Impact description
	capacity of the ocean. The plume will quickly lose heat and water in only a small area around the outfall will have a substantially elevated temperature (Black et al. 1994). The consequence was assessed as negligible. Residual brine typically has a salinity of 40,000 ppm in comparison to seawater which has a salinity of 35,000 ppm. Any increase in salinity within the receiving environment as a result of desalination brine discharges is expected to be limited to the immediate point of discharge. As brine is of greater density than seawater and it is expected to sink and rapidly disperse in the currents. For desalination brine discharges from the Montara FPSO the increase in salinity will be further reduced due to combining of the brine with the return seawater from the cooling water system prior to discharge. The consequence was assessed as ***negligible***. *Treated Sewage, grey water, guano and food waste* The potential impact associated with the routine discharge of guano contaminated washwater, sewage, grey water and putrescible food waste on water quality is changes to ambient water quality and BOD levels from nutrient loading within the direct vicinity of the FPSO and support vessels. The discharges of guano washwater, treated sewage and grey water result in localised increases in nutrient concentrations, exert Biological Oxygen Demand (BOD) on the receiving waters and may promote localised elevated levels of phytoplankton and bacteria activity due to nutrient inputs. Guano discharge studies have found that biological recycling of nutrients by seabirds likely supports marine primary production and enhances productivity of associated food webs in the vicinity of islands where the surrounding coastal waters are nutrient limited (Shatova *et al*, 2016). However, 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). The consequence was assessed as ***Negligible***. *Summary* The consequence of liquid discharges to the marine environment are considered to be negligible given the low toxicity of the discharges and expected dilution within the open water.
Marine fauna: cetaceans, turtles, fish, seasnakes, sharks, rays, seabirds	Changes in water quality as a result of liquid discharges can lead to impacts on fauna including: • Potential chemical toxicity to marine species within the direct vicinity of the facilities and support vessels; • Potential behavioural change in marine species; • Chemical effects to marine fauna; • Alteration of physiological processes of exposed biota; • Bio-stimulation of planktonic communities; • Biological exposure to pathogens; and • Deposition and accumulation of solids/ particulates leading to a change in sediment quality *Deck drainage and bilge water* 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 facilities and support vessels. 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 marine ecology. The consequence was assessed as negligible.

Sensitive Receptor	Impact description
	Cooling water and desalination brine 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. 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). A water quality monitoring program conducted in 2017 (Jacobs 2017) have confirmed at 100 m from the point of discharge, there has not been greater than 3°C above the ambient water temperature. Most marine species are able to tolerate short-term fluctuations in salinity in the order of 20–30% (Walker and McComb 1990), and it is expected that most pelagic species would be able to tolerate short-term exposure to the slight increase in salinity caused by the discharged brine. Given the relatively low volume of discharge, low salinity increase and deep, open water surrounding the operational area, impacts on fauna from increased salinity in the operational area is expected to be low. 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 Shelf significant impacts on a larger ecosystem or population level to fish or plankton are not expected to occur. Given the hydro-dynamically active open water environment surrounding the Montara operations, it is expected that the surface discharges of cooling water and desalination brine would rapidly disperse, cool and dilute in the surrounding waters, therefore temperature, biocides and increased salinity loading leading to changes to water quality or behavioural changes in marine species would be negligible. Therefore, only receptors in close proximity to the discharge point have the potential to be impacted. *Sewage, greywater and putrescible food waste* The potential impact associated with the routine discharge of sewage, grey water and putrescible food waste is changes to water quality resulting in a change in BOD and behavioural responses of marine fauna to discharges as an alternative food source. As cited within NERA (2017), any potential change in phytoplankton or zooplankton abundance and composition is expected to be localised, typically returning to background conditions within tens to a few hundred metres of the discharge location (e.g. Abdellatif 1993; Axelrad et al. 1981; Parnell, 2003). Effects on environmental receptors further up the food chain, namely, fish, reptiles, birds and cetaceans are therefore not expected beyond the immediate vicinity of the discharge in deep open waters. Some fish and oceanic seabirds may be attracted to the FPSO 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. *Summary* No important foraging or nesting BIA for marine turtles, fish or marine mammals overlaps the Operational area. However, the northern boundary of the whale shark foraging BIA does overlap providing potential for whale sharks to be present. The presence of marine fauna is expected to be limited to individuals transiting through the area with the exception of the seabirds that use the

Sensitive Receptor	Impact description
	facilities as a roosting and nesting location, including whale sharks due to the size of the whale shark foraging BIA. Impacts to marine fauna are expected to be short term with rapid recovery and the consequence of liquid discharges was assessed as ***negligible.***

Consequence	Ranking
Negligible	Acceptable

7.4.3 Environmental performance

Aspect		Operational discharges		
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**
	Deck drainage and bilge water			
–	Oily water discharge from FPSO	Oily water on the FPSO discharged via produced water treatment system – refer **Section 7.6**		
009	Oily water filtering and monitoring equipment fitted and maintained	If required under MARPOL, support vessels have oily water filtering and monitoring equipment that is compliant (e.g. discharges oily water with OIW <15 mg/L) and surveyed/ maintained as per MARPOL	Maintenance records IOPP certificate	Marine Superintendent
010	Oily sludge is contained	Oily residue (sludge) is not discharged to sea but is contained and transferred to shore for disposal.	Oil Record Book	OIM/Vessel Master
	Cooling water			
011	Water cooled equipment on FPSO is maintained	Water cooled equipment/ machinery and heat exchangers maintained in accordance with the CMMS	CMMS shows maintenance is scheduled and completed	Maintenance Supervisor
012	Production chemicals dosed to the production processing system regularly monitored (MV-02-PR-P-00002)	Production chemicals to be added to the system at a dosage rate as prescribed in the chemical approval request	Production Technician checks dosage rate on all running chemical systems including biocide dosing every 12 hours and records measurements in the log sheet	Operations Supervisor
	Desalination brine			
013	Potable water systems are maintained	Potable water systems maintained in accordance with the CMMS	CMMS shows maintenance has been satisfactorily completed as scheduled	Maintenance Supervisor

Aspect		Operational discharges		
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 and greywater			
014	FPSO STP meets operational needs and is maintained	Pursuant to MARPOL, FPSO has a current International Sewage Pollution Prevention (ISPP) Certificate or equivalent which confirms that required measures to reduce impacts from sewage disposal are in place	Valid ISPP Certificate	Maintenance Supervisor
	Putrescible waste			
015	Garbage record book maintained	Vessel's garbage record book maintained to record quantities of food waste in accordance with MARPOL	Garbage Record Book	OIM/Vessel Master

7.4.4 ALARP Assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage liquid waste discharges from the FPSO and support/ supply vessels to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Tolerable as they are within the green category (negligible impacts). No further controls are required and therefore ALARP has been demonstrated.

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 reengineering 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.
Re-engineer equipment to retain wastes onboard	Engineering	No	No	Costs associated with complete reengineering 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 facility 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 on 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.

7.4.5 Acceptability assessment

The potential impacts of liquid waste discharges are considered acceptable in accordance with Section 4.4, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes and the environmental consequence is considered negligible.

Policy & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Stakeholders & reputation	Stakeholder consultation has been undertaken (see **Section 6**), and no stakeholder concerns have been raised with regard to impacts from liquid waste discharges on sensitive receptors.
Industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) objectives are met with regard to offshore production operations.

Environmental context & ESD	While there are liquid waste discharges to sea surface immediately around the Montara, the impact and risk assessment process indicates that discharges will not result in significant effects to marine fauna. 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	No Management Plans identified operational discharges 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 EMBA, 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 marine parks. This is consistent with the objectives of the protected area management plans (Appendix C), and considered acceptable.

7.5 Chemical Discharges

7.5.1 Description of aspect

Chemical discharges	Chemicals are planned to be discharged via ongoing operations within the operational area. Chemicals that are planned for discharge include: • Firefighting foam; • Chemicals and chemically treated water from maintenance & well intervention; and • Subsea control fluids. *Firefighting Foam* The discharge of fire-fighting foams from the FPSO is required for safety critical annual fire system testing as part of the automatic fire protection performance standard. This chemical will also be discharged during emergency situations and annual testing of the emergency systems on board the facility. The foam blanket suppresses evaporation preventing emissions of flammable and toxic gases. The fire risk and environmental impact thus are reduced considerably. During testing, discharge of between 50–100 L of fire extinguishing agent is to be expected. During an emergency incident, the volume will be higher. *Discharges from Maintenance* Discharges to the marine environment associated with maintenance activities include: • Fluorescein and other marker dyes; • Biocides and oxygen scavengers in flowlines and subsea equipment; • Guano removal and other high-pressure spraying. *Discharges during LWI activities* Discharges to the marine environment associated with LWI activities include: • Fluorescein and other marker dyes (~250ml); • Pressure control grease and control fluid (~1000L - 15,000L); • Hydrate management and decalcification chemicals (~200L); • Corrosion inhibitor/ biocide (~50L); • Brine (~2,000 bbl); and

	• Descaler (~32 bbl). *Subsea Control Fluids* Subsea control valves are required to be opened and closed depending on operational requirements. Each time a subsea tree or manifold is closed completely, control fluid is vented. Shutting in a single subsea tree releases approximately 14 L of control fluid. The volume of the subsea tree value actuators varies with the largest discharge volume being 16.6 L for the Manifold gate valves. In the case of an emergency shutdown and closure of all subsea actuated valves, 130 L of fluid is vented.

All chemicals that may be used in LWI activities are subject toChemical Selection, Evaluation and Approval Procedure (JS-70-PR-I-00033) which reviews the risk ranking, concentrations and discahrges. Chemicals may be trialled and tested before phasing out other chemicals for example due to a change in chemical supplier..

7.5.2 Impacts

Sensitive Receptor	Impact description
Plankton; Fish, Sharks and Rays; Marine reptiles; Marine Mammals; Seabirds	The impacts associated with the discharge of liquids to the marine environment include a potential change to ambient water quality within the direct vicinity of the facilities and support vessels through chemical loading. This can lead to toxic effects on marine fauna in the vicinity. *Firefighting foam* The potential for exposure of marine fauna to fire extinguishing agents is limited to individuals close to the discharge point at the time of release. The closest worst-case impact may include a biochemical oxygen demand (BOD) on the surrounding water or toxic effects or irritation from exposure to toxic compounds in local waters surrounding the point of discharge. The potential impacts associated with fire extinguishing agent are: • Physical contact with floating or suspended foam solids; • Potential change to ambient water quality (e.g. BOD, acute/chronic toxicity) through chemical loading within the direct vicinity of the facilities and support vessels; • Potential chemical toxicity to marine species within the vicinity of the release; and • Chemical contact with the atmosphere as it may evolve toxic gases (carbon oxides, hydrocarbons) when heated to decomposition. On discharge to the marine environment, the small volumes of treated water and chemicals are expected to rapidly disperse in the offshore marine environment. Hence, any potential impacts would be confined to a highly-localised area immediately surrounding the release location. There may be a localised and temporary (hours) reduction in water quality in the immediate vicinity of the release. Toxicity impacts to marine fauna/seabirds from the release of chemically-dosed water are unlikely to eventuate because: • The chemicals have been risk assessed for their suitability for discharge to the marine environment prior to use; • Strong ocean currents mean that the discharge will become further diluted upon discharge, so the duration of exposure of chemicals to fauna will be minimal; and • Potential discharges will be localised and temporary within the operational area. There is no emergent habitat that could be impacted by a surface discharge and the benthic habitat is predominately bare sand, with a very sparse assemblage infauna. Sub-lethal or lethal effects from toxic chemicals to marine fauna and seabirds, is considered unlikely given the expected low concentrations and short exposure times. Given the small volumes that could be released to the marine environment and the nature of the marine environment within the vicinity of the operational area, the discharge of chemicals and treated seawater is unlikely to have spatially or ecologically significant effects and was assessed as ***Negligible***. *Subsea control fluids, LWI discharges, and maintenance discharges* Hydraulic fluids are used extensively in the petroleum industry in subsea production systems. Hydraulic fluids are either petroleum or water-based blends with additives. The main properties required of a hydraulic control fluid are low viscosity, low compressibility, corrosion protection, resistance to microbiological attack, and compatibility with seawater. The potential impacts of hydraulic fluid discharges near the seabed are a localised reduction in water quality and potential toxicity to benthic marine fauna associated with bare sediments or attracted/ attached to subsea infrastructure (e.g. fish, infauna and sessile filter feeding organisms). Marker dyes, biocides, oxygen scavengers, descalers/decalcifiers, brine and hydrate management fluids that will be used as part of the activities are also commonly used in the offshore oil and gas industry.

Sensitive Receptor	Impact description
	Biocides in offshore oil and gas are commonly used in the treatment of infrastructure susceptible to corrosion due to sulphate reducing bacteria. Biocides are commonly disinfectants, antiseptics and preservatives and often have the action of damaging cellular membranes and are therefore particularly toxic to unicellular organisms due to an oxidative effect. Oxygen scavengers alternatively are administered with the intent of removing oxygen from the immediate are to reduce the reducing effect of oxygen-respiring organisms (commonly microorganisms). The scavenging effect is chemical and effective as long as the active agent is free of being bound by an oxygen molecule. Thus, the effect of oxygen scavengers in the open environment is often short-lived as their effect is void once oxygen is encountered. Brine is commonly used during LWI activities to establish a barrier while working within the well, and hydrate management product (often methanol) is used to ensure production flow from the wells. The Offshore Chemical Notification Scheme (OCNS) system (based on UK North Sea chemicals) uses the ecotoxicity data for offshore chemical products to assess the potential environmental risk in the marine environment. The least environmentally hazardous grade is Gold (CHARM assessed), and E (through a non-CHARM assessment). The OCNS system requires bioaccumulation and biodegradation data, and aquatic toxicity data from three trophic levels (algae, crustacean and fish) to predict the potential ecosystem risk and, in turn, rank the product by Hazard Quotient (HQ). The subsea control fluid, decalcifier/descaler, hydrate management and brine products (refer **Table 7-3**) used at the Montara facilities for these activities have an OCNS rating of E. To achieve this ranking, the chemicals have the least environmental impact in terms of ecotoxicity, biodegradation and bioaccumulation, and indicates negligible impacts to the marine environment result from the discharge of the fluid. *Summary* Benthic communities within the operational area are primarily associated with soft sediment habitats and are considered to be relatively low sensitivity and widely represented in the region. No important foraging or nesting BIA for marine turtles or marine mammals overlaps the area. The northern boundary of the whale shark foraging BIA does overlap the area providing potential for whale sharks to be present. The presence of marine fauna is expected to be limited to individuals transiting through the area, including whale sharks due to the size of the whale shark foraging BIA. There is also only a small overlap of active commercial fisheries with the Operational area. As such, with the controls on place the impacts from chemical discharges was assessed as ***Negligible.***

Consequence	Ranking
Negligible	Acceptable

7.5.3 Environmental performance

Aspect		Operational discharges		
Performance outcome		**No unplanned chemical discharges within the Operational Area**		
ID	**Management controls**	**Performance standard**	**Measurement criteria**	**Responsibility**
	Firefighting Foam			
016	Performance Standards Report (MV-70-REP-F-00002) ensures automatic fire protection system is adhered to	Performance standards implemented for fire-fighting foam to ensure fire protection system is maintained and operated in accordance with Montara's Automatic Fire Protection System	CMMS maintenance record close out	Maintenance Supervisor
	Subsea Control Fluids & Chemicals for Maintenance			
017	Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033)	Chemicals used are Gold/Silver/D or E rated through OCNS, or PLONOR substances listed by OSPAR, or have a complete risk assessment so that only environmentally acceptable products are used	Chemical Risk Assessment completed form	OIM

7.5.4 ALARP assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage chemical discharges from the FPSO and support/ supply vessels to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Tolerable as they are within the green category (negligible impacts). No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
Zero discharge of fire-fighting foam, subsea control fluids and chemicals	Eliminate	No	No	Costs associated with complete reengineering such that drainage is all contained from areas where fire-fighting foam is present and disposed of onshore; followed by onshore treatment and disposal costs 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. Subsea control fluids discharged through valve actuation cannot be practically avoided.
Reduce toxicity of discharges	Substitute	No	No	Chemicals selected for discharge in accordance with the procedure to ensure that there is a low potential impact. Further substitution of all chemicals to the lowest potential impact only (e.g. only PLONOR) is not practicable as chemicals are required for the activity. Little benefit given lack of sensitive receptors in area.
N/a	Isolation	N/a	N/a	The activity is located at distance from sensitive receptors and the coastline and no significant impacts on receptors are predicted.
N/a	Administrative	N/a	N/a	Compliance with chemical selection procedures ensures toxicity to the marine environment is as low as practicable.

7.5.5 Acceptability assessment

The potential impacts of chemical discharges are considered acceptable in accordance with Section 4.4, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes and the environmental consequence is considered negligible.

Policy & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Stakeholders & reputation	Stakeholder consultation has been undertaken (see **Section 6**), and no stakeholder concerns have been raised with regard to impacts from chemical discharges on sensitive receptors.
Environmental context & ESD	While there are chemical discharges to sea surface and subsea in the vicinity of infrastructure immediately around the Montara, the impact and risk assessment process indicates that discharges will not result in significant effects to marine fauna.

	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	No Management Plans identified operational discharges 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 EMBA, and the respective management plans and other published information. Impacts from chemical discharges 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 (Appendix C), and considered acceptable.

7.6 Produced Water Discharge

7.6.1 Description of aspect

Produced water	Water produced during the recovery of hydrocarbon from the reservoir and during processing of the production fluid stream, is termed produced water. Produced water is separated from gas and oil within the production fluid stream during topsides processing at the FPSO. The resultant produced water is a mixture of condensed water extracted from the reservoir as a gas, and formation water extracted from the reservoir as a liquid. Produced water at the Montara facility contains a mixture of dissolved hydrocarbons and suspended oil droplets, naturally occurring radioactive materials (NORMs), inorganic salts, metals, as well as low residual concentrations of a small number of chemical additives that are introduced during the production process such as wax inhibitor, corrosion and scale inhibitors and biocides. Produced water is discharged overboard in batches at sea surface. Adjacent to the produced water discharge the cooling water discharge from the FPSO also occurs.

In describing the produced water discharges made from the *Montara Venture* FPSO, the following information is provided:

- **Production and processing**: an outline of where produced water originates during the Activity and how the discharge is modified/ added to during topside processing (**Section 7.6.1.1**);
- **Characterisation:** a list of produced water constituents and concentrations, and ecotoxicological information gathered from Whole Effluent Toxicity (WET) testing (**Section 7.6.1.2**);
- **Volume and loads**: a history of produced water discharge volumes and loads (**Section 7.6.1.3**); and
- **Area of Impact**: the area of dispersion within the marine environment from produced water discharges as determined by modelling and verification of the modelling with field data (**Section 7.4.1.4**).

7.6.1.1 Production and processing

Well fluids from the wellhead platform are transferred to the FPSO via two flow lines. The fluid from each flow line enters first stage separators ‘A’ or ‘B’ before the separated oil continues forward for further processing in the second and third stage separators. Produced water is separated from other well fluids (oil, gas) in each separator.

Produced water from first stage separators 'A' and 'B' and the second and third stage separators are co-mingled and routed to the produced water degasser 44-VA-001 where associated gas is separated and sent to flare. Produced water from the third stage separator, which operates at near atmospheric pressure, is routed via produced water rundown pumps 44-PC-002A/B to the produced water degasser. These pumps operate on a duty/ standby basis.

In produced water degasser 44-VA-001, further separation of oil, gas and water occurs. The gas exits the vessel to the low-pressure flare. Any oil rises to the top of the liquid level and is skimmed into a bucket arrangement. Reverse emulsion breaker injection points are provided upstream and downstream of the produced water degasser 44-VA-001. Reverse emulsion breaker is injected when necessary to assist oil/ water separation.

The produced water exits the produced water degasser via a vortex breaker and is directed to the tube side of produced water discharge cooler 44-HA-001. Fresh cooling water enters on the shell side and flows counter current. Produced water exiting the cooler is directed to produced water tanks 5P/5S.

The operating philosophy is that one produced water tank is designated as the receiving 'settling' tank for water from the produced water degasser; the other produced water tank is designated as the 'supply tank' for water directed to the produced water hydrocyclones 44-VX-001A/B. The tanks are connected by a decanting line with two nozzles (with shut off valves) in each tank. Produced water in the 'settling' tank enters the open base nozzle of the decanting line and exits the open 11 m riser nozzle on the decanting line of the supply tank. This ensures the 'settling' tank always has sufficient retention time/ height for most of the entrained oil to separate from the produced water. The oil layer that eventually builds up on the produced water in the 'settling' tank is detected by level and interface elements provided in each tank. Oil is removed by closing the decanting line and allowing the level in the 'settling' tank to increase to the level of the stripping and oil skimming nozzle at 17 m. Skimmed oil is directed to the existing cargo oil stripping and bilge pump 33-PB-001 in pump room.

Note: in the case of a rapidly increase in produced water level in the settling tank, decanting can also be carried out via the bottom line instead of going via the 11 m nozzle in the supply tank.

Produced water from the designated produced water tanks is transferred by produced water pumps 44-PS-001A/B to produced water hydrocyclones 44-VX-001A/B. Produced water flows into the hydrocyclone chamber and enters the top of the hydrocyclone liners. In each liner, water enters tangentially inducing a swirling motion, which is maintained over the length of the liner. The centrifugal force generated by the swirling motion results in the water, having higher specific gravity, being forced to the wall of the liner and the lighter oil and gas forming an inner core in the centre low pressure area. By setting up the valving to give backpressure control on the oil reject line, the inner oil column is made to flow in the reverse direction back up the column and out through the reject line to the third stage separator for re-processing.

Two produced water hydrocyclones (2 x 50%) are provided, each with a design capacity of 30,000 bbl/d (200 m^3/h) of gross liquids. The produced water hydrocyclones are designed to separate oil-in-water down to a level of less than 36 ppm to meet overboard discharge specifications. The water flows out of the end of the liner into the outlet chamber. In the outlet chamber, the water mixes with the water from the other liners and enters the disposal line for discharge overboard or is returned to produced water tanks 5P/5S for further treatment if it is not below the desired specification. Manual liquid sampling points are provided on each hydrocyclone reject oil outlet lines and produced water outlet lines.

The oil-in-water content is continuously measured by the oil-in-water meter AIT-4400. High oil-in-water protection content diverts flow of off-specification water from overboard discharge to the produced water tanks 5P/5S for further processing.

Manual liquid sampling points are provided upstream of the oil-in-water meter on both hydrocyclone underflow lines to allow calibration and verification of the oil-in-water meter AIT-4400 measurements. A log of the discharge is maintained to conform to statutory requirements. Sampling must be carried out by approved personnel and to required standards, while observing all safety regulations.

Produced water tanks 5P/5S are located within the hull of the FPSO. These were originally cargo oil tanks. The produced water tanks contain enough capacity for approximately 20 hours (52,000 bbls) of full water production at a rate of 60,000 bbls/d.

For noting, the contents of the bilge holding tank are discharged to the starboard slops tank for further treatment and discharge with the slops water via the produced water system.

A number of chemicals are used during processing of the production fluid stream. Their purposes include:

- Corrosion inhibition
- Biocide
- Hydrate inhibition
- Reverse emulsion breaker
- Scale inhibitor

All chemicals that may be present in produced water are subject to the Chemical Selection, Evaluation and Approval Procedure (JS-70-PR-I-00033) which reviews the risk ranking, concentrations and dosages, and discharges. Chemicals may be trialled and tested before phasing out other chemicals for example due to a change in chemical supplier.

7.6.1.2 Characterisation

The main contaminants of concern in discharged produced water are (Neff et al., 2011):

- Oil in water (OIW);
- Aromatic hydrocarbons as a component of OIW;
- Trace metals and nutrients; and
- Naturally occurring radioactive materials (NORMs).

To understand the potential impacts of the effluent discharge in the receiving environment, produced water characterisation and toxicity testing are used to assess the discharge stream. Provided below is a summary of results collected for the Montara produced water discharge stream between 2018 and 2022.

<u>Oil in water</u>

Measurement of oil in water concentrations within the produced water discharged is made using the inline spectrophotometer (TD-4100XD) and verified with a hand-held spec unit (TD500).

<u>Metals/metalloids, nutrients and physico-chemical parameters</u>

Results of annual analyses for trace metals nutrient concentrations and physico-chemistry measured in produced water samples collected over the last five years are provided in

Table 7-7, **Table 7-10** and **Table 7-11**. Ammonia, total nitrogen, barium, manganese and zinc are the only analytes in high enough concentration to be detectable in the receiving water. In the most recent receiving water monitoring (April 2022) concentrations of these analytes were not able to be detected above background concentrations any further than 200 m from the discharge.

Table 7-7: Nutrients and physico-chemicals measured in produced water annual analyses 2018–2022

Analyte	2018	2019	2020	2021	2022
pH	5.8	6.0	5.9	5.9	5.7
Salinity (ppt)	111	113	111	112	112
TOC (mg/L	95	61	86	86	90
DOC (mg/L)	92	62	92	82	89
BOD (mg/L)	170	170	57	83	70
TSS (mg/L)	69	14	9	4	7
Total sulphide (mg/L)	<0.1	<0.1	<0.5	0.2	<0.5
Orthophosphate (µg/L)	16	45	100	100	<50
Ammonia (NH_3-N µg/L)[b]	110,000	80,000	96,000	96,000	90,000
Nitrate+nitrite (µg/L)	<6	52	<40	<40	<40
Total phosphorus (µg/L)	840	1,100	590	590	560
Total nitrogen (µg/L)	110,000	84,000	100,000	100,000	91,000

Table 7-8: Filtered metals/metalloids (µg/L) measured in produced water annual analyses 2018–2022

Analyte	ANZG (2018) Guideline value*	2018	2019	2020	2021	2022
Silver	0.8 (mod)	<0.3	<0.3	<0.3	<0.3	<0.3
Arsenic	2.3(III) (low)	<1.5	<1.5	<1.5	<1.5	3
Barium	5.5‡	29,000	6,800	7,600	18,000	26,000
Cadmium	0.7 (very high)	<0.3	<0.3	<0.3	<0.3	<0.3
Cobalt	1 (95% high)	0.5	0.3	<0.15	0.2	0.3
Chromium	0.14 (VI) (very high)	<0.6	<0.6	<0.6	<0.6	<0.6
Copper	0.3 (very high)	4.9	0.8	0.9	1.8	2.6
Manganese	130†	1,100	1,600	890	900	1,600
Molybdenum	10‡	<1.5	<1.5	<1.5	<1.5	<1.5
Nickel	7 (very high)	7.8	2.5	2.3	6.3	4.5
Lead	2.2 (low)	1.3	<0.3	0.3	1.3	0.6
Vanadium	50 (mod)	<0.9	<0.9	<0.9	<0.9	<0.9
Zinc	3.3 (very high)	1,900	110	76	140	220
Inorganic Mercury	0.1 (very high)	<0.3	<0.3	<0.5	<0.5	<0.5

* 99% species protection guideline value (ANZG, 2018) as of 18 July 2022. Rankings of very low, low, moderate, high and very high reliability are shown in parenthesis.

‡ No guideline value – background concentration in the receiving water (surface water) 2 km from the FPSO discharge location

† Draft submission paper to the Council of Australian Government's Standing Council on Environment and Water (Stauber et al. 2008).

Table 7-9 Particle size distribution measured in produced water annual analyses 2018–2022

Year	Size range (µm)	% smaller than 5 µm	% ≤ 63 µm
2018	0.25 - 159	54	98
2019	0.25 - 63	78	100
2020	0.25 - 142	77	99
2021	0.28 - 89	76	99.9
2022	0.28 - 50	62	100

Hydrocarbons and other organics

Results of annual analyses for hydrocarbon concentrations and other organics measured in produced water samples collected over the last five years are provided in **Table 7-10**. Total petroleum hydrocarbon concentrations (TPH) are high in the PW, however, organic matter is also known to be high in some of the Montara wells. Silica gel cleanup was undertaken in the 2022 PW monitoring to determine if some of the readings were due to naturally occurring non-hydrocarbon organics. After silica gel cleanup the TPH concentration decreased to 25 mg/L indicating naturally occurring organics are also present. A sheen can also be detected in the receiving water surrounding the FPSO however surface water grabs were unable to detect hydrocarbons (TPH, BTEX or PAH) any further than 200 m from the discharge

Table 7-10: Aromatic hydrocarbons (mg/L) measured in produced water samples 2018-2022

Analyte		ANZG Guideline value*	2018	2019	2020	2021	2022
BTEX	Benzene	0.5 (moderate)	5.3	5.1	5.2	7.6	5.0
	Toluene	0.11 (unknown)	3.4	2.7	3.1	5.6	2.9
	Ethylbenzene	0.05 (unknown)	0.14	0.16	0.13	<0.5	<0.25
	m&p-Xylene	0.25 (unknown)	1.1	0.83	0.84	2.0	0.81
	o-Xylene	0.35 (unknown)	0.35	0.35	0.28	0.62	0.28
TPH	Total C6-C36		19.8	24.3	32.2	43.5	33.1
TPH after silica gel cleanup	Total C6-C36						25.1
PAHs	Naphthalene	50 (moderate)	188	110	290	270	190
	Acenaphthylene	0.1‡	<9.4	<0.1	<0.3	<2	<5
	Acenaphthene	0.1‡	<9.4	<0.1	<3	<2	<5
	Fluorene	0.1‡	<9.4	2.4	8.8	19	11
	Phenanthrene	0.6 (unknown)	<9.4	2.3	20	28	28
	Anthracene	0.01 (unknown)	<9.4	<0.1	<3	<2	<0.4
	Fluoranthene	1 (unknown)	<9.4	<0.1	1.2	2	<0.3
	Pyrene	0.1‡	<9.4	<0.1	0.4	<2	<0.7

Phenols	Phenol	0.27 (moderate)	2.8	4.6	3.5	4.0	6.2
	2-Methylphenol	0.0077†	1.1	1.2	1.6	0.42	1.5
	3-&4-Methylphenol	0.0077†	1.3	1.3	1.7	2.1	1.9
	2,4-Dimethylphenol	0.002 (unknown)	0.22	0.25	0.58	<6	0.32
Organic acids	Acetic Acid	10	156	96	130	50	74
	Butyric Acid	10‡	4.1	<10	<10	<10	<10
	Propionic Acid	10‡	16.7	13	10	<10	12

*ANZG (2018) guideline values for 99% species protection in marine water. Rankings of unknown, very low, low, moderate, high and very high reliability are shown in parenthesis.

‡ No guideline value - laboratory limit of reporting (if background concentration below the LOR)

† OSPAR Commission (2014) PNECs for various toxicants

Naturally Occurring Radioactive Materials

NORMs were analysed several ways to determine whether they are associated with the particulates in the PW or the dissolved fraction by examining gross alpha and beta fractions in unfiltered and filtered forms. The most abundant NORM radionuclides in produced water are the natural radioactive elements radium-226 and radium-228 (Neff et al, 2011), therefore these were also examined. Radium 226 and radium 228 were compared to the National Health and Medical Research Council and Natural Resource Management Ministerial Council Australian Drinking Water Guidelines (NHMRC & NRMMC 2011). The principle of environmental radiation protection for flora and fauna is based on the International Commission on Radiological Protection (ICRP) recommendation (ICRP 1991). If people are protected by certain radiological standards, then biota are also protected.

The results and trigger values are provided in **Table 7-11**.

Table 7-11: NORMS activity levels measured in filtered (dissolved) and unfiltered (total) produced water samples

Analyte		Guideline value*	2018	2019	2020	2021	2022
NORMs (Bq/L)	Gross Alpha unfiltered	0.5[a]	11.8	10.5	16.2	8.9	23.1
	Gross Alpha filtered		2.86	10.3	16.0	15.2	13.2
	Gross Beta unfiltered[b]	0.5[a]	14.2	15	16.5	10.3	21.5
	Gross Beta filtered[b]		<5.0	11.5	13.3	17.2	15.2
	Radium 226†	1	2.40	7.51	11.1	7.6	18.0
	Radium 228†	0.1	1.92	6.88	11.6	7.7	13.5

[a] Guideline values for drinking water NHMRC/ARMCANZ (2011).

[b] Excluding K-40

† Guideline values for drinking water WHO (2017).

Whole of Effluent (WET) Toxicity Testing

Full toxicity assessment of produced water was undertaken by Ecotox Services Australia and Hydrobiology Pty Ltd using a sample of produced water collected in August 2017 (Jacobs 2017).

A total of eight toxicity tests were carried out with the produced water sample. The toxicity tests included a range of tropical and temperate Australian marine species and were selected based on their ecological relevance, known sensitivity to contaminants, availability of robust test protocols and known reproducibility and sensitivity as tests species for assessing produced water in marine environments. The tests used were:

- Microalgal 72 hour growth rate inhibition using *Tisochrysis lutea*, previously called *Isochrysis galbana* (chronic, tropical);
- Macroalgal 14 day growth rate inhibition using *Ecklonia radiata* (chronic, sub-tropical/ temperate);
- Copepod 7 day early life stage development test with *Gladioferens imparipes* (chronic, temperate);
- Sea urchin 72 hour larval development with *Echinometra mathaei* (chronic, tropical/ sub-tropical);
- Oyster 48 hour larval development test with *Saccostrea echinate* (chronic, tropical);
- Sea anemone 8 day pedal lacerate development with *Aiptasia pulchella* (chronic, tropical); and
- Fish 7 day imbalance/ biomass using *Lates calcarifer* (chronic, tropical).

As all eight toxicity tests used were chronic, the general fit of the species sensitivity distributions (SSDs) determined provided a good general fit of the SSD curve to the toxicity data and thereby improved the reliability of the safe dilution estimate of produced water required in the receiving environment to achieve environmental performance requirements.

The guideline values derived from the SSD included a concentration that is protective of 95% of species (PC95 = 0.67%), and a concentration which is protective of 99% of species (PC99 = 0.31%). Corresponding safe dilution factor estimates of 1 in 149, and 1 in 322 dilutions, respectively.

7.6.1.3 Single species toxicity assessment

The 2022 Montara PW was toxic to the bacteria (Vibrio fischeri), with an IC50 of 5.8% (Table 7-12). Therefore, only 5.8% PW is required to cause a 50% inhibition in bacterial light output. The IC10 value was 0.8%. The toxicity of the Montara PW to the bacteria was very similar to the 2021 PW sample and decreased from 2020.

Table 7-12: Bacteria (microtox) toxicity data of the PW (%, v/v) over various years

Year of Study	NOEC[a]	IC_{50}[b]	IC_{10}[c]
2020	<0.4%	1.27%	0.097%
2021	0.8%	5.44%	0.9%
2022	0.8%	5.76%	0.85%

a Highest concentration tested to have no significant ($p \leq 0.05$) inhibition in bacterial light output compared to control
b Concentration of the sample to cause 50% inhibition in bacterial light output. In which the lower the IC50, the more toxic the sample.
c Concentration of the sample to cause 10% inhibition in bacterial light output

7.6.1.4 Volumes

The produced water generated during processing of the production fluid stream is discharged at sea surface from the side of the FPSO in batches (that is, an intermittent discharge).

The volumes of produced water discharged from the *Montara Venture* FPSO to the marine environment vary depending on production profiles and rates. **Figure 7-5** displays daily discharge rates between 1 January and 30 June 2018. Daily discharge volumes vary widely from 0 to 5,957 m^3.

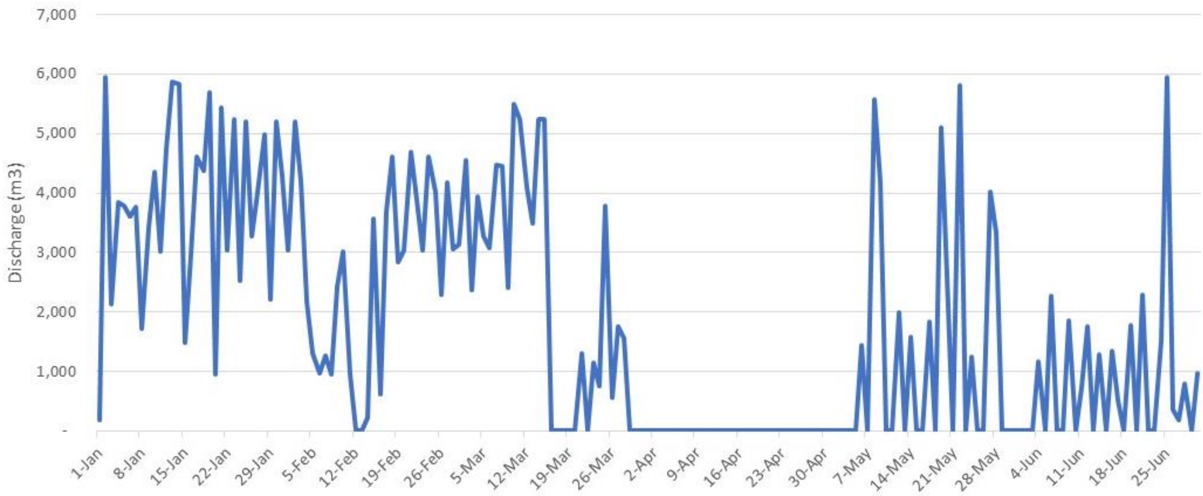


Figure 7-5: Produced water discharge volumes (m^3/d) January to June 2018 from the Montara Venture FPSO

7.6.2 Impacts

7.6.2.1 Area of impact

RPS was engaged to prepare modelling representing the discharge of produced water from the *Montara Venture* FPSO. Modelling (RPS 2018) represented the current discharge arrangements as follows:

- Treated produced water is discharged at sea surface from the side of the FPSO;
- Adjacent to the produced water discharge is the cooling water discharge; and
- The ratio of produced water discharge volume to cooling water discharge volume is 1:4.28. The modelling represented this ratio.

To account for uncertainty of the exact mixing ratio due to cooling water in the receiving environment, additional mixing scenarios of 1:2 and 1:1 due to cooling water influence were considered as well as the 1:4 expected mixing scenario, based on discharge volumes.

The input parameters for the produced water and cooling water discharge streams used in the modelling are provided in **Table 7-13**.

Table 7-13: Produced water and cooling water discharge characteristics applied in modelling

Parameter	Produced water	Cooling water	Co-mingled – summer	Co-mingled – winter
Salinity (ppt)	110	Ambient	48.94	48.69
Temperature (°C)	37	40	39.43	39.43
Flow (m^3/h)	420	1,800	2,220	2,220
Diameter (m)	0.25	0.45	0.5	0.5

The objectives of the modelling study were to:

- Model mixing and dispersion of produced water discharge plume under seasonal receiving water conditions; and
- Model the distance from the release site at which the plume temperature and contaminants comply with environmental guidelines across all seasonal conditions.

Based on the ecotoxicity testing (Jacobs, 2017), RPS was advised that the level of dilution required in the receiving environment to meet water quality management criteria (ANZG, 2018) were:

- Dilution of 1:322 times to meet 99% protection criteria by the edge of the mixing zone; and
- Dilution of 1:149 times to meet 95% protection criteria by the edge of the mixing zone.

Results of the modelling were as follows:

- Scenario 1 – dilution of 1:322 times: for the strong and moderate current circumstances, the required dilutions are achieved in the near-field mixing zone and within 500 m from the discharge location for summer and winter seasons regardless the pre-dilution level due to cooling water influence. For the weak current conditions, required dilution was achieved in the far-field where influence of cooling water had a dilution effect of only 1:1; where cooling water had a dilution effect of 1:2 or 1:4, required dilution was achieved in the near-field.
- Scenario 2 – dilution of 1:149 times: regardless of the level of dilution effect due to cooling water, the required dilutions were predicted to occur for all seasonal and current circumstances in the near-field mixing zone and within 500 m from the discharge location.

A summary of the predicted plume characteristics in the near-field mixing zone is provided in **Table 7-14**.

Table 7-14: Plume characteristics at the end of the modelled near-field mixing zone

Parameter	Summer/ current scenario			Winter/ current scenario		
	Strong	Moderate	Weak	Strong	Moderate	Weak
Distance from source (m)	620.94	247.7	70.31	629.74	244.3	67.88
Dilution (1:S)	1:1,654	1:860	1:148	1:1,621	1:827	1:147
Plume width (m)	63.24	62.7	187.24	63.24	62.64	173.9
Travel time to end of near-field (min)	19.5	13.3	13.5	20.2	15.58	12.8

Modelling of the far-field plume behaviour was then modelled to determine the likely mixing and dispersion of contaminants within the produced water discharge stream. The main objective of the far-field modelling was to predict the extent of the mixing zones under representative environmental conditions by modelling a complete year. The far-field adds to the near-field as it takes into account the time-varying nature of currents as well as the potential for recirculation of the plume back to the discharge location for second dosing with fresh produced water. The discharge was modelled as a 12-month continuous discharge. This is a conservative assumption as the discharge is typically only intermittently discharged for 1 to 18 hours.

A summary of the far-field modelling results is provided in **Table 7-15** for each scenario due to mixing with the cooling water discharge stream.

For the purposes of impact management in this EP, the 1:1 discharge scenario has been assumed as this is the most conservative mixing scenario for the produced water discharge (i.e. the biggest impact footprint).

Table 7-15: Summary of maximum distance to achieve required 1:322 dilutions to meet 99% species protection criteria

Cooling water effect	Maximum distance from source (m)	Total area (km^2)
1:1	340	0.14
1:2	150	0.075
1:4	51	0.0096

Based on the modelling results summarised above, the predicted area of impact due to produced water discharge from the *Montara Venture* FPSO is depicted in **Figure 7-6**.

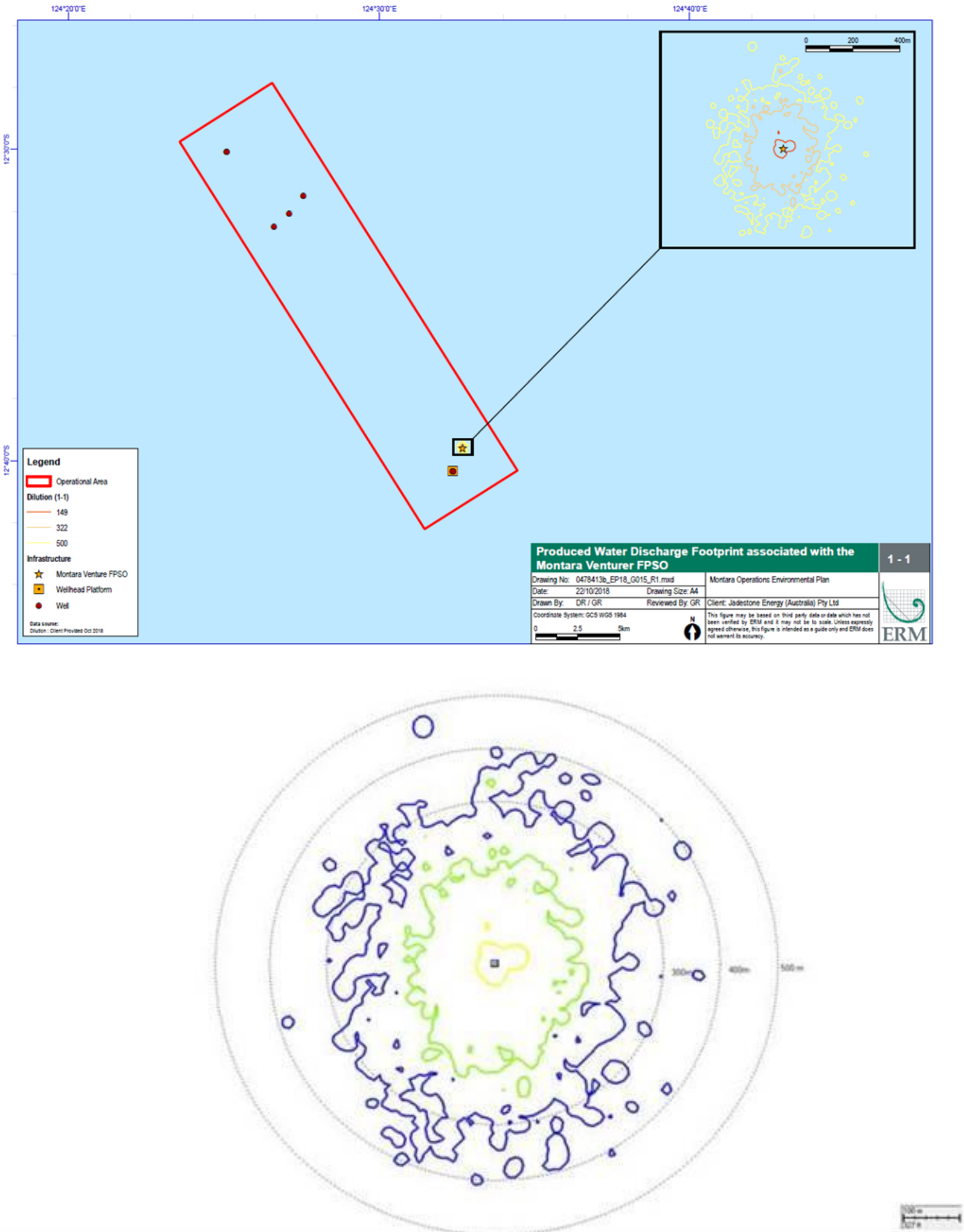


Figure 7-6: Predicted produced water discharge impact area in a locality context (top), and enlargement to show the discharge area (bottom)

7.6.2.2 Contaminants of concern

Potential impacts to sensitive receptors from discharged produced water may be attributable to dissolved hydrocarbons and suspended oil droplets, naturally occurring radioactive materials (NORMs), dissolved metals and nutrients as well as low residual concentrations of a small number of process chemicals such as corrosion and scale inhibitors and biocides. Hydrocarbons, however, are considered the constituent of most concern to marine fauna, particularly polycyclic aromatic hydrocarbons (PAHs).

Hydrocarbons

Dissolved hydrocarbons in produced water comprise monocyclic aromatic hydrocarbons (MAH), such as BTEX (benzene, toluene, ethylbenzene and xylene), and lower molecular weight polycyclic aromatic hydrocarbons (PAHs) such as naphthalene, phenanthrene and their alkyl homologues (Neff *et al*., 2011a).

Hydrocarbon exposure may lead to mortality in marine organisms as well as sub-lethal chronic (long exposure) effects such as decreased genetic diversity in communities, decreased growth and fecundity, lower reproductive success, respiratory problems, behavioural and physiological problems, decreased developmental success and endocrine disruption (Neff *et al*., 2011a). It is generally agreed that within produced water the components of greatest threat to the environment are the more persistent hydrocarbons, primarily PAHs (Neff et al., 2011a), which can bioaccumulate within marine organisms (that is, increase in tissue of marine organisms over time; see Bioaccumulation below).

Metals

The type and concentration of trace metals within produced water depends on the geology of the reservoir formation from which it is produced (Neff et al., 2011a). The metals most frequently found at elevated concentrations in produced water include barium, iron, manganese, mercury and zinc (Neff *et al*., 2011a).

As with hydrocarbons, dissolved metals may create impacts to marine organisms if present at high enough concentrations. Some metals also have the potential to bioaccumulate within marine organisms. ANZECC/ ANZG (2018) suggest the heavy metals mercury, selenium and cadmium have the greatest potential for bioaccumulation and secondary poisoning, although bioaccumulation may occur for a range of metals.

Metal-bioaccumulation, is a complex process and depends upon the concentration and bioavailability of metals and physiology of individual species and can vary greatly among species in the same environment (Luoma and Rainbow, 2005).

Heavy metals in produced water undergo a series of chemical reactions once they enter seawater and ultimately precipitate out as metal hydroxides or sulphides. Metals present in marine sediments as hydroxides or sulphides are not generally available for biological uptake.

Nutrients

Elevated nutrient levels can lead to increased bacterial and phytoplankton production (e.g. phytoplankton blooms). In nutrient poor waters such as those in offshore marine environments, introduction of dissolved nutrients such as ammonia and nitrate to surface waters where high light levels are available will lead to rapid uptake by phytoplankton with associated increased biomass. Increased biomass will be a highly-localised feature (within tens of metres) associated with the availability of dissolved nutrients.

NORMs

Naturally occurring radioactive materials (NORMs) are present within geological formations and are typically found in produced water. Within produced water the most abundant radionuclides are ^{226}Ra and ^{228}Ra, derived from the radioactive decay of ^{238}U and ^{232}Th, respectively (Bou-Rabee *et al*., 2009). Other radionuclides have been identified in produced water including ^{212}Bi, ^{214}Bi, ^{228}Ac, ^{210}Pb, ^{212}Pb and ^{214}Pb, however, activities of these radionuclides are typically lower than that of ^{226}Ra and ^{228}Ra (Bou-Rabee *et al*., 2009).

When formation water is brought to the surface, the rapid drop in temperature and pressure causes NORMs (primarily ^{226}Ra and ^{228}Ra) to precipitate out, which may result in accumulation of sludge and hard scales in the gas processing equipment (OGP, 2005). However, ^{226}Ra and ^{228}Ra may also remain dissolved within produced water.

A review of the ^{226}Ra and ^{228}Ra concentrations in produced water by Neff *et al*. (2011a) across discharges worldwide indicated that ^{226}Ra activity ranges from 0.002 to 1,119 Bq/L and ^{228}Ra activity ranges from 0.3 to 180 Bq/L. This compares to natural levels within ocean surface waters of 0.001–0.0015 Bq/l and 0.0002–0.0011 Bq/L for ^{226}Ra and ^{228}Ra, respectively (Neff *et al*., 2011a).

The environmental risk around radioisotopes in produced water is due to ionising radiation (alpha, beta and gamma radiation). Within produced water the radioisotopes of primary concern are ^{226}Ra and ^{228}Ra, which are more likely to be dissolved within produced water than other NORMs, and which have the relatively longest half-lives of 1,601 and 5.7 years, respectively (i.e. they show greatest persistence in the marine environment).

The principal radionuclide of concern is ^{226}Ra for which studies into health and ecological impact have been carried out (OGP, 2005). A food web study by Brookhaven National Laboratory in the Gulf of Mexico concluded that there would be no detectable impacts on fish, molluscs and crustaceans and the environmental risk of discharge within Gulf of Mexico is small (OGP, 2005). The MARINA II study conducted in the North Sea determined that the offshore oil and gas industry was the largest contributor of alpha radiation emitters in the North Sea but that the discharges were of insignificant risk to the health of marine life or humans (OGP, 2005).

7.6.2.3 Impact mechanisms

Bioaccumulation

Chronic exposure to a contaminant can lead to bioaccumulation of the contaminant within marine organisms over time (accumulation of chemicals from the water or from food sources into tissues over time). ANZECC/ ANZG (2018) guidelines provide an indication of chemicals for which possible bioaccumulation and secondary poisoning effects should be considered. These include PAHs and the heavy metals mercury, selenium and cadmium.

Uptake of PAHs can occur in all marine organisms to varying levels; however, there is a wide range in tissue concentrations from variable environmental concentrations, level and time of exposure, and species ability to metabolise these compounds (Meandor et al. 1995). Since the elimination of PAHs is generally very efficient in fish and other vertebrates, bioaccumulation of PAH within these taxa do not generally reflect their level of exposure (van der Oost et al. 2003). Instead bioaccumulation of PAH has been mainly recorded within invertebrates which are less efficient at metabolising PAH.

Hydrocarbon taint

Elevated hydrocarbon levels in fish flesh have the potential to impact humans if affected fish species are targeted by fisheries. When present in foods, petroleum hydrocarbons stimulate an olfactory response in humans that causes a tainting of flavour or taste. Connell and Miller (1981) compiled a summary of studies listing the threshold concentrations at which tainting occurred for hydrocarbons. The results contained in their review indicate that tainting of fish occurs when fish are exposed to ambient concentrations of 4–300 ppm (mg/L) of hydrocarbons in the water, for durations of 24 hours or more, with response to phenols and naphthenic acids being the strongest.

Accumulation of contaminants in sediments

While the produced water plume from the *Montara Venture* FPSO primarily influences the quality of localised surface waters, there is the potential for particles and associated contaminants (e.g. higher molecular weight PAHs), to drop out of the plume in the far-field mixing zone (Neff et al. 2011a). These components of the produced water then have the potential to accumulate in sediments, resulting in longer term contamination.

Jadestone conducted sediment quality monitoring of the sediments surrounding the FPSO in September 2021. All metals and metalloids were below ANZG (2018) default guideline values (DGVs) in the sediment at each site sampled. Four of the metals had no DGVs including barium, manganese, molybdenum and cobalt. Silver, molybdenum and mercury were also below the laboratory limits of reporting (LOR) at each site.

Cobalt concentrations in the sediment at the reference sites ranged from 1.6 to 2.0 mg/kg; all of the sites around the FPSO were within this range. Manganese concentrations in the sediment at the reference sites ranged from 79 to 87 mg/kg, while the manganese concentrations in the sediment at the sites sampled around the FPSO ranged from 53 to 96 mg/kg. Barium was lowest at the reference sites ranging from 9.4 to 10 mg/kg and highest at sites SW3 (270 mg/kg), SW4 (260 mg/kg), W (250 mg/kg) and S (median 150 mg/kg), these sites were closest to the well head platform where drilling was being undertaken. The European Chemicals Agency (ECHA) has a PNEC for barium in freshwater sediments of 589.9 mg/kg while there is no hazard identified for barium in marine sediments (https://echa.europa.eu/registration-dossier/-/registered-dossier/19625/6/1). Barium transported into marine systems combines with sulfate ions present in salt water to form barium sulfate. Barium compounds that do not dissolve well in water are not generally harmful therefore the precipitation of barium as a sulfate salt reduces its potential for adverse health effects.

Biomagnification

Biomagnification occurs when concentrations in the tissues of one organism exceed those in its food or in an adjacent trophic level (Reinfelder et al. 1998). Biomagnification of PAHs is possible in invertebrate food webs (Jorgensen 2010), although unlikely to occur within food chains comprising marine vertebrates (e.g. fish, marine reptiles and mammals and seabirds).

In a field study, PAHs in lower order consumers (molluscs) were shown to be higher than in higher order consumers (fish and decapod crustaceans) indicating biomagnification of PAH was unlikely to be occurring (Takeuchi et al. 2009). Organisms at higher trophic levels tend to show increased ability to metabolise PAHs indicating that biomagnification of PAH up the food chain is unlikely to occur (Takeuchi et al. 2009).

In terms of metals, biomagnification of inorganic mercury (as methyl-mercury) in aquatic food webs has been observed in a number of studies with highest concentrations in the long-lived high order consumers (Cabanna and Rasmussen 1994, Bowles et al. 2001, Power et al. 2002). However, for other metals biomagnification into higher trophic levels is not believed to occur (Fisher and Reinfelder 1995, Miramand et al. 1998, Gray 2002). Instead concentration within a trophic level is mainly determined by the feeding strategy of the particular species at that trophic level (Rainbow 2002).

7.6.2.4 Potential impacts to sensitive receptors

Pelagic environment

WET testing of produced water discharged from *Montara Venture* FPSO captured potential additive effects of constituents of the produced water. The WET testing determined that after sufficient dilution (assessed as 322:1 dilution) 99% species protection limits will be met. The spatial scale of the area of impact is described in **Section 7.6.2.1** and it accommodates this dilution for 99% species protection.

NORMs within produced water discharged from *Montara Venture* FPSO have been measured up to 23 and 21 Bq/L (alpha/beta, respectively) which is at the lower range of levels recorded in produced water samples worldwide (Neff et al., 2011a). Given that studies from regions of very active oil and gas regions have not concluded significant environmental impacts from NORMs it is not predicted that NORMs in discharged produced water will lead to significant environmental impacts.

Plankton and invertebrates

Components of the plankton that could be impacted by produced water include micro-invertebrates; eggs; larvae of invertebrates; and fish. Acute effects include lysis of single-celled organisms and narcosis of motile invertebrates leading to impaired swimming ability.

The predicted small scale of the area of impact suggests that exposure impacts (sub-lethal or lethal) from produced water are likely to be insignificant at population or ecosystem scales. There are no nearby hard coral areas that would suggest that impacts from produced water on hard coral eggs and larvae would occur during coral spawning season (peaking in March/ April).

In addition to invertebrates within the plankton assemblage, larger pelagic invertebrates (e.g. jellyfish, squid, salps) may be present in the area of the discharge activity. Based on WET testing of produced water, impacts could occur to these invertebrates within the discharge area of impact.

Macro-invertebrates present in surface waters are expected to be mobile and while they may be exposed to produced water and may experience sub-lethal effects such as impaired mobility, these effects will be short-term and will recover rapidly once outside the area of impact of the produced water discharge (approximately 340 m from the discharge point).

Fish and fisheries

Effects may be experienced by pelagic fish within the produced water discharge area of impact. Impacts to pelagic fish are likely to be caused by exposure to dissolved hydrocarbons (e.g. BTEX hydrocarbons) or metals across gill structures, although impacts could also occur through ingestion of hydrocarbon droplets. PAHs are the hydrocarbon of most concern in terms of long-term exposure to produced water. While PAH concentrations may be elevated in fishes exposed to the discharge, the elimination of PAHs is generally very efficient in fish and other vertebrates and bioaccumulation of PAH within these taxa do not generally reflect their level of exposure (van der Oost et al., 2003).

No fishing is permitted within the 500 m exclusion zone around the *Montara Venture* FPSO. Given that the area of impact for produced water discharge lies within this exclusion zone, no impact to fish targeted by nearby fisheries is predicted.

Furthermore, for the actively fished commercial fisheries in the area, the approved fishing area is extensive for the purposes of flexibility and boundary simplicity, rather than being a true representation of where catch and effort is actually undertaken. Although the habitat within the operational area may represent suitable habitat for some of the commercial species (**Section 5.3.4**), in reality fishing effort for these species will be focussed on areas of most suitable habitat and away from constraints such as infrastructure. Noting only one fishery (the Northern Demersal Scalefish Managed Fishery (WA)) has recent recorded catch in the Operations Area and its immediate vicinity (2015-2017). Although some of the larger fish species may be transient through the operational area and then travel significant distances to active fishing grounds, this was not considered a significant risk.

EPBC species

With regards to impacts to protected matters, a conservative 1 km search radius from the *Montara Venture* FPSO was used to conduct the EPBC protected matters search to cover the risk of produced water discharges. For noting, the 1 km radius EPBC protected matters search area used is well beyond the 340 m radial distance from the FPSO for mixing of produced water discharge.

The search found 22 listed threatened species and 35 migratory species that may or do occur within the discharge impact area. No Australian marine parks were identified as occurring within the Operational area.

The Conservation advice for the whale shark identifies habitat disruption from the resource sector as a minor threat to the species (SPRAT Whale shark, DEE 2017as). Whale sharks spend the majority of their time in deeper waters, and would avoid the surface produced water plume, however it may have a small indirect effect on plankton which is a food source for whale sharks (Meekan 2008). The predicted small scale of the area of impact however suggests that exposure impacts (sub-lethal or lethal) from produced water is not likely to significantly impact whale shark food sources (as described above in impacts to fish).

Blue whale migration is thought to follow deep oceanic routes, although little is known about their precise migration routes (DoEE 2017b). Observations suggest most Pygmy Blue whales pass along the shelf edge out to water depths of 1,000 m depth contour. The Operational area does not include any recognised blue whale migratory routes or known feeding, breeding or resting areas. However, low numbers of blue whales migrating to and from Indonesian waters may occasionally pass through the Operational area, most likely during the southern migration (October to November) (DoEE 2017b).

The conservation management plan for pygmy blue whales identifies the threats of whaling, acute and chronic chemical discharge, climate variability and change, noise interference and vessel disturbance. The discharge of produced water is not considered likely to have any impact on the species or habitat used by the species due to the small area affected by the produced water discharge in spatial extent and depth, relative to the habitat range of the species considered.

As such, with the controls on place the impacts from produced water was assessed as localised within the mixing zone boundary with a consequence assessment of ***Negligible.***

7.6.3 Environmental performance

Hazard		Discharge of produced water						
Performance outcome		Produced water discharges achieve the national marine water quality guidelines for protection of 99% of species as defined by ANZG (2018) at the boundary of the area of impact						
		Planned operations		Contingency operations		Adaptive Management		Responsibility
ID	Management Control	Performance standard	Measurement criteria	Performance standard	Measurement criteria	Performance standard	Measurement criteria	
	Monitoring							
018	Daily discharge of PW is monitored and recorded spec as per Produced Water System (MV-19-PR-G-00001)	Daily discharge rate from the FPSO does not exceed 9,500 kL	Daily report shows PW volume discharged not >9,500 kL	If total daily volume approaches 9,500 kL, calculate total oil load discharged for the day (i.e. [OIW] x volume discharged) and ensure the total load does not exceed 145 kg oil/d [6]	Daily report shows a total oil load does not exceed 145 kg	If an increase in total daily discharge load is required, undertake MoC to determine if changes to risks and impacts (as per **Section 4**) as provided for in the EP. If new or significant increases to risks and impacts are expected, revise EP and submit to NOPSEMA for acceptance	Completed Management of Change process	OIM

[6] The rationale of calculating a discharged daily load of oil recognises multiple components of a discharge contribute to pollution of the environment – as well as the volume it is also the quality of the discharge that needs to be considered when evaluating environmental performance.

Hazard		Discharge of produced water						
Performance outcome		Produced water discharges achieve the national marine water quality guidelines for protection of 99% of species as defined by ANZG (2018) at the boundary of the area of impact						
		Planned operations		Contingency operations		Adaptive Management		Responsibility
ID	Management Control	Performance standard	Measurement criteria	Performance standard	Measurement criteria	Performance standard	Measurement criteria	
	Monitoring							
019		Batch average OIW concentration measured by inline spec is < 18 ppmV[7]	Daily report shows batch average OIW concentration < 18 ppmV	Inline spec of OIW concentration >36ppmV overboard discharge ceases	CCR Log shows if discharge diverts inboard			Operations Supervisor
020		Produced water is monitored for TPH and EOM fortnightly	Fortnightly data reporting on TPH and EOM concentrations					Operations Supervisor
021		If inline spec is not operational, lab sampling to be done every three hours	Daily report shows OIW concentrations <18 ppmV batch average	If manual sample results show a concentration above 18 ppmV increase manual monitoring frequency to every two hours	Daily report shows OIW concentrations <18 ppmV batch average			Operations Supervisor

[7] The calculation of mg/L to ppmV is 0.85, therefore <15 mg/l (measured as <18 ppmv by in line meter) and <30 mg/l (measured as <36 ppmv by in line meter).

Hazard		Discharge of produced water						
Performance outcome		Produced water discharges achieve the national marine water quality guidelines for protection of 99% of species as defined by ANZG (2018) at the boundary of the area of impact						
		Planned operations		Contingency operations		Adaptive Management		Responsibility
ID	Management Control	Performance standard	Measurement criteria	Performance standard	Measurement criteria	Performance standard	Measurement criteria	
	Monitoring							
022	HACH hand held turbidity meter operating manual	Weekly monitoring of the produced water discharge finds a turbidity less than 322 NTU	Prod Tech record keeping sheet shows produced water turbidity <322 NTU	If weekly sample shows a turbidity above 322 NTU, increase monitoring frequency to daily for one week	Prod Tech record keeping sheet shows produced water average turbidity of daily results is <322 NTU	If the average of the daily NTU measurements are above 322 NTU, a sample of produced water will be collected and analysed for particle size distribution	Particle Sized Distribution of the produced water sample shows >50% of particles are less than 40 µm in size	Operations Supervisor
	Calibration[8] & assurance							
023	Equipment is successfully calibrated as per MV-19-PR-P-00005 and MV-14-PR-M-00015	Prior to batch start-up inline spec is calibrated within tolerance requirements	Calibration results recorded by Prod Technicians	If inline spec does not successfully calibrate, manual sampling to be done every three hours if OIW <18 ppmV, and every two hours if OIW >18 ppmV	Daily report shows OIW concentrations <18 ppmV batch average			Maintenance Supervisor

[8] For noting, successful calibration for all instruments listed in this section of the performance table used for measurement of produced water discharges is assumed to be achieved if the instrument accepts the reading of the calibration standard and does not reject the standard measurement, notified by the instrument as an error. This is as per the calibration procedure provided by the vendor of the instrumentation.

Hazard		Discharge of produced water						
Performance outcome		Produced water discharges achieve the national marine water quality guidelines for protection of 99% of species as defined by ANZG (2018) at the boundary of the area of impact						
		Planned operations		Contingency operations		Adaptive Management		Responsibility
ID	Management Control	Performance standard	Measurement criteria	Performance standard	Measurement criteria	Performance standard	Measurement criteria	
	Monitoring							
024		Accuracy of hand-held meter checked weekly	Check results recorded by Production Technicians	If check unsuccessful, calibrate handheld meter according to manufacturer's specs	Calibration results recorded by competent person	Raise a work order to repair/ replace hand held meter as required	Corrective work order successfully closed out	Operations Supervisor
025		Six monthly calibration and service of inline spec by prod tech	Calibration results recorded by competent person, and completed maintenance records	If calibration unsuccessful, reattempt calibration of the inline spec Raise a work order and repair/replace inline spec	Calibration results recorded by competent person Corrective work order successfully closed out			Operations Supervisor
26		Annual service and calibration by third-party	Calibration results recorded by competent person, and completed maintenance records	If calibration unsuccessful, reattempt calibration of the inline spec Raise a work order and have the vendor repair / replace inline spec	Calibration results recorded and corrective work order successfully closed out			Operations Supervisor

Hazard		Discharge of produced water						
Performance outcome		Produced water discharges achieve the national marine water quality guidelines for protection of 99% of species as defined by ANZG (2018) at the boundary of the area of impact						
		Planned operations		Contingency operations		Adaptive Management		Responsibility
ID	Management Control	Performance standard	Measurement criteria	Performance standard	Measurement criteria	Performance standard	Measurement criteria	
	Monitoring							
	Maintenance							
027	Equipment maintained as per Produced Water System (MV-19-PR-G-00001)	Inline OIW spec serviced weekly by production technician	Completed maintenance records					Operations Supervisor
	Measurement							
029	Montara Produced Water Monitoring & Management Framework (TM-70-PLN-I-00001)	Annual characterisation of contaminants in PW	Check contaminant concentrations are acceptable by applying a 1:322 dilution rate to concentrations and are < 99% ANZG (2018) guideline values	If contaminant concentration/s will not be sufficiently diluted to required background levels undertake WET testing of relevant effluent stream	WET testing results show a 1:322 dilution requirement of discharge stream is still achievable	If WET testing shows PW does not meet 1:322 dilution requirements, undertake MoC to determine if changes to risks and impacts (as per **Section 4**) as provided for in the EP. If new or significant increases to risks and impacts are expected, revise EP and submit to NOPSEMA for acceptance.	Completed Management of Change process	Environment Lead

Hazard		Discharge of produced water						
Performance outcome		Produced water discharges achieve the national marine water quality guidelines for protection of 99% of species as defined by ANZG (2018) at the boundary of the area of impact						
		Planned operations		Contingency operations		Adaptive Management		Responsibility
ID	Management Control	Performance standard	Measurement criteria	Performance standard	Measurement criteria	Performance standard	Measurement criteria	
	Monitoring							
030		Annual in situ marine water quality monitoring	Check contaminant concentrations against ANZG (2018) guideline values	If one or more samples are above the trigger values, one sample t-test determine if difference is significant	T-test result(s) <0.05	If results indicate a mixing zone greater than in the in-force EP by more than 10% undertake WET testing within 3 months	WET test results	Environment Lead
031		Three-yearly in situ marine sediment quality monitoring	Check contaminant concentrations against ANZG (2018) SQG low guidelines	If one or more samples are above the guideline values, one sample t-test determine if difference is significant	T-test result(s) <0.05	Conduct modelling to determine if predicted extent of impact is outside the mixing zone within the in-force EP	Modelling results	Environment Lead

Hazard		Discharge of produced water						
Performance outcome		Produced water discharges achieve the national marine water quality guidelines for protection of 99% of species as defined by ANZG (2018) at the boundary of the area of impact						
		Planned operations		Contingency operations		Adaptive Management		Responsibility
ID	Management Control	Performance standard	Measurement criteria	Performance standard	Measurement criteria	Performance standard	Measurement criteria	
	Monitoring							
032		WET testing every three years of PW discharge with the first test to occur in 2020	WET testing results less than 2017 results used to determine mixing zone (i.e. 1:322 dilution)	If WET testing results >2017 results, re-run mixing zone modelling to determine if extent of mixing zone increases	Modelling shows no change in extent of PW discharge plume	If mixing zone area is predicted to increase based on WET results, undertake MoC to determine if changes to risks and impacts (as per **Section 4**) as provided for in the EP. If new or significant increases to risks and impacts are expected, revise EP and submit to NOPSEMA for acceptance.	Completed Management of Change process	Environment Lead

Hazard		Discharge of produced water						
Performance outcome		Produced water discharges achieve the national marine water quality guidelines for protection of 99% of species as defined by ANZG (2018) at the boundary of the area of impact						
		Planned operations		Contingency operations		Adaptive Management		Responsibility
ID	Management Control	Performance standard	Measurement criteria	Performance standard	Measurement criteria	Performance standard	Measurement criteria	
	Monitoring							
	Production & processing							
033	Chemical Selection and Approval Procedure (JS-70-PR-I-00033) details requirements of risk assessment for production chemicals	Production chemicals to be assessed and approved for use before application according to the process outlined on page 32 of the Procedure.	Approval record					OIM

Hazard		Discharge of produced water						
Performance outcome		Produced water discharges achieve the national marine water quality guidelines for protection of 99% of species as defined by ANZG (2018) at the boundary of the area of impact						
		Planned operations		Contingency operations		Adaptive Management		Responsibility
ID	Management Control	Performance standard	Measurement criteria	Performance standard	Measurement criteria	Performance standard	Measurement criteria	
	Monitoring							
034	Production chemicals dosed to the production processing system regularly monitored (MV-02-PR-P-00002)	Production chemicals to be added to the system at a dosage rate as prescribed in the chemical approval request	Production Technician checks dosage rate on all running chemical systems and records measurements in the log sheet					Operations Supervisor
035	Change management process details the requirement for risk and impact assessment prior to change to operation	Production fluids to be processed as per the activity description in the EP	Daily reporting shows production is as per planned activity			If a new reservoir section is added to production stream, the impact assessment process for PW must be repeated	Repeat of impact assessment process as per **Figure 7-5** of new PW stream finds no change to the mixing zone	Operations Supervisor
036						If a change to the production processing equipment occurs, impact assessment process for PW must be repeated	Repeat of impact assessment process as per **Figure 7-5** of new PW stream finds no change to the mixing zone	Operations Supervisor

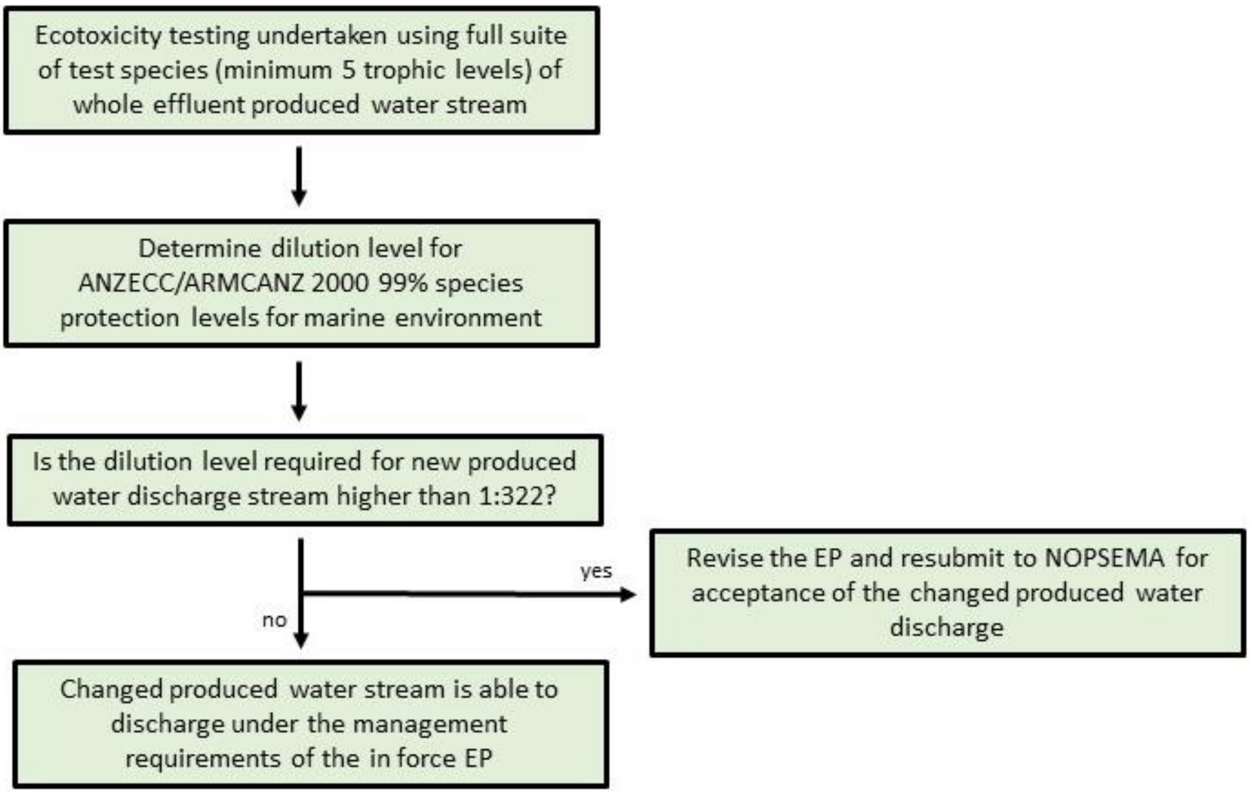


Figure 7-7: Impact assessment process for produced water discharge from the Montara Venture FPSO

7.6.4 ALARP assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage produced water discharges from the FPSO to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Tolerable as they are within the green category (negligible impacts). No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
Contain all PW and transfer to shore for onshore treatment and disposal	Eliminate	No	No	The daily discharge volume would require multiple trips to shore. Containment would require storage on tanker for approx. 2 weeks, mooring system would be required, offtake tanker or swap for another one. Increases risk of vessel collision incident with increased frequency of vessel trips. SIMOPS additional vessel in field, additional costs for treatment and disposal onshore
Reinjection of produced water to the reservoir	Substitute	Yes	No	Drilling of a well to allow reinjection of produced water to the reservoir would cost in the order of $15 to 20 million. Given the expected environmental impacts associated with discharge of produced water, the environmental benefit that would be gained

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage produced water discharges from the FPSO to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Tolerable as they are within the green category (negligible impacts). No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
				from reinjection of produced water would not be commensurate to the cost required.
Process polishing	Engineering	Yes	No	Additional modifications to the treatment system include a coalescer package and additional automation to allow monitoring of OIW during continuous over-boarding. Design expectation is to reduce OIW relative to current readings. While improvements in produced water quality can be achieved at this time purchasing and installation costs in disproportionate to the benefit that would be achieved.
N/a	Administrat-ive	N/a	N/a	The primary means of reducing the risk of environmental impacts from the composition of these chemicals is through the implementation of Jadestone's Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033) which promotes the use of environmentally low risk chemicals based on ecotoxicity data and information gathered from ChemAlert. Production chemicals are required to be added to the production process to ensure the process is operating efficiently.
N/a	Administrat-ive	N/a	N/a	The quantity of chemicals used in the production process, and therefore the residual concentration discharged within produced water, is reduced to as low as practicable through routine sampling and assessment from various points in the production process. Concentrations of these chemicals have optimal levels; dosages need to be maintained above certain levels to meet the production requirements but excessive levels are reduced to reduce costs and the potential for environmental impacts from discharge of produced water.

7.6.5 Acceptability assessment

The potential impacts of produced water discharges are considered 'Acceptable' in accordance with the Environment Regulations, based on the acceptability assessment provided in the table below, and as per **Section 4.3**. In particular, the acceptability assessment provided below presents the risks, acceptable level of impact and an assessment of impact for each of the following environmental values:

- Water;
- Fauna and habitat;
- Commercial fishing; and
- Principles of ecologically sustainable development.

For each environmental value, a Summary of the acceptable level of impact is provided at the end of each sub-section within the table.

Impact aspect	Acceptable level of impact	Assessment
Water		
Consideration: the key contaminants of concern in produced water are hydrocarbons, naturally occurring radioactive materials (NORMs), dissolved metals and nutrients. These contaminants may be associated with the water fraction, and/ or the particulate fraction, of the discharge stream.		
Hydrocarbons are considered the constituent of most concern to marine fauna within produced water, particularly polycyclic aromatic hydrocarbons (PAHs). Hydrocarbon exposure may lead to mortality in marine organisms as well as sub-lethal chronic (long exposure) effects such as decreased genetic diversity in communities, decreased growth and fecundity, lower reproductive success, respiratory problems, behavioural and physiological problems, decreased developmental success and endocrine disruption (Neff *et al*., 2011a).	Water quality concentrations for hydrocarbons, metals and nutrients meet the 99% species protection guidelines for contaminants (ANZG, 2018) after accounting for the 1:322 required dilution rate. For noting, the 99% species protection limits provide for the management of bioaccumulation/	Components of the plankton that could be impacted by produced water include micro-invertebrates; eggs; larvae of invertebrates; and fish. In addition to invertebrates within the plankton assemblage, larger pelagic invertebrates (e.g. jellyfish, squid, salps) will be present around the Facility. The attached assemblages have an increased frequency and duration of exposure to the discharge stream given their fixed placement in the receiving environment. For motile species within the open water plankton assemblage, the exposure is limited in frequency (perhaps one-off events with the exception of motile species that may return to the artificial structure of the CPF and become exposed again), and duration given they are not held at one point in the environment. Pathways of exposure to the contaminants within the produced water stream include uptake of dissolved constituents (e.g. volatile, low molecular weight hydrocarbons such as BTEX hydrocarbons) across cellular structures, ingestion (filter feeding) of higher molecular weight hydrocarbons (e.g. PAHs associated with suspended oil droplets) or precipitated
Dissolved metals may create impacts to marine organisms if present at high enough concentrations and some metals have the		

Impact aspect	Acceptable level of impact	Assessment
potential to bioaccumulate, in particular mercury, selenium and cadmium (ANZG (2018)	biomagnification processes.	metals which may be bound to organic particulate matter that is small enough to remain buoyant (i.e. <63 µm in size). Impacts include acute effects at high concentrations such as lysis of single-celled organisms and narcosis of motile invertebrates leading to impaired swimming ability. Bioaccumulation of hydrocarbons (e.g. PAHs) and metals (in particular, Hg, Se and Cd) is most likely to occur in sessile invertebrates attached to the FPSO hull close to the discharge location experiencing repeated exposure. Included in this assemblage are macroalgae and macroinvertebrates (e.g. tunicates, soft coral, molluscs). The area of impact for the water column environment is predicted to be small scale (up to 340 m from the discharge point before reaching 99% species protection concentrations) and is therefore unlikely to be significant at population or ecosystem scales for the organisms exposed to the discharge stream.
Elevated nutrient levels can lead to increased bacterial and phytoplankton production (e.g. phytoplankton blooms). In nutrient poor waters such as those in offshore marine environments, introduction of dissolved nutrients such as ammonia and nitrate to surface waters where high light levels are available will lead to rapid uptake by phytoplankton with associated increased biomass.		Increased water column biomass will be a highly-localised feature (within tens of metres) associated with the availability of dissolved nutrients. The influence of produced water on nutrient levels within the water column is predicted to dissipate within 340 m of the discharge point and does not exceed ANZG (2018) 99% species protection concentrations beyond this distance.
Within produced water the radioisotopes of primary concern are ^{226}Ra and ^{228}Ra, which are more likely to be dissolved within produced water than other NORMs, and which have the relatively longest half-lives of 1,601 and 5.7 years, respectively (i.e. they show greatest persistence in the marine environment).	Radium 226 and radium 228 meet the National Health and Medical Research Council and Natural Resource Management Ministerial Council Australian Drinking Water Guidelines (NHMRC & NRMMC 2011). after	The environmental risk around radioisotopes in produced water is due to ionising radiation (alpha, beta and gamma radiation). Ionising radiation is high in energy and can break chemical bonds of exposed atoms. In some cases in which the ionising energy is high enough, the nucleus of an atom may be damaged or destroyed, and in the circumstance of an organism’s cell being exposed, the DNA may be damaged leading to mutations (Gordon, 1957). Within produced water the radioisotopes of primary concern are ^{226}Ra and ^{228}Ra, which are more likely to be dissolved within produced water than other NORMs, and which have the relatively longest half-lives of 1,601 and 5.7 years, respectively (i.e. they show greatest persistence in the marine environment) (OGP, 2005). A food web study by Brookhaven

<table>
<tr><th>Impact aspect</th><th>Acceptable level of impact</th><th>Assessment</th></tr>
<tr><td></td><td>accounting for the 1:322 dilution rate.</td><td>National Laboratory in the Gulf of Mexico concluded that there would be no detectable impacts on fish, molluscs and crustaceans and the environmental risk of discharge within Gulf of Mexico is small (OGP, 2005). The MARINA II study conducted in the North Sea determined that the offshore oil and gas industry was the largest contributor of alpha radiation emitters in the North Sea but that the discharges were of insignificant risk to the health of marine life or humans (OGP, 2005).

Jadestone completed water quality analysis of NORMs in produced water samples to evaluate water quality for radioactivity and to determine whether they are associated with the particulates in the PW or the dissolved fraction by examining gross alpha and beta fractions in unfiltered and filtered forms. Radium 226 and radium 228 were also compared to the National Health and Medical Research Council and Natural Resource Management Ministerial Council Australian Drinking Water Guidelines (NHMRC & NRMMC 2011).

Gross alpha and gross beta concentrations were lower than guideline values with dilutions taken into account. Similarly, Radium-226 and radium-228 concentrations were lower than guideline values with dilutions considered.</td></tr>
<tr><td colspan="3">Summary: monitoring and measurement of the produced water discharge demonstrates that the marine water quality trigger values recommended by ANZG (2018) for the protection of 99% species are met when taking into account a 1:322 dilution, as required by the Area of Impact showing that the discharge has an acceptable level of impact on water quality of the receiving environment.</td></tr>
<tr><td colspan="3">Fauna and habitat values (incl. recovery plans and conservation advices)</td></tr>
<tr><td colspan="3">Consideration: The Area of Impact for the discharge of the produced water from the FPSO coincides with habitats that support fauna with conservation status, or the fauna directly.</td></tr>
<tr><td>The facility and produced water discharge environment overlaps with the whale shark and pygmy blue whale BIAs.</td><td>Produced water discharges do not contravene management objectives of fauna and habitat values as identified in bioregional plans, including recovery plans and conservation advices</td><td>Conservation advice for the whale shark identifies habitat disruption from the resource sector as a minor threat to the species (SPRAT Whale shark, DEE 2017as). Whale sharks spend the majority of their time in deeper waters, and would avoid the surface produced water plume, however it may have a small indirect effect on plankton which is a food source for whale sharks (Meekan 2008). The predicted small scale of the area of impact however suggests that exposure impacts (sub-lethal or lethal) from produced water is not likely to significantly impact whale shark food sources.

Blue whale migration is thought to follow deep oceanic routes, although little is known about their precise migration routes (DoEE 2017b). Observations suggest most pygmy blue</td></tr>
</table>

Impact aspect	Acceptable level of impact	Assessment
		whales pass along the shelf edge out to water depths of 1,000 m depth contour. The Operational area does not include any recognised blue whale migratory routes or known feeding, breeding or resting areas. However, low numbers of blue whales migrating to and from Indonesian waters may occasionally pass through the Operational area, most likely during the southern migration (October to November) (DoEE 2017b). The conservation management plan for pygmy blue whales identifies the threats of acute and chronic chemical discharge, whaling, climate variability and blue whale change, noise interference and vessel disturbance. The discharge of produced water is not considered likely to have any impact on the species or habitat used by the species.
Summary: evaluation of the Area of Impact and quality considerations of the produced water discharge did not identify that either conservation objectives are compromised by the discharge stream, or threaten the fauna of interest, showing that the discharge is acceptable to conservation objectives relevant to the area.		
Commercial fishing values		
Consideration: The Area of Impact for the discharge of the produced water from the FPSO coincides with habitats that support commercial fishing interests.		
Elevated hydrocarbon levels in fish flesh have the potential to impact humans if affected fish species are targeted by fisheries. When present in foods, petroleum hydrocarbons stimulate an olfactory response in humans that causes a tainting of flavour or taste. Connell and Miller (1981) compiled a summary of studies listing the threshold concentrations at which tainting occurred for hydrocarbons. The results contained in their review indicate that tainting of fish occurs when fish are exposed to ambient concentrations of 4–300 ppm (mg/L) of hydrocarbons in the water, for durations of 24 hours or more, with response to phenols and naphthenic acids being the strongest.	Water quality concentrations for hydrocarbons meet the 99% species protection guidelines for contaminants (ANZG 2018) after accounting for the 1:322 required dilution rate.	Effects may be experienced by pelagic fish within the produced water area of impact. Pelagic fish are commonly associated with offshore structures and therefore higher abundances are likely to occur around the CPF and FSO than in surrounding open water. Impacts to pelagic fish are likely to be caused by exposure to dissolved hydrocarbons (e.g. BTEX hydrocarbons) or metals across gill structures, although impacts could also occur through ingestion of hydrocarbon droplets. PAHs are the hydrocarbon of most concern in terms of long term exposure to produced water. While PAH concentrations may be elevated in fishes attracted to the FPSO the elimination of PAHs is generally very efficient in fish and other vertebrates and bioaccumulation of PAH within these taxa do not generally reflect their level of exposure (van der Oost *et al*. 2003). No fishing is permitted within the 500 m restricted zone around the FPSO and other subsea infrastructure. Given that the area of impact for produced water discharge lies within this PSZ, no impact to fish targeted by nearby fisheries is predicted. Furthermore, for the actively fished commercial fisheries in the area, the approved fishing area is extensive the purposes of flexibility and boundary simplicity, rather than being a true representation of where catch and effort is actually undertaken. Although the habitat

Impact aspect	Acceptable level of impact	Assessment
		within the operational area may represent suitable habitat for some of the commercial species, in reality fishing effort for these species will be focussed on areas of most suitable habitat and away from constraints such as infrastructure. Although some of the larger fish species may be transient through the operational area and then travel significant distances to active fishing grounds, this is was not considered a significant risk.
Summary: evaluation of the Area of Impact and quality considerations of the produced water discharge did not identify that commercial fishing activities are or will be compromised by the discharge stream, or threaten target species, showing that the discharge is acceptable to conservation objectives relevant to the area.		
Ecologically sustainable development		
Consideration: Jadestone must ensure that discharge of produced water from the FPSO does not contravene or perform in conflict with the intent of the principles of Ecologically Sustainable Development.		
a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations	The activity does not contravene or perform in conflict with the intent of the principles of Ecologically Sustainable Development.	The Jadestone risk assessment process and the Jadestone business management system both include long-term and short-term economic, environmental, social and equitable considerations when assessing exploration and development activities. The residual consequence ranking for discharge of produced water to the environment from the FPSO was assessed as a category 1, 'slight effect; recovery in days to weeks; injury to organism'.
(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		No threats of serious or irreversible environmental damage were identified in the impact assessment process for the discharge of produced water to the environment. Scientific knowledge is available and supports this: produced water has been researched for over 20 years and is well documented in the scientific literature.
(c) the 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		As assessed above in the impact pathway overviews, no medium to long term effects are predicted or expected from the discharge of produced water from the FPSO that will have inter-generational equity considerations.
(d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making		No impacts are expected or predicted that will threaten or contravene conservation values for those species that do or may occur in the discharge footprint. The deliberation on this

Impact aspect	Acceptable level of impact	Assessment
		matter is documented above in this table under ***Fauna and habitat values (incl. recovery plans and conservation advices)***
(e) improved valuation, pricing and incentive mechanisms should be promoted		Technical risk assessments for new or changes to activities within Jadestone consider safety, the environment and the economics of the activity prior to approval and implementation. By taking multiple lines of risk into account when planning and implementing activities, Jadestone includes the consideration of improved value, pricing and incentive mechanisms for itself, as well as other beneficiaries.
Summary: Evaluation of the Area of Impact and quality considerations of produced water did not identify that discharge from the FPSO will contravene or perform in conflict with the intent of the principles of Ecologically Sustainable Development, showing that the discharge is acceptable in this regard.		

7.7 Physical Presence

7.7.1 Description of aspect

Physical presence	The Montara FPSO, WHP and subsea infrastructure are static facilities fixed to the sea floor. A permanent 500 m Petroleum Safety Zone (PSZ) is present around the facilities to ensure restricted and controlled vessel access within close proximity of the facilities. There is currently no PSZ around the Montara-1,2,3 wellheads, however all infrastructure in the field is marked on nautical charts and will continue to be going forward. A cautionary zone of 2.5 nautical miles (NM) radius is maintained around subsea structures including all wellheads. Support vessels and offtake tankers move in and out of the Operational area on a routine basis. The physical presence of the Montara operation, associated infrastructure and PSZ result in the preclusion of other users including commercial and recreational fishers, and commercial shipping traffic, to use the area for their purposes. The physical presence of infrastructure may alter marine fauna behaviour and creates habitat for organisms that are attracted to and/ or attach to hard substrates. Significant numbers of brown noddies have been recorded nesting on the FPSO (266 nests at last count in August 2022), with brown noddies, bridled terns and brown boobies also using the FPSO and WHP as roosting sites. Helicopters operating at low altitude during ascent from and descent to the FPSO helideck also have the potential to disrupt the behaviour of marine fauna because of noise. Avoidance behaviours in response to vessel and helicopter noise are assessed separately in **Section 8.3**.

7.7.1.1 Health and Safety issues associated with bird presence

Due to the significant numbers of birds roosting and nesting on the FPSO and WHP, there are several issues identified that pose a risk to human health and safety:

- Risk of bird strike during helicopter operations;
- Health and hygiene issues associated with guano deposition on infrastructure (including cable trays);
- Aggressive adult bird territorial behaviour towards workforce members onboard the Montara Venture;
- A negative effect on the anti-slip properties provided by heli-deck surface due to guano, and thereby does not achieve friction testing requirement;
- Emergency signage and lights become obscured;
- Several illnesses can arise from contact with guano, e.g. respiratory infections, transmission of avian bird flu, eye infections (conjunctivitis) and skin infections (shigellosis). This can occur through everyday activities on the facility, and through the implementation of controls such as housekeeping (pressure washing) of the facility;
- Transient obstruction (by guano and/or birds) of the communications path by birds, with the signal obscured for sufficient time to indicate a system loss and therefore shutdown (ESD).

Jadestone completes annual monitoring of the birds, but active management is also required to minimise the potential impacts to human health and safety. A number of "active" control measures are considered within the Montara Bird Management Plan (TM-70-PLN-I-00002) and are yet to be trialled on the facility. Once one or more controls are implemented, monitoring of their effectiveness is required to ensure adequate management.

Through consultation, the DCCEEW has advised that no additional permitting is required to undertake bird management measures on the facility.

The objective of implementing management control measures is to remove or significantly reduce bird presence and guano build-up at the FPSO and WHP. Any management measures need to consider the most effective way of achieving this without introducing secondary threats to the health and safety of personnel and the facility. This chapter summarises the control measures that are currently implemented and those that may be implemented on the facility under this EP.

7.7.1.2 Current control measures for bird management

There are a number of passive controls implemented on the FPSO and WHP that deter birds from roosting and nesting from some areas of the facility i.e. they do not actively interfere with nesting or roosting birds but deter them from roosting and nesting in certain areas. Over the life of this EP, these will continue to be installed on the facilities and maintained throughout the operations to reduce the number of nesting and roosting birds on the facility.

The control measures adopted are dependent on the location as to whether they are appropriate as detailed in Table 7-16 below to ensure the continued safety of personnel and the operation of the facility (e.g. bird spikes cannot be affixed to handrails as this would render the access area unsafe for personnel). The implementation of these controls is managed under direction of the OIM on the facility and is documented to ensure ongoing maintenance of the measures and to understand the efficacy of the control measures in each area.

Table 7-16: Passive control measures implemented on FPSOand WHP

Control measure and feasibility	Implementation location	Purpose	Considerations
Deck housekeeping	All areas (MV)	Sweeping of decks, litter retrieval to remove material that maybe used for nests before nest building season will reduce nesting materials available on vessel and potentially reduce nest numbers.	Must be completed regularly. Collection of all material must include debris including ropes, cable ties, ID tags, circlips, PVC tape, Denso tape, paint flakes, washers, loose rust. If present, nesting material should not be removed from active nesting sites
Bird Control Spiders Has potential in limited areas for Brown Noddies and Bridled Terns only. Brown boobies are too large	Heat shield / cable tray covers (MV)	Deters birds from nesting and roosting on heat shields.	Spiders need to be rigid enough to install on heat shields
Bird mesh or barrier Has potential to be effective in reducing numbers of bridled terns roosting on gunnels. However, moves the bird roosting/nesting problem to other areas of the Montara facility. This in effect can make egg/nest treatments more difficult due to height and poor access/egress to nesting sites.	Gunwales & pipe racks (MV)	Deters birds from nesting and roosting on heat shields.	Size of mesh must be small to reduce entanglement risk Ability to remain in situ during cyclone season untrialled Must be regularly checked and maintained
Cyclone wire mesh fencing Has proven successful at other facilities on WA NWS (Wandoo Platform) to reduce Brown booby roosting on decks below Helideck.	All areas (WHP)	Effective at preventing access to roosting areas by brown boobies.	Can be implemented below mezzanine deck.
Rail Guards Is effective, some have been trialled at MV.	All areas (FPSO & WHP)	Prevent Brown Boobies on handrails and other suitable structures WHP.	Wires must be taught and fixed firmly. Could impact on functionality of the handrails.
Aviwire Potential to be installed on heatshield areas over cable trays.	All areas (FPSO & WHP)	Reduce nesting of Brown Noddies.	May not be robust enough to prevent Brown boobies roosting. May be adapted to key areas of superstructure
Bird Spikes Further trials required, small sections placed on beams overhead of central walkway on MV.	All areas (FPSO & WHP)	Reduces areas for roosting birds	Can be strategically located on superstructure areas where guano will impact areas below May not be stiff enough to prevent brown booby and brown noddy roosting.

7.7.1.3 Potential active control measures for bird management

Accessibility issues limit the implementation of many potential active control methodologies. The best-case scenario is to manage the location of and potential carrying capacity of the FPSO through control measures to reduce the availability of nesting areas and/or direct nesting activities away from critical infrastructure and areas that pose exposure risks to personnel. Coupled with this are management strategies to maintain deck areas and other areas free of guano which is undertaken through washdown of decks to rinse the guano into the ocean. A combination of passive and active measures may be implemented.

An overview of the potential bird management measures that could be implemented on the facility include a combination of the following:

- Visual – Predator cues, lighting, randomised laser light sources.
- Acoustic – ultrasonic, randomised distress calls, horns.
- Physical –water sprinklers, electrical barrier tapes.
- Chemical – D-Ter and other low toxicity-based deterrents (yet unproven for seabirds).
- Alternative roosting sites – assess potential alternative roosting sites on or adjacent to facilities, decoys.
- Disruption of breeding – nest and egg removal

For the strategies to be as successful as possible it is important that both breeding and roosting be addressed concurrently. Elsewhere (Calladine *et al.* 2006) when adult birds still roost even after nesting controls were implemented, this was still enough stimulus for other undisturbed birds to initiate nesting. Evidence of brown noddies establishing a new colony on Lancelin Island 275 km away from the Houtman Abrolhos Islands, where significant numbers of nesting brown noddies are established, indicated that only five nesting pairs were needed to start a colony (Dunlop and Goldberg, 1997). So, it is essential to reduce the numbers of potential breeders roosting, as well as to reduce and deter actual nesting.

Through implementation of a combination of control measures, the numbers of roosting and nesting birds can be reduced but are unlikely to be eliminated altogether.

Active management strategies that intend to be trialled on the facility are detailed in Table 7-20: Significant Impact Criteria for listed migratory species

Significant Impact Criteria	Impact assessment for the Montara Facility
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Through the installation of the facility, additional habitat has been introduced to the area that provides a suitable roosting and nesting habitat for 3 migratory listed species. However, implementation of management controls to deter roosting and nesting from continuing to occur in large numbers on the facility will likely result in the birds returning to their usual roosting and nesting areas (such as Ashmore Reef). With reference to Table 7-19, the FPSO is not considered to be important habitat and therefore this significant impact criteria is not met by either facility presence or implementation of control measures.
result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	Through implementation of control measures outlined in Section 8.2, the risk of introducing an invasive species that is harmful to any migratory species in the area is not considered to have a real chance or possibility of occurring. Therefore, this significant impact criteria is not met by facility presence.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically	Through the implementation of both active and passive control measures, Jadestone intend to disrupt the breeding and resting behaviour of the 3 listed migratory species that utilise the facility as the numbers that

significant proportion of the population of a migratory species	currently utilise the facility are now posing a risk to human health and safety. This is through a number of aspects described in Section 7.7.1.1 such as deposition of guano (health hazards) and helicopter strike with a potential for helicopter and personnel loss. Therefore, some action is required to manage the potential impacts, whilst removal of all birds from the facility is not considered feasible, a reduction in numbers is essential to the ongoing safe operation of the facility. However, the population of the 3 species at Montara are not considered to be an ecologically significant proportion of the population given the % of the overall WA and global population that have been counted at the facility is <2% in all cases, representing a very small proportion of the population. The population at the facility is not considered ecologically significant as the species are not identified as threatened or vulnerable and the species are generally considered common both globally and within Australia with broad range, with the usual breeding and roosting areas within flying distance for the species, so they have some to be displaced to. Therefore, this significant impact criteria is not considered to be met by the implementation of control measures to reduce the current roosting and nesting populations on the facility.

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Prior to implementation of these active management controls, Jadestone will work with the supplier to ensure correct placement locations and ongoing testing, maintenance and monitoring of the effectiveness of the controls is undertaken.

Table 7-17: Active control measures that may be implemented on FPSO and WHP

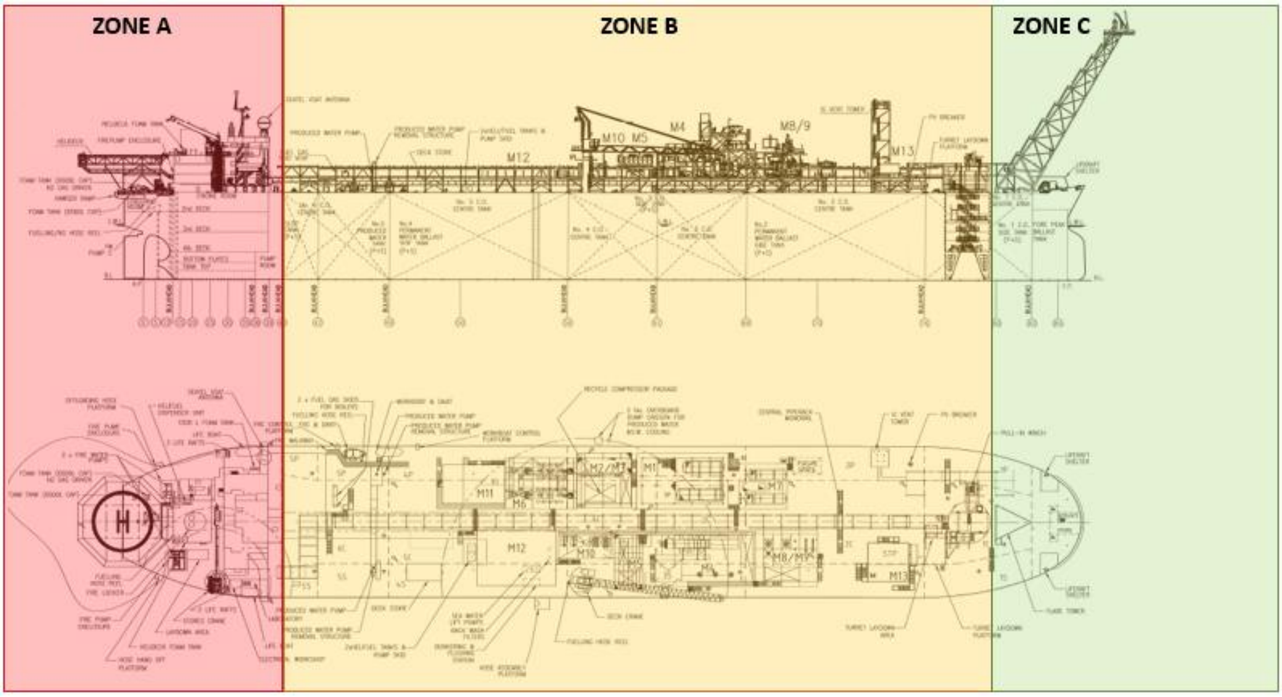
Control measure and feasibility	Implementation location	Purpose	Considerations
Water Sprinklers/Cannon Bromel (2000) found this to be the most effective method of reducing seabird roosting numbers of helidecks in the North Sea, birds discouraged were gannets and gulls.	Heli-decks (FPSO & WHP)	Deters birds from roosting and resting on helideck through frequent water blasting	May require engineering to allow this to occur Water supply must be considered
Laser Proven success at other sites including North Sea and WA Northwest shelf.	All areas (FPSO & WHP)	Deters birds from roosting and nesting on infrastructure through laser activation	Expensive Can be activated remotely Implemented in areas away from personnel Would need to be turned off at what point before helicopter arrival.
Sound Limited success due to acclimatisation and residual background noise but could be trialled to determine success rate.	All areas (FPSO & WHP)	Deters birds from roosting and nesting on infrastructure through frequent noise activation	Can be activated remotely Implemented in areas away from personnel (including consideration of accommodation block)

7.7.1.4 Adaptive Management Controls

For the purposes of bird management, Jadestone have identified three zones on the FPSO that will be maintained to allow safety risks to be reduced to ALARP whilst not having a significant impact on a significant proportion of the population of a migratory species (Section 7.7.2). The three zones are shown in Figure 7-8 and have been selected to reduce the risks from birds to helicopter approach routes and line of sight gas detection:

- **Zone A** covers both main and alternate helicopter approach routes and associated fly-off paths. To reduce the Major Accident Event (MAE) risks associated with helicopter down scenarios caused by bird strikes, no nesting or roosting is tolerable during helicopter transits. During all other periods this area will be treated as Zone B.
- **Zone B** covers the process areas covered by line-of-sight detectors. In this area, no nesting is tolerable and roosting will be discouraged so as not to interfere with line of sight gas detection in order to avoid unnecessary emergency flaring events.
- **Zone C** covers the bow area where roosting can be tolerated, but nesting always maintained below five pairs at all times to avoid a colony forming that would encroach into other zones.

Figure 7-8: Bird Management tolerance zones on the FPSO



Following implementation of passive controls and one or more active control (i.e. water cannon/sprinklers, laser, noise) for at least 12 months, if the number of birds roosting and nesting in each of the zones has not reduced to ALARP as described above, then additional control measures may be adopted to manage numbers of birds returning in the following season. This could include additional nest removal and egg removal. Some nest removal may be required on a daily basis during normal operations if within areas of egress for personnel such as thoroughfares or to maintain a safe working environment; but if the number of birds continue to increase, further removal of nests and eggs may be required. Removal of nests and nesting material may impact on breeding success on the localised population.

The control measures that would be considered are described in Table 7-18, this would only be required on the FPSO as birds are nesting on this facility.

Table 7-18: Adaptive management control measures that may be implemented on FPSO

Control measure and feasibility	Purpose	Considerations
Interference- Nest removal from areas outside of thoroughfares and line of sight detectors (i.e. in harder to reach areas) Will disrupt nesting.	Regularly removing nesting material and nests prior to egg-laying may impact upon breeding	Would require rope access teams to undertake the work, added risk of working at heights and being swooped/attacked by nesting birds Removal of nest material must be completed regularly from hard to reach areas
Interference- Egg removal Will disrupt nesting. Euthanasia of the fresh eggs would be undertaken . One of two strategies could be adopted to stimulate behavioural responses to unsuccessful breeding: leave in place or remove the sterilised egg to elicit a breeding failure behavioural response in the adult birds. Removal or leaving of eggs at the nest site will have different behavioural outcomes. By leaving the "sterilised egg", the adult will continue to incubate until too late in the season (if there is one) to relay. If eggs are sterilised and removed this will typically stimulate relaying after approximately 14 days of having lost the egg, followed by subsequent removal of the second clutch which will continue to impress failure and will result in a higher energetic response from the bird and presumably a larger imprinting of breeding failure. It is anticipated that there will be a noted reduction in breeding performance and output of these seabirds. Whether this will displace the birds is not clear however by reducing the reproductive output should prevent new recruitment if the program is followed up for 3 to 5 years.	Repeat removal of fresh eggs may disrupt breeding and make site unattractive.	Would require rope access teams to undertake the work, added risk of working at heights and being swooped/attacked by nesting birds

Monitoring over the medium term (multi seasonal) of nesting sites and tagged individuals will allow an assessment of whether new individuals are being recruited to the population (i.e., that the FPSO has become a known reliable nesting location) and whether birds know to have nested previously have returned after having a breeding attempt disrupted.

Any interference with eggs will be completed by trained personnel to ensure a humane methodology is selected and that the age of the egg is determined so that only freshly laid eggs are euthanised, unless a safety incident is imminent.

7.7.2 Impacts

7.7.2.1 Bird management controls

To assess the potential impact of both the physical presence of the facility on the local migratory bird population, and the potential impact of implementation of bird management controls, they have been assessed under the Matters of National Environmental Significance Significant Impact Guidelines 1.1 (under the EPBC Act) as detailed in Table 7-20. To determine the potential impacts, it is important to understand the definition of important habitat as defined in the guidelines and whether that habitat is present within the potential area of impact (Table 7-19).

Table 7-19: Important habitat definitions and presence in Montara Field

Important habitat category	Habitat present in Montara Field
a. habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species	Habitat within the Montara Field is utilised by migratory species occasionally and periodically (i.e seasonally by 3 migratory bird species), however the operational area currently supports <1% of the global populations of these species, and <1.1% of the WA population. Therefore, the region is not considered to support an ecologically significant proportion of the population of the species.
b. habitat that is of critical importance to the species at particular life-cycle stages	Although the FPSO does support nesting brown noddies, (nesting is considered a critical life stage), the habitat itself is not the natural habitat for nesting birds. It also only currently accounts for supporting 0.4% of the WA population of brown noddies. Their usual nesting area on Ashmore Reef supports the second largest breeding population of brown noddies in WA, on which the FPSO does not have any impacts from ongoing operations.
c. habitat utilised by a migratory species which is at the limit of the species range	Brown noddies, brown boobies and bridled terns are found globally (DCCEEW SPRAT database, 2023) throughout the oceans and islands and the facility is not at the limit of the species range
d. habitat within an area where the species is declining	There is no evidence in current literature to suggest that the brown noddy species is declining in numbers. The brown noddy is considered to be mostly secure in Australia, but some colonies have suffered declines that appear mainly to be due to introduced predators (e.g., rats on Christmas Island), but Ashmore Reef (the nearest breeding colony) does not show signs of introduced predators affecting their numbers. The brown booby is a very common booby occurring through all tropical oceans approximately bounded by latitudes 30° N and 30° S. Some declines in Australian populations (unknown causes) documented in South and East Australia (Heatwole *et al*., 1996) but not in WA. Worldwide, the bridled tern occupies tropical and subtropical waters and coastlines, with several apparently discrete populations, which are treated as subspecies. In Australia, Bridled Terns are widespread, breeding on offshore islands in western, northern and north-eastern Australia. There is no estimate of the extent of occurrence of Bridled Terns in Australia. Estimated global extent of occurrence is between 400 000 and 1 000 000 km² (BirdLife International 2023). The source of this estimate is not known, and there are no available data to indicate past declines or future changes (DCCEEW, 2023)

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will result in any of the significant impact criteria listed in Table 7-20.

Table 7-20: Significant Impact Criteria for listed migratory species

Significant Impact Criteria	Impact assessment for the Montara Facility
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Through the installation of the facility, additional habitat has been introduced to the area that provides a suitable roosting and nesting habitat for 3 migratory listed species. However, implementation of management controls to deter roosting and nesting from continuing to occur in large numbers on the facility will likely result in the birds returning to their usual roosting and nesting areas (such as Ashmore Reef). With reference to Table 7-19, the FPSO is not considered to be important habitat and therefore this significant impact criteria is not met by either facility presence or implementation of control measures.
result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	Through implementation of control measures outlined in Section 8.2, the risk of introducing an invasive species that is harmful to any migratory species in the area is not considered to have a real chance or possibility of occurring. Therefore, this significant impact criteria is not met by facility presence.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	Through the implementation of both active and passive control measures, Jadestone intend to disrupt the breeding and resting behaviour of the 3 listed migratory species that utilise the facility as the numbers that currently utilise the facility are now posing a risk to human health and safety. This is through a number of aspects described in Section 7.7.1.1 such as deposition of guano (health hazards) and helicopter strike with a potential for helicopter and personnel loss. Therefore, some action is required to manage the potential impacts, whilst removal of all birds from the facility is not considered feasible, a reduction in numbers is essential to the ongoing safe operation of the facility. However, the population of the 3 species at Montara are not considered to be an ecologically significant proportion of the population given the % of the overall WA and global population that have been counted at the facility is <2% in all cases, representing a very small proportion of the population. The population at the facility is not considered ecologically significant as the species are not identified as threatened or vulnerable and the species are generally considered common both globally and within Australia with broad range, with the usual breeding and roosting areas within flying distance for the species, so they have some to be displaced to. Therefore, this significant impact criteria is not considered to be met by the implementation of control measures to reduce the current roosting and nesting populations on the facility.

Table 7-: Impact Assessment Summary

Sensitive Receptor	Impact description
Social receptors	
Fishing Shipping	Interaction between Montara support vessels and other marine users is expected to be minimal due to the remote location and low fishing effort expended within the Operational area. The Montara facilities and PSZs have been established and effective since 2012. Any overlap with active fisheries is relatively small, with only the Northern Demersal Scalefish Managed Fishery having recent catch returns for the Operations Area or its immediate vicinity. The PSZ represents

Sensitive Receptor	Impact description
	a very small part of the Northern Demersal Scalefish Managed Fishery licenced area, with numerous alternatives available. There is the potential for interactions between fishing activities and support vessels. The presence of the Montara facility and 500 m PSZ, and the movement of support vessels, present obstacles for shipping traffic in the region and are potential navigational hazards and a collision risk. The Montara Facility is located northwest of the nearest designated shipping route with heavy vessels utilising the Osborne passage in the northern part of the permit areas, however it is not anticipated there will be high commercial shipping traffic in the Operational Area or immediate surrounds (refer to **Section 5.6** and **Figure 5-8** 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. As such impacts to other users are considered ***negligible.***
Environmental receptors	
Seabirds	Migratory species such as seabirds may experience localised and short-term effects through behavioural changes; such as resting or roosting on platforms (Montara FPSO and WHP), 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) with subsequent short term positive effects. 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. Birds striking infrastructure or being struck by helicopters, causing injury/mortality, may cause a minor disruption to a small proportion of the population. The utilisation of the FPSO as a nesting site for Brown Noddies poses several risks to Brown Noddies. Impacts to the species that could impact the local population include: • Human activity may disturb nesting birds – most nest sites are elevated and situated away from high traffic areas. The delineated pathways used by staff on the FPSO means that human activity is predictable and poses little threat to disturbance to breeding brown noddies unless active nest removal is required; • Cleaning activities – due to the large volume of guano deposited by the nesting birds onto infrastructure and the decks below, regular high-pressure cleaning is undertaken. The birds do not react to the increased noise level; however, they may leave the nest site if water jets deflect and spray close to the nest. Deck cleaning is unlikely to impact most nesting birds unless the jet is directed to areas (such as pipe racks under the central walkway) where nesting occurs. The potential impact on water quality as a result of the deck washdown is discussed in Section 7.4. • Deluge testing – the fire deluge system includes piped water to production modules, with intermittent nozzle jets located in the system, and is tested at a predefined frequency to ensure the system disperses water at rates and coverage as required by the Safety Case performance standards. Although there are no nozzles in areas that brown noddies are currently nesting so the regular testing of the fire system is unlikely to impact seabirds, the increase in nests in future could result in the location of some near these nozzles; and • Loss of breeding attempts due to deck roll/rough seas – Brown noddies are capable of building elaborate nests of seaweed, shells and vegetative materials when nesting on land. Most nests on the FPSO are rudimentary, comprised of some materials collected from the deck and depending upon availability, brown algae from the adjacent sea. The lack of nesting material allows eggs to roll from the nest location if rough seas produce a roll. Similarly, the elevated and exposed location of some nests (i.e., those on the heat shield) often results in some younger chicks being blown from the nest site onto the deck below where they invariably die from exposure or starvation.

Sensitive Receptor	Impact description
	• Potential impacts from deterrents could include permanent impacts to hearing from noise deterrents and burns or skin damage from lasers. The inherent design of the noise deterrents must be considered to ensure that potential impacts to hearing can be mitigated. This may include volume control such as using the lower range with short intermittent bursts of noise to aid dispersion, coupled with monitoring of effectiveness. • To prevent significant impacts from lasers, the inherent design must also be considered to ensure the lowest power laser is selected for use to prevent physical impact to the seabirds, and instead only illicit a startle response to deter the birds. • Implementation of passive and active management controls will result in dispersion of seabirds from their preferred roosting and nesting sites. It may also result in the displacement of seabirds from foraging around the infrastructure. • Active management strategies adopted such as egg euthanisation and nest removal will result in an imprinting of breeding failure and deterrence of the birds from nesting at that location again. This will also result in a proportion of the population having an unsuccessful breeding season which will impact on the immediate local population. Behavioural impacts from implementation of any proposed strategies will result in dispersion of seabirds from their preferred roosting and nesting sites. It may also result in the displacement of seabirds from foraging around the infrastructure. Noting that foraging can still occur around the infrastructure regardless of any bird management strategies selected, and that the area represents a very small area within the overall range for all species. Ideally this displacement will be permanent, however it is not likely to be feasible across the whole facility due to accessibility issues to install some bird management measures, and therefore some of the localised population will likely remain in situ. Passive management measures will also be implemented across the FPSO to minimise potential impacts to nesting birds and encourage breeding elsewhere for the following season. The nearby Ashmore Reef provides adequate roosting, foraging and nesting areas for the bird species which are using the FPSO and WHP and therefore limited impacts to the overall population are expected. Impacts to nesting birds are expected to be Moderate due to the planned potential impacts to the localised population which could, in the worst-case scenario, result in loss of a successful year of breeding for some individual breeding pairs.
Cetaceans, Whale sharks	The only known biologically important areas (BIAs) that overlap the Operational area are the most northern part of the whale shark foraging BIA and the broad pygmy blue whale (distribution) BIA, as described in **Section 5.5.5**. However, only occasional individuals are expected to occur as there are no whale shark aggregations (such as the Ningaloo Reef aggregation) in the region and pygmy blue whales are typically solitary animals. Both species may occur year-round. Slight deviations by migrating marine fauna including whale sharks and pygmy blue whales, to avoid the Facility may be required, however this impact is considered negligible given the large navigable area available and the relatively small Operational Area. Overall, impacts to cetaceans and whale sharks are considered ***moderate.***

Sensitive Receptor	Impact description
Benthic fauna	The presence of subsea infrastructure has the potential to act as artificial habitat or hard substrate for the settlement of marine organisms that would not otherwise be successful in colonising the area. Over time the colonisation of subsea infrastructure can lead to the development of a ‘fouling’ community, which subsequently provides predator or prey refuges, foraging resources for pelagic fish species and artificial reefs potentially supporting fish aggregations (Gallaway et al. 1981). Infrastructure that no longer has cathodic protection (such as the Montara-1,2,3 wellheads) will slowly degrade over time releasing corrosion material. The wellheads are comprised predominantly of mild steel. Iron, the primary component of steel (98%), is only toxic to marine organisms at extremely high concentrations (Grimwood and Dixon, 1997). All iron oxides are included on the OSPAR PLONOR list (Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment). Elastomeric seals and thread grease are present in small quantities which will also slowly be released to the environment. Given the low rate of release (as they would be released gradually and in small pieces as the wellheads break down, the concentrations are not expected to have a significant impact on the water and sediment quality. Based on the low toxicity of iron, the slow-release rate and rapid dilution of the open ocean environment, any impacts to sediments and water quality will be low and in the immediate vicinity of the wellhead. Expert advice has guided that based on the NACE Corrosion Engineers Handbook, page 188 for steel in soil <1000 ohm-cm, that a corrosion rate of 0.2mm/year for unprotected steel can be utilised. In the presence of paint and other protective films, corrosion would be delayed. On the basis of no cathodic protection from when the wells were first drilled, they can be left without cathodic protection for a further 126 years without compromising the ability to mechanically recover and lift to the recovery vessel. The presence of seabed and floating structures may have a minor positive benefit with reef associated species such as cods and snappers preferring habitat of structural complexity. Similarly, near-surface infrastructure can support pelagic species that are commonly attracted to fixed and drifting surface structures in areas of open-ocean (Lindquist et al. 2005). Impacts associated with the provision of artificial habitat from Montara infrastructure are increased biological productivity and diversity, which can result in a localised influence on marine communities. Given the small scale of the artificial habitat created, the potential impacts are expected to be highly localised and considered ***negligible***. The abandoned wellheads are comprised of steel with metal-to-metal ring gaskets, 3-4 elastomeric seals and small quantities of thread grease. Some debris is associated with these wellheads, including wire rope, drill pipe and a j-hook (present around the abandoned Montara-1,2,3 wellheads). ROV footage indicates the abandoned wellheads are stable. Over time the wellhead will break down, potentially large pieces will break off onto the surrounding seabed, though will likely remain within the immediate vicinity (<10m radius) of the wellhead and bury/ re-bury over time. Given the remote offshore location of the wellhead and the water depth of >72 m, no significant credible health and safety risks to marine users have been identified from leaving the wellheads in situ. The wellheads have been in place since 1988, 1991 and 2002 and no harm or events are known to have occurred as a result of their placement during this time. Impacts from the presence of unused infrastructure in field until they are removed is considered to be ***negligible***.

7.7.3 Environmental performance

Aspect		Physical presence		
Performance outcome		**Recreational and commercial fishers, and shipping traffic, are aware of the Operational Area and associated activities** **Montara Operations are managed to ensure Jadestone can meet obligations under s.572 of the OPGGS Act** **Ensure that birds are managed and monitored on the FPSO and WHP**		
ID	**Management control**	**Performance standard**	**Measurement criteria**	**Responsible**
037	FPSO and WHP navigational and communication equipment installed, maintained and operated in accordance with Performance Standard Report (MV-70-REP-F-00002).	The Montara facility and associated infrastructure are charted on Australian Hydrographic Service (AHS) nautical charts with PSZ	AHS Chart	Marine Superintendent
038		Navigation and communication equipment on the FPSO comply with Safety of Life at Sea (SOLAS) requirements	PMS records show evidence of navigation and communication equipment maintenance	Maintenance Superintendent
039		ARPA with integrated AIS system are located on the FPSO	CCR panel.	OIM
040		A Marine VHF Radio is located and functioning in the central control room (CCR)	CMMS and assurance through daily use	OIM
041	Jadestone Energy Stakeholder Engagement Plan (JS-70-STD-I-00001) details consultation requirements to ensure other marine users are aware of the activity	Consultation undertaken with relevant stakeholders as **Section 6**	Stakeholder communication records	HSE Manager
177	Decommissioning framework	No later than five years prior to the end of field life, Jadestone will have a decommissioning framework that details how JSE will meet the obligations under s.572 of the OPGGS Act. This will include	Established decommissioning project five years prior to end of field life	Country Manager

Aspect		Physical presence		
Performance outcome		**Recreational and commercial fishers, and shipping traffic, are aware of the Operational Area and associated activities** **Montara Operations are managed to ensure Jadestone can meet obligations under s.572 of the OPGGS Act** **Ensure that birds are managed and monitored on the FPSO and WHP**		
ID	**Management control**	**Performance standard**	**Measurement criteria**	**Responsible**
	implemented prior to end of field life	• timeframes for regulatory approval documents • inventory of all in-field infrastructure • Status of all in-field infrastructure • Overall decommissioning concept		
178	Maintenance of inactive infrastructure in accordance with the CMMS	Jadestone will maintain in good condition and repair all active and inactive subsea structures that are, and all subsea equipment and other property that is used in connection with the Montara Operations to ensure they can meet obligations under s.572 of the OPGGS Act.	Inspection records in BASSnet	Engineering & Maintenance Manager
179	Inspection of subsurface infrastructure completed in accordance with NOPSEMA accepted WOMPs	Jadestone will inspect subsurface infrastructure in accordance with the • Montara WOMP (MV-00-PLN-W-00001) • Montara-1, Montara-2, Montara-3 WOMP (MV-00-PLN-W-00007) and • Subsea Well ROV GVI & Seabed Survey Procedure (TM-50-PR-U-00001).	Inspection records in BASSnet	Drilling Manager / Engineering and Maintenance Manager
180	Implementation of bird management measures in accordance with Montara Bird Management Plan	Jadestone will implement the Montara Bird Management Plan to ensure that birds are managed and monitored on the FPSO and WHP to prevent health and safety issues with personnel. The plan includes: • Implementation plan for controls which will be implemented on a hierarchy basis starting with passive controls, then active controls and finally take controls. An escalation in controls will occur if the previous controls measured proved to be ineffective;	Incident reports Monitoring report(s)	OIM

Aspect		Physical presence		
Performance outcome		Recreational and commercial fishers, and shipping traffic, are aware of the Operational Area and associated activities Montara Operations are managed to ensure Jadestone can meet obligations under s.572 of the OPGGS Act Ensure that birds are managed and monitored on the FPSO and WHP		
ID	**Management control**	**Performance standard**	**Measurement criteria**	**Responsible**
	(TM-70-PLN-I-00002)	• Control measures for managing and reducing migratory seabirds on the FPSO and WHP; and • Routine monitoring to assess effectiveness of deterrent options implemented and assess related environmental impacts • Routine monitoring of the local bird population • Reporting requirements to NOPSEMA and DCCEEW		
181	Deck Housekeeping is conducted on a regular basis	Sweeping of decks and other accessible areas to remove unoccupied nests and material that may be used for nests. Collection of all material must include debris including ropes, cable ties, ID tags, circlips, PVC tape, Denso tape, paint flakes, washers, loose rust. For egg removal, refer ID 182	Maintenance records Reports by exception via HAZID	OIM
182	Egg removal is conducted when necessary to prevent threat to human health and safety	If eggs in a nest need to be removed to undertake safety critical work e.g. to prevent escalation of an incident; an incident report is logged. Any eggs in nests that are removed are handled in accordance with the Montara Bird Management Plan (TM-70-PLN-I-00002), refer also ID 186.	Incident report Regulatory reporting to DCCEEW	OIM
184	Monitoring and maintenance of active and passive bird management measures is conducted to	Bird management controls will be checked during regular housekeeping checks on the FPSO and WHP to ensure they are: - Still in-situ - Maintained in good condition and repair - Replaced if damaged - Checked after extreme weather e.g. cyclone activity	Maintenance records	OIM

Aspect		Physical presence		
Performance outcome		**Recreational and commercial fishers, and shipping traffic, are aware of the Operational Area and associated activities** **Montara Operations are managed to ensure Jadestone can meet obligations under s.572 of the OPGGS Act** **Ensure that birds are managed and monitored on the FPSO and WHP**		
ID	**Management control**	**Performance standard**	**Measurement criteria**	**Responsible**
	ensure they are functional	- Location is documented to determine effectiveness		
185	An implementation plan is developed prior to activation and use of active bird management measures	Prior to the installation of water sprinklers/cannons, lasers or sound deterrents (active bird management measures) for the purposes of deterring birds from roosting or nesting on the FPSO or WHP, an implementation plan will be prepared to ensure: - The location of the deterrent is chosen to minimise potential impacts to personnel and other marine fauna - Regular testing and maintenance is documented - Monitoring of the impacts on bird numbers through use of the deterrents is documented including: time taken for birds to return to site following activation of a deterrent, any habitualisation observed, location of resettlement after disturbance - In the event that an unintentional injury or mortality occurs to marine fauna due to implementation of an active bird management measure, use of the control will be evaluated to reduce the risk of injury or mortality.	Implementation plan for active bird management measures Maintenance records	HSE Manager
186	If the effectiveness of passive controls and one or more active control does not reduce the number of nesting birds in zones A, B and C on the FPSO, egg euthanisation will be undertaken.	Following implementation of passive controls and one or more active control (i.e. water cannon/sprinklers, laser, noise) for at least 12 months, if the number of birds roosting and nesting in each of the zones (Figure 7-8) has not reduced to ALARP as described above (Section 7.7.1.4), then egg euthanisation from all accessible active nests will be implemented on freshly laid eggs in accordance with the methodology described in the Montara Bird Management Plan (TM-70-PLN-I-00002) under the direction of an ornithologist.	Egg euthanisation records	HSE Manager

Aspect		Physical presence		
Performance outcome		Recreational and commercial fishers, and shipping traffic, are aware of the Operational Area and associated activities Montara Operations are managed to ensure Jadestone can meet obligations under s.572 of the OPGGS Act Ensure that birds are managed and monitored on the FPSO and WHP		
ID	**Management control**	**Performance standard**	**Measurement criteria**	**Responsible**
187	Monitoring of bird populations is undertaken on the FPSO and WHP	Annual monitoring of bird populations present on both the WHP and FPSO will be conducted by an appropriately qualified ornithologist during peak season (determined by ornithologist) to measure: - Seasonal seabird roosting and nesting activity - Number of tagged individual birds - Overview of location of nest sites to determine if deterrent measures are successful	Annual Monitoring report	HSE Manager
188		Monthly monitoring of the bird population on FPSO will be conducted by personnel on board the facility to estimate the number of birds present and location on the facility.	Work instruction details species identification Bird record sheet	HSE Manager
189		Bird numbers will be recorded on WHP during visits to WHP at beginning of any major campaign as required in *First on, last off WHP Checklist* (MW-02-WP-G-00002)	Work instruction details species identification Bird record sheet	HSE Manager

7.7.4 ALARP assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to reduce the imposition due to the physical presence of the Montara facility to activities undertaken by relevant persons in the area to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Tolerable as they are within the green category (moderate impacts). No further controls are required and therefore ALARP has been demonstrated.				
Rejected control	**Hierarchy**	**Practicable**	**Cost effective**	**Justification**
Removal of facility and vessels	Eliminate	No	No	Operation of the facility would not be possible without the infrastructure or without vessels to replenish supplies required for safe operations.
Re-engineer to remove requirement for topsides altogether	Engineering	No	No	Costs associated with complete re-engineering of the facility such that the need for topsides infrastructure was not required would be grossly disproportionate to the benefit that would be received by other users of the area.
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 facility. Montara facility is located outside of shipping fairways and is not positioned in highly prized fishing habitat.
Additional activity specific navigational or communications requirements	Administrative	No	No	The 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 Montara facility are undertaken. Additional procedures would provide no further benefit.
Additional support vessels on location to inform third party vessels in	Engineering	No	No	The additional cost of 24/7 vessel presence in field is considered grossly disproportionate to the benefit gained given the facility is marked on hydrographic charts and is visible above water. The

the vicinity of the facility				radio room on the FPSO is manned 24/7 allowing contact to be made with 3rd part vessels in the vicinity as required. If radio cannot raise the vessel, calls are made to the Home Affairs Office for their control.
Undertake planned maintenance activities on the WHP outside of season of peak presence of seabirds roosting on facility	Isolation	No	No	Avoidance of peak roosting and nesting periods when bird numbers are at their peak would result in less potential interaction with helicopters and personnel. However, the weather conditions must be considered when planning maintenance campaigns to ensure reduced cyclone risk and/or suitable weather for undertaking major campaign work. Compliance with safety case performance standards is required to ensure frequencies are met. Therefore, although bird presence is a consideration when planning major maintenance campaigns, avoidance of peak seasons cannot be guaranteed.
Only use workboat for transfer of personnel	Substitute	No	No	Eliminating the use of helicopters for personnel transfer removes the risk of helicopter strike to avifauna. However, the sea state for workboat use is considered further and this may not be practicable as the weather conditions may adversely impact payload availability resulting in the need to increase the number of flights to WHP.
Capture and relocation of birds to remove breeding birds from FPSO and relocate to natural breeding areas.	Substitute	No	No	Given the species are long range foragers, it is considered likely they will return. The location of FPSO adjacent to Ashmore reef provides an additional source of other breeders. Logistically this option is not feasible.
Alternative nest sites present attractive alternative nest sites to divert birds away from undesirable	Substitute	No	No	Has been successful in Philippines though is unlikely to deter all nesters. Logistically too difficult for the area due to sheer numbers. It must also be noted that there is little to no space to place alternate nesting sites on the Montara platform.

areas of the MV**.**				
Hawk/Owl Scare attempts to deter birds from roosting and nesting	Engineering	Yes	No	Has been trialled on WHP and shown to be ineffective as the hawk scarer was covered in Brown Booby guano at WHP. It did not deter birds roosting on WHP or at other areas on MV.
Chemical deterrent (e.g. DTer) a non-harmful bird repellent to deter birds from roosting/nesting	Engineering	No	No	Has been trialled on other facilities on WA NWS (Harriet Alpha; Surman 2007) and was shown to not impact on Silver Gulls or Crested Terns suggesting it is ineffective for these types of seabirds and this offshore situation.
Bird repellent gel (Bird Free Gel' a non-harmful bird repellent to deter birds from roosting/nesting	Engineering	No	No	Has been proven successful for gulls in the North Sea, though they have a more acute sense of smell. Needs to be trialled for Brown Boobies, Bridled Terns and Brown Noddies to assess efficacy before implementing on FPSO but other methods are likely to be more effective over this method.

7.7.5 Acceptability assessment

The potential impacts of physical presence from Montara infrastructure and vessels during operations are considered 'Acceptable' in accordance with Section 4.4 based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes, and the environmental consequence is considered negligible.	
Policy & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** 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 6**), and no stakeholder concerns have been raised with regards to physical presence as denoted by the PSZ and preclusions within it.

Environmental context	While the Montara facility presents 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. With these considerations in mind, the key objective of an ongoing suspended infrastructure inspection regime to is verify no macro or external event (such as a fishing net) has accelerated the window for removal. Given the wells have already been in place for >20 years, the likelihood of an event of consequence for wellhead recovery is very low. Moreover, while the field is in active service, the license area is monitored for external fishing and any potentially encroaching vessels are hailed. 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	No Management Plans identified physical presence as described above as being a threat to marine fauna or habitats. The Wildlife Conservation Plan for Seabirds (CoA, 2020) states that an action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will: • substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for migratory species; or • seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species. Due to the size of the population on FPSO and WHP compared to the significant population at Ashmore Reef, any actions implemented are not considered in contradiction of the EPBC Act or the Wildlife Conservation Plan for Seabirds as the actions will not modify or destroy a *substantial* area of important habitat or seriously disrupt the life cycle of an *ecologically significant proportion* of the population. Jadestone has had regard to the representative values of the protected areas within the EMBA, 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 (Appendix C) and considered acceptable.

7.8 Seabed Disturbance

7.8.1 Description of aspect

Seabed disturbance	The FPSO, WHP and subsea infrastructure are static facilities fixed to the sea floor. Temporary or permanent direct loss of benthic habitat and associated biota will/has occurred under the footprint of subsea infrastructure. The Montara FPSO and other infrastructure have been in place since commissioning in 2012. In the event that:

	• The installation of additional or replacement subsea infrastructure (e.g. tie in spools, freespans, umbilicals, wet parked equipment) is required, this will create further disturbance to the seabed in the immediate area of existing infrastructure; and • There may be some minor seabed disturbance associated with, routine inspection, maintenance and repair (IMR) activities and well intervention activities. It is expected, IMR activities may include but not be limited to the installation of concrete mattresses (or other physical structures to stabilise and protect infrastructure on the seabed), flowline span correction, the removal of risers and the interaction of remote operated vehicles (ROV). Such disturbances will be limited to the immediate vicinity of existing facilities, that is within tens of metres of the affected infrastructure. During IMR activities and well interventions, there may be vessel anchoring in the Operational Area. The physical presence of the FPSO, the WHP and subsea infrastructure is discussed in **Section 7.7**.

7.8.2 Impacts

Sensitive Receptor	Impact description
Benthic receptors	Previous marine baseline surveys conducted within AC/L7 (outlined in Section 5.5.1), revealed a homogenous, flat, featureless sandy habitat with low and patchy abundance of microbenthic faunal assemblages. The benthic habitats and communities in AC/L8, immediately adjacent to AC/L7 have not been surveyed. The bathymetry and water depths of AC/L7 and AC/L8 are similar and so the substrate and communities are expected to be similar. The potential impacts associated with seabed disturbance from IMR activities and light well interventions are: • Direct disturbance to benthic habitats and communities within the footprint of the Operational area; and • Temporary and localised increase in water column turbidity as a direct result of sediment disturbance The scale of habitat loss and seabed disturbance from the installation of new infrastructure, or due to disturbance during IMR or LWI activities are small limited tens of metres either side of existing infrastructure in comparison to the vast size of soft substrata habitats spanning the North-west Shelf. 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.

7.8.3 Environmental performance

Aspect		Seabed disturbance		
Performance outcome		**No unintentional disturbance to the seabed and marine environment in the Operational Area** **Seabed disturbance limited to planned activities and defined locations**		
ID	**Management Control**	**Performance standards**	**Measurement criteria**	**Responsibility**
042	Change Management Procedure (MoC) (JS-90-PR-G-00017)	Prior to commencement of integrity, maintenance or repair work on subsea infrastructure, a survey using ROV/ AUV/ diving will be undertaken which will include a visual survey of the seabed within the footprint of the work area.	Survey report	Engineering and Maintenance Manager
043	Designated anchoring area	Offtake tanker anchoring within designated area only, as marked on charts.	Voyage Instruction	Marine Superintendent

7.8.4 ALARP assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to reduce the impacts due to the seabed disturbance to ALARP. The residual risk ranking for this potential impact is considered Low. Additional controls considered but rejected are detailed below. No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
No additional infrastructure	Eliminate	No	No	Future production of the facility would not be possible without additional infrastructure or without vessels to replenish supplies required for safe operations.
No maintenance of subsea infrastructure	Eliminate	No	No	Safe operation of the facility could not occur without regular IMR or LWI intervention activities.

7.8.5 Acceptability assessment

The potential impacts of seabed disturbance from Montara infrastructure and vessels during operations 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 & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Stakeholder & reputation	Stakeholder consultation has been undertaken (**Section 6**), and no stakeholder concerns have been raised with regards to seabed disturbance.
Environmental context & ESD	Disturbance is localised to immediately under or near to the footprint of Montara Facility and subsea infrastructure within the Operational Area. The impacted benthic habitats and associated biota are well represented in the region. 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	There are no relevant management plans for – Seabed disturbance. Jadestone has had regard to the representative values of the protected areas within the EMBA, and the respective management plans and other published information. Impacts from seabed disturbance 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 (Appendix C), and considered acceptable.

7.9 Spill Response Activities

7.9.1 Description of aspect

Spill Response	In the event of a hydrocarbon spill, contingency spill response activities will be undertaken to reduce the level of impact to sensitive receptors within the environment. In summary, the response activities include (**Table 7-21**): • Source control; • Monitoring, evaluation and surveillance; • Protection and deflection; • Containment and recovery; • Shoreline clean-up; • Dispersant application; and • Oiled wildlife response. The Montara Operations Oil Pollution Emergency Plan (OPEP) provides further detail on how these strategies will be implemented. While the aim of undertaking these spill response activities is to reduce environmental impacts from the spill, there is the potential for these activities to create additional impacts or to exacerbate existing oil spill impacts. Poorly selected or implemented spill response activities may therefore do more environmental harm than good. Spill response activities will involve: • The use of vessels which are required at a minimum to display navigational lighting. Vessels may operate near shoreline areas during spill response activities; • Spill response activities may also involve onshore operations including the use of vehicles and temporary camps which may require lighting; • The use of aircraft and vessels which will generate noise both offshore and in proximity to sensitive receptors in coastal areas; • The use of equipment on coastal areas during clean-up of shorelines (e.g. pumps); • The use of fuels to power vessel engines, generators and mobile equipment that will result in emissions of greenhouse gases (GHG) such as carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O), along with non-GHG such as sulphur oxides (SOx) and nitrous oxides (NOx); • Operational discharges including those routine discharges (**Section 7.4**) from vessels used during spill response. In addition, there are specific spill response discharges and waste creation that may occur, including: o Cleaning of oily equipment/vessels; o Flushing water for the cleaning of shoreline habitats; o Sewage/putrescible and municipal waste on vessels; and o Creation, storage and transport of oily waste and contaminated organics. • Dispersant operations; • Movement and operation of vessels, personnel and equipment on the shoreline areas including the marine/ coastal habitats and fauna, which may include those habitats and fauna within protected areas; and • Oiled wildlife response activities may involve deliberate disturbance (hazing), capture, handling, cleaning, rehabilitation and release of wildlife.

Table 7-21: Spill response strategies considered for the mitigation of hydrocarbon spills

Strategy	Description	Environmental Benefits	Decision
Source control	Implementation of the FPSO SOPEP	Reduce the volume of oil entering the marine environment	**Adopt**
	Implementation of Emergency Pipeline Repair Plan (GF-09-PLN-L-00039)	Reduce the volume of oil entering the marine environment	**Adopt**
	Implementation of LOWC Source Control Plan	Reduce the volume of oil entering the marine environment	**Adopt**
	Subsea dispersants are applied close to the release point with the objective of minimising the amount of oil from reaching the sea surface. This technique helps to break up the oil droplets so that they are dispersed, diluted and biodegraded more rapidly in the water column, and is beneficial in reducing the amount of volatile organic compounds at the sea surface in the vicinity of the well site.	This strategy is only suitable for a loss of well control release. Subsea dispersant application can reduce the amount of surface hydrocarbons drifting towards sensitive receptors, by increasing the availability of oil droplets for biodegradation. Subsea dispersant typically requires smaller volumes of dispersant to treat the oil as compared to surface dispersant application, resulting in lower volumes of dispersant being applied to treat the spill. Subsea dispersant application will only be undertaken when there is a net environmental benefit. Applicability of chemical dispersant is limited to the conditions, locations and circumstances described in the OPEP.	**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 measures (vessel/ aerial surveillance, tracking buoys, oil spill modelling, fluorometry, SCAT) 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 a primary response to ensure that there is sufficient information to gain situational awareness and make informed decisions on response planning, execution and termination.	**Adopt**
Surface chemical dispersion	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, either by vessel or plane, or subsea. Evidence from the Montara oil spill in 2009 from AMSA reported that 'based on experienced personnel during the response the use of dispersant was highly effective in assisting the natural process of biodegradation and minimising the risk of oil impacts on reefs and shorelines' (Refer Appendix 4 of the OPEP). If there is a weather condition that prevents the application of dispersant (which is unusual for the environment around the Montara facility), this in itself, creates dispersion.	**Adopt**

Strategy	Description	Environmental Benefits	Decision
		The OSTM output for Montara oil comparing dispersant and non-dispersant models indicated shoreline oil loading to be reduced by up to 40% when applied to oil thickness of 100 g/2, up to 56% when applied to oil thickness of 50g/m2 and up to 58% when applied to oil thickness of 16g/m2. 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. Diesel is not considered a persistent hydrocarbon, and has high natural dispersion rates in the marine environment. Chemical dispersant application is not recommended as a beneficial option for Diesel as it has a low probability of increasing the dispersal rate of the spill while introducing more chemicals to the marine environment. 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. The majority of potential contacted shorelines are mangroves and tidal flats subjected to very high tidal influences, which make shoreline response infeasible, cause more damage than not responding or unsafe. 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 deemed to be a primary strategy. Chemical dispersion will only be undertaken when there is a net environmental 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**

Strategy	Description	Environmental Benefits	Decision
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 Montara or SKUA oil, this is the preferred way to remove hydrocarbons from the water surface before the risk of contacting shorelines/sensitive receptors. Given the fast spreading nature of Diesel, and the expected moderate to high sea states of the area causing the slick to break up and disperse, this response is not considered to be effective in reducing the net environmental impacts of a Diesel spill. The ability to contain and recover spreading Diesel on the ocean water surface is extremely limited due the very low viscosity of the fuel. Containment and recovery may be applicable once evaporation of highly volatile components has occurred. Based on the crude oil assays, 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, this strategy is considered a primary strategy in 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.	Anchoring of booms may result in additional damage to the subsurface environment (coral reef) surrounding most offshore islands. Booms themselves would also move around on the coral intertidal reef during periods of lower tides, potentially resulting in physical damage to the benthos of the reef platform. Due to the types of shorelines that may be impacted (i.e. remote, high tidal - high energy beaches/intertidal reef platforms), protect and deflect would under most circumstances, not be considered to result in a net environmental benefit. The use of vessels to deploy booming may be feasible to protect priority locations. If a tangible, positive outcome could be demonstrated a protect and deflect operation may be possible. Consequently, this strategy may not be applicable across all shorelines identified as being contacted by oil but is considered a secondary strategy for targeted use.	**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. The selection of the most appropriate clean-up techniques requires a rapid evaluation of the degree and type of contamination, together with the length, nature and accessibility of the affected coastline.	**Adopt**

Strategy	Description	Environmental Benefits	Decision
		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. Diesel is relatively non-adhesive and will not form a thick adhesive barrier on a shoreline (Fingas 2012). The clean-up of diesel spills from a beach or shoreline is likely to be difficult, generating high volumes of waste in comparison to the oil recovered, and therefore not recommended. Consequently, this strategy may not be applicable across all shorelines identified as being oiled but is considered a secondary strategy for targeted use.	
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) and relevant regional plans.	**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 water.	Operational and oil constraints expected during a spill from the Montara Operations suggest in-situ burning is not feasible. For in-situ burning to be undertaken, oil has to be thicker than 1-2 mm but diesel, Montara and SKUA oil tend to have high evaporation rate and spreads into thin films rapidly. Due to operational constraints and the expected hydrocarbon not being suitable for in-situ burning, this response strategy is deemed inapplicable for Montara 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). This strategy also evaluates recovery from the spill.	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**

7.9.2 Impacts

The key environmental impacts associated with the potential spill response strategies are provided together with a description of associated potential impacts to sensitive receptors. Some of these hazards are unique to spill response (e.g. shoreline clean-up, oiled wildlife response). Some hazards common to the operations have also been detailed and re-evaluated on the basis that the environment within which spill response activities take place may be of higher sensitivity than the environment within which the Montara operations occurs.

Light

Lighting may cause behavioural changes to fish, birds and marine turtles which can have a heightened consequence during key life-cycle activities, for example turtle nesting and hatching. Turtles and birds, which includes threatened and migratory fauna (**Section 5.4.2**), have been identified as key fauna susceptible to lighting impacts that occur within the EMBA. **Section 7.1** provides further detail on the nature of light impacts to fish, birds and marine turtles.

Spill response activities which require lighting may take place in protected areas important to turtles and birds, for example nearshore Cartier Island, Kimberley and Northern Territory coasts, and Indonesian and Timor Leste coasts/ islands.

Noise

Underwater noise from the use of vessels may impact marine fauna, such as fish, marine reptiles and marine mammals which may impact key life-cycle process (e.g. spawning, breeding, calving). Underwater noise can also mask communication or echolocation used by cetaceans. **Section 7.2** provides further detail on these impacts from vessels.

Spill response activities using vessels have the potential to impact fauna in protected areas; this includes the whale migration pathways (Figure 5-6).

Noise and vibration from terrestrial activities on shorelines also has the potential to cause behavioural disturbance to coastal fauna including protected and migratory species of shorebirds and turtles. Shoreline activities involving the use of noise generating equipment may take place in important nesting areas for turtles and/ or roosting/ feeding areas for shorebirds; this includes potential sites at Kimberley and NT coast (Figure 5-9).

Atmospheric Emissions

Atmospheric emissions from spill response equipment such as the use of mobile equipment, vessels and vehicles may result in a temporary, localised reduction of air quality in the environment immediately surrounding the emission points.

Operational Discharges

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 7.4**. However, given vessel use may occur in shallower coastal waters during spill response activities a different set of receptors may be impacted than previously described. Discharge could potentially occur adjacent to marine habitats such as corals, seagrass, macroalgae, and in protected areas, which support a more diverse faunal community, however discharges will still 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 at temporary camps 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, which may be within protected 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.

Physical Presence

The use of vessels may disturb benthic habitats in coastal waters including corals, seagrass, macroalgae and mangroves. Impacts to habitats from vessels include damage through the deployment of anchor/chain, nearshore booms and grounding. Vessel use in shallow coastal waters also increases the chance of contact or physical disturbance with marine megafauna such as turtles and dugongs. Booms create a physical barrier on the surface waters that has the potential to injure or entangle passing marine fauna that are either surface breathing or feeding.

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.

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 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. In shallow coastal areas, such as areas where vessel-based spill response activities may take place, conditions are likely to be more favourable for invasive marine species.

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.

The disturbance to marine and coastal natural habitat, as well as the potential for disruption to culturally sensitive areas, which may occur in specially protected areas, may have flow on impacts to socio-economic values and industry (e.g. tourism, fisheries).

Chemical dispersant application

The application of chemical dispersants has the aim of enhancing oil dispersion and entrainment into the water column, thereby avoiding or reducing the volume of oil that could reach the shoreline.

While the aim of chemical dispersants is to provide a net benefit to the environment, the use of dispersants has the potential to increase the impact to receptors under the sea surface, including coral, seagrass and macroalgae, by increasing entrained oil and dissolved aromatic hydrocarbon concentration. These sensitive receptors are generally located in shallow coastal areas of the mainland and offshore islands.

Increased entrained and aromatic hydrocarbon concentration may also impact on marine fauna either directly or through impacts to subsea habitats. Direct impacts are most likely to be encountered by 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 impact to marine fauna and subtidal habitats, including those that represent values of protected areas, socio-economic impacts may be felt through industries such as tourism and commercial fishing.

A detailed description of the impacts from entrained oil and aromatic hydrocarbons, which may be exacerbated by the application of chemical dispersants, is provided in **Section 8.7.**

Disruption to other users

The use of vessels in the nearshore and offshore environment may impact on livelihoods and revenue with respect to coastal communities, and industries such as commercial fishing.

Table 7-22: Impact assessment of spill response operations

Sensitive Receptor	Impact description
Light	The receptors considered most sensitive to lighting from vessel and shoreline operations are seabirds/ shorebirds and marine turtles. Emerging turtle hatchlings on the beaches are particularly sensitive to light spill, however, the potential impact is considered negligible as stated below. Following restrictions on night time operations by spill response vessels, which will demobilise to mooring areas offshore with safety lighting only, light impacts from vessels are considered to be ***Negligible***. The positioning of temporary camps will be done in consultation with DBaC and any camp lighting will be restricted to minimum directional lighting that will reduce fauna disturbance. Following these controls, the consequence of shoreline lighting is considered *Negligible*. These species are likely to be values of the protected area they occur in, and the impact to the protected area from light is also considered *Negligible*. Response activities may occur within the highly sensitive locations of Ashmore, Cartier, (priority receptors) response activities related light impacts to the key values within the applicable Management Plans are also expected to be *Negligible* due reasons described above.
Noise	The receptor considered most sensitive to vessel noise disturbance are cetaceans. The humpback whale and Blue pygmy whale (distribution) BIAs overlaps the EMBA and species may be vulnerable during their peak activity season (July–October; April - Aug) as they migrate north/ south through the EMBA **Section 5.5.5**. Control measures, by means of compliance to Part 8 of EPBC Regulations, will reduce potential impacts from response activities within this area during whale activity seasons. Given the activity will only introduce vessel engine noise, the consequence is considered to be consistent with noise impacts from activities (*minor*). With respect to noise from onshore operations (mobile equipment and vehicles), nesting, roosting or feeding birds are considered to be the most sensitive to noise, in particular shorebirds may be aggregating at Tiwi and Indonesian coast lines. However, the equipment used is not considered to have excessive sound levels and following consultation with DoT and DBCA on the location of temporary camp areas, the consequence to birds from noise is expected to be *Negligible*. These species are likely to be values of the protected area they occur in, and the impact to the protected area from noise is also considered ***Negligibl****e*.
Atmospheric	Atmospheric emissions from spill response equipment will be localised and impacts to even the most sensitive fauna, such as birds, are expected to be ***Negligible*****.**

Sensitive Receptor	Impact description
Operational discharges	Operational discharges from vessels may create a localised and temporary reduction in marine water quality, which has the potential to impact shallow coastal habitats in particular, however, following the adoption of regulatory requirements for vessel discharges, which prevent discharges close to shorelines, discharges will have a *Negligible* impact. Furthermore, washing of vessels and equipment will take place only in defined offshore hot zones preventing impacts to shallow coastal habitats. Onshore, the use of flushing water has the potential to damage sensitive shoreline and intertidal habitats, e.g. mangroves, however low pressure flushing only will be used, preventing further damage to habitats or erosion of sediments. For sensitive habitats, the deployment of booms will be considered to retain flushed hydrocarbons, if this presents a net benefit. Following these controls the use of flushing to clean shorelines and intertidal habitats is seen to have a *Negligible* additional impact. The cleaning of contaminated vehicles and equipment onshore has the potential to spread oily waste and damage habitats if not contained. Decontamination units will be used during the spill response thus containing waste and preventing any secondary contamination. The consequence of cleaning discharges is therefore ranked as *Negligible*. Sewage, putrescible and municipal waste generated onshore will be stored disposed of at approved locations. There will be no discharges of this waste to the marine or coastal environment and the likelihood of an unplanned discharge is considered *Unlikely* following those controls provided. In the event that those controls failed and secondary contamination or loss of municipal waste occurred the additional consequence to coastal habitat has been assessed as *Minor.* The Risk ranking for an *Unlikely* event with a *Minor* consequence is *Low*. *The response activities may occur within the Protected Areas, response activities related discharge impacts to the key values within the Protected Area also expected to be* ***Negligible****, with low risk of any unplanned releases.*
Physical presence	*Physical presence of nearshore response vessels and spill equipment* The use of vessels and nearshore booms has the potential to disturb benthic habitats including sensitive habitats in coastal waters such as corals, seagrass, macroalgae and mangroves. A review of shoreline and shallow water habitats, and bathymetry, and the establishment of demarcated areas for access and anchoring (along with other controls in **Section 7.7.3**) will reduce the level of impact to *Negligible*. *Onshore vehicle movements, equipment use and camp set-up* The use and movement of vehicles, equipment and personnel during shoreline response activities has the potential to disturb coastal habitats such as dune vegetation, samphire and mangroves, and important habitats of threatened and migratory fauna including nests of turtles and birds and bird roosting areas. A clean-up can also involve physical removal of substrates that could cause impact habitats, fauna and alter coastal hydrodynamics. As with vessel use, an assessment of appropriate vehicles and equipment to reduce habitat damage, along with the establishment of access routes/demarcation zones, and operational restrictions on equipment/ vehicles use will limit sensitive habitat damage and damage to important fauna areas. The establishment of temporary camp areas will be done with consultation to DoT, DBCA and with a Heritage Advisor if access is sought to culturally significant areas. Following these controls the overall resultant consequence to the physical environment and habitat is assessed as ***Minor***, indicating that there may be a detectable reduction in habitat area from response activities (as separate from spill impacts), but recovery will be relatively rapid once spill response activities cease. As with all spill response activities this disturbance will only occur if there is a net benefit to accessing and cleaning shoreline areas. *Wildlife response*

Sensitive Receptor	Impact description
	The main direct disturbance to fauna would be the hazing, capture, handling, transportation, cleaning and release of wildlife susceptible to oiling impacts, such as birds and marine turtles. This would only be done if this intervention were to deliver a net benefit to the species but may result in a *Minor* consequence following close adherence to the WA Oiled Wildlife Response Plan and the Kimberley Region Oiled Wildlife Response Plan. *Physical disturbance in protected area* These habitats/environments are likely to be values of the protected area they occur in, and the impact to the protected area from physical disturbance is also considered ***Minor***.
IMS	*Invasive Marine Species* The mobilisation of vessels, vehicles and equipment into sensitive nearshore and coastal habitats brings the potential for non-indigenous and potentially invasive species, either attached as biofouling, in the case of vessels or as seeds/plant propagules or invasive fauna within equipment and vehicles. The release of such species is an unplanned event which is considered to have a likelihood of *Unlikely* following vessel risk assessments (on all international and interstate Australian vessels) and pre-cleaning and quarantine inspections of onshore equipment. The consequence of an outbreak of an invasive marine species is considered *Major* in the nearshore/ coastal environment, which is more conducive to establishment of invasive marine species than deeper offshore waters. Given the Unlikely likelihood the overall Risk Ranking is ***Medium*.**
Disturbance to other users	The use of vessels in the nearshore and offshore environment and spill response activities at shoreline locations, and within townships, may exclude general public (community villages) and industry use. It should be noted that this is distinct from the socio-economic impact of a spill itself which would have a far greater detrimental impact to industry and recreation. Following the controls outlined in **Section 7.9.3** it is considered that the additional impact of spill response activities on affected industries would be *Minor*.
Dispersants	*Dispersants* 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. During a response, the area over which entrained oil will increase will be a function of the area treated with aerial dispersants. 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. A description of the potential impacts from entrained oil and aromatic hydrocarbons from a maximum credible worst-case spill is provided in **Section 8.7**. Jadestone provided detailed assay information of Montara crude oil (Leeder 2013) to RPS to commission a report (RPS, 2018), 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 by 40% total volume ashore, and greater prediction times to sensitive locations following application of chemical dispersant. These key findings support the use of chemical dispersants on Montara crude as they have potential to reduce hydrocarbon contact with sensitive locations and increase the time of the hydrocarbon

Sensitive Receptor	Impact description
	contact to shorelines, thus giving time for other response strategies to take effect and further reduce impacts. **Section 7.9.3** provides a summary evaluation of the selected strategies performance outcomes and controls, and the benefit that will be provided in applying this strategy.

Table 7-23: Summary evaluation of performance outcomes and controls and associated benefits from spill response activities

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) (Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008)	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) [9]	Ensures spill response activities are undertaken by competent personnel	**Adopt**	Considered a standard control
	DoT and DBC consulted with on shoreline operations location(s) in State waters as per **Section 6**	Prevents additional impacts to shoreline locations and fauna	**Adopt**	If a temporary camp is required then will be determined in consultation
	Response operations conducted during daylight hours only	Reduces potential for behavioural disturbance	**Adopt**	Accepted on safety, operational effectiveness and environmental grounds.
	Montara Venture Waste Management Plan (MV-70-PR-I-00001)	Prevents secondary contamination and litter	**Adopt**	Considered a standard control
Light emissions				
Light spill onto shorelines and coastal waters is	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.

[9] 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.

Performance Outcome	Control measure	Benefit	Outcome	Evaluation
reduced to ALARP during spill response	Review vessel lighting to a type (colour) that will reduce impacts to fauna	Reduces potential for behavioural disturbance	**Reject**	Not required given vessel restrictions at 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) (Montara Marine Facility Manual MV-90-PR-H-00001, Aviation Operations Procedure (MV-90-PR-G-00004)	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.

Performance Outcome	Control measure	Benefit	Outcome	Evaluation
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 requirements	Reduces water quality impacts in nearshore environment	**Adopt**	Considered a standard control (regulatory requirement)
	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
	Decant oily water from offshore containment and recovery behind boom	Prevents spreading of oily water	**Adopt**	Considered a standard control
	Pre-approval obtained from DoT/ AMSA prior to decanting oily water	Prevents spreading of oily water	**Adopt**	Considered a standard control (regulatory requirement)
	Offshore Equipment washdown confined to hotzone	Prevents spreading of oily water	**Adopt**	Considered a standard control
	Use of environmentally friendly degreaser for offshore washdown	Reduces toxic impacts within water column	**Adopt**	Can be achieved with minimal cost
	Onshore equipment washdown in defined area	Prevents spreading of oily water	**Adopt**	Considered a standard control

Performance Outcome	Control measure	Benefit	Outcome	Evaluation
	Low pressure flushing of shoreline habitats using ambient temperature seawater	Reduces habitat damage, penetration of oil into sediments and erosion	**Adopt**	Considered a standard control
	Use of booms to contain shoreline flushing liquids	Reduces spread of oily water	**Adopt**	Will be accepted on a case by case basis – may be preferred if remobilisation of oil could further impact sensitive habitats. May not be applied if impacts from deploying booms exceed potential 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
	Compliance with local government municipal waste requirements	Prevents incorrect disposal	**Adopt**	Considered a standard control (regulatory requirement)
Physical presence and disturbance				
Disturbance to habitats, fauna and culturally sensitive areas during spill response is reduced to ALARP	Use of shallow draft vessels for shoreline and nearshore operations	Reduce seabed and shoreline habitat disturbance	**Adopt**	Considered a standard control
	Conduct shoreline assessment	Reduce seabed and shoreline habitat disturbance	**Adopt**	Considered a standard control
	Establish demarcation zones for vessel, boom and skimmer usage	Reduce seabed and shoreline habitat disturbance	**Adopt**	Accept based on potential for spill to enter sensitive shoreline locations and can be adopted during planning with minimal cost
	Maintenance and inspection personnel assigned to boom sets	Reduce seabed and shoreline habitat disturbance	**Adopt**	Considered a standard control
	IMT assessment/ selection of vehicles appropriate to shoreline conditions	Reduce coastal habitat and fauna disturbance	**Adopt**	Considered a standard control

Performance Outcome	Control measure	Benefit	Outcome	Evaluation
	Establish demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/ roosting areas and turtle nesting habitat	Reduce coastal habitat and fauna disturbance	**Adopt**	Considered a standard control
	Operational restriction of vehicle and personnel movement to limit erosion, compaction and disturbance to birdlife	Reduce coastal habitat erosion and compaction and disturbance to birdlife	**Adopt**	Considered a standard control
	Prioritise use of existing roads and tracks	Reduce coastal habitat and fauna disturbance	**Adopt**	Considered a standard control
	Use of landing barges	Reduce coastal habitat and fauna disturbance	**Adopt**	Will be assessed as part of site evaluation
	Use of Specialist Advisor if Operational Area overlapped with potential areas of cultural and heritage significance	Reduce disturbance to cultural and heritage significant sites	**Adopt**	Specialised knowledge may be required to identify cultural and heritage significant sites
	Pre-cleaning and inspection of equipment	Prevent introduction of invasive species	**Adopt**	Minimal costs and good practice considering potential for high value nature reserves and remote areas, with relatively undisturbed environments, to be accessed
	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
	Vessel Check Biofouling Risk Assessment Tool (Vessel Check) completed for interstate and international vessels (only)	Reduce risk for introduction of invasive marine species as part of vessel biofouling	**Adopt**	Considered a standard control
	Vessel Check for all vessels	Small reduction in IMS risk given most vessels are local and already operate in the region	**Reject**	Minimal benefit in terms of risk reduction is outweighed by the delays in implementing Vessel Check over the many

Performance Outcome	Control measure	Benefit	Outcome	Evaluation
		Greatest risk is international and interstate vessels		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
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
	Field trial undertaken of dispersant efficacy	Ensures dispersants are not added for no potential benefit	**Reject**	Montara crude has been evaluated in the laboratory and the field and dispersants are known to be effective
	Dispersant application location and volume assessment undertaken in IAP	Reduces impacts from dispersant and oil (entrained and dissolved) to sensitive shallow water habitats	**Adopt**	Considered a standard control
	Selection of correct equipment for application	Ensures correct dosage	**Adopt**	Considered a standard control

Performance Outcome	Control measure	Benefit	Outcome	Evaluation
	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.
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 6**)	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

7.9.3 Environmental performance

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
	Overall spill response			
044	OPEP provides for NEBA, notifications and consultation requirements to ensure net environmental benefit from response	NEBA undertaken every operational period and considered in development of following period Incident Action Plan.	Incident log	IMT Leader
045		OPEP activated as per OPEP notification table	Incident log	IMT Leader
047	Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008) procedure details IMT Core team members, resource pool and responsibilities	Jadestone IMT comply with Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008)	Incident log	IMT Leader
	Light emissions			
048	OPEP provides for task description for response activities to manage lighting during spill response	Refer to OPEP for detailed performance standards		
049		Vessels to maintain minimal lighting required for safety and navigation requirements	Vessel checklist or other confirmation from vessel master that requirements will be met	IMT Leader
	Noise			
050	Montara Marine Facility Manual (MV-90-PR-H-00001) details vessel and helicopter operating requirements to reduce interactions with cetaceans	Spill response vessels and aircraft comply with EPBC Act Regulation 8 (cetacean interaction).	Incident log	IMT Leader
	Atmospheric emissions			

Hazard		**Oil Spill Response Activities**		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
051	International Air Pollution Prevention (IAPP) Certificate valid to certify measures are in place to reduce air emissions	If required under MARPOL, vessels have a current International Air Pollution Prevention (IAPP) Certificate.	IAPP or vessel inspection document	IMT Leader
	Operational discharges and waste			
052	Vessels comply with MARPOL and protected area sewage disposal requirements	Vessel sewage disposal will meet MARPOL Annex IV requirements. If vessel activities occur within protected areas, discharges will meet marine park management plan requirements and the DoT sewage strategy[10]	Vessel checklist or other confirmation from vessel master that requirements will be met	IMT Leader
053	Vessels comply with MARPOL requirements for oily water (bilge) discharges	Vessel oily water disposal will meet MARPOL Annex I requirements.	Vessel checklist or other confirmation from vessel master that requirements will be met	IMT Leader
054	OPEP details controls in place to manage oily water during shoreline flushing	Refer to OPEP for detailed performance standards	Incident log	IMT Leader
061	Jadestones Waste Management Plan – Oil Spill Response Support (JS-70-PR-I-00037) details requirements and capability for waste treatment in the event of a spill	All waste associated with oil spill response activity transported and disposed of in accordance with Environmental Protection (Controlled Waste) Regulations 2004, EP Act 1986 and associated regulations as detailed in the OPEP	Waste tracking records	Supply Chain Manager

[10] http://www.transport.wa.gov.au/mediaFiles/marine/MAC-IS-SewageStrategy.pdf

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
	Physical presence and disturbance			
067	OPEP details appropriate equipment and sites for response selected during spill response activities to minimise potential impacts from vessel/equipment presence	Refer OPEP for detailed performance standards		
076	Vessels comply with Montara Marine Facility Manual (MV-90-PR-H-00001) which provides IMS prevention requirements	All vessels and MODUs demonstrate compliance with the biosecurity manual requirements	Documented evidence of compliance	
	Oiled Wildlife Response			
078	OPEP provides linkage to NTOWRP, WAOWRP and KOWRP	OWR undertaken in accordance with the NT and WA Oiled Wildlife Response Plans and the Regional Oiled Wildlife Response Plans	Incident log	IMT Leader
	Chemical dispersant application			
079	Prioritise the use of dispersants that are listed as approved on the Register of Oil Spill Control Agents (OSCA) - National Plan for Maritime Environmental Emergencies	Dispersants listed as approved on the Register of Oil Spill Control Agents (OSCA) - National Plan for Maritime Environmental Emergencies shall be used prior to any other dispersant being considered for use	Incident log	IMT Leader
080	Chemical dispersant selected in accordance with Operations Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033)	Chemical dispersant to be applied is selected after having undergone a risk assessment by Jadestone. The evaluation must find the chemical dispersant acceptable for use prior to application.	Incident log	IMT Leader
081	OPEP provides chemical dispersant application requirements	Refer OPEP for detailed performance standards	Incident log	IMT Leader

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
	Disruption to other users of marine and coastal area and townships			
086	Consultation undertaken in accordance with Jadestone Energy Consultation of Relevant Persons Procedure (JS-70-PR-I-00034) prior to deployment in populated areas	Consultation is undertaken with relevant stakeholders prior to deployment of resources to townships and marine/coastal areas.	Consultation records	IMT Leader
087	Localised Risk Management Assessment undertaken to minimise potential impacts on populated areas	A Risk Management Assessment is undertaken prior to large scale deployment to populated areas	Risk Management Assessment	
	Spill response preparedness			
088	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 for the supply of personnel and materials in place and current with competent service providers and suppliers	Contractor assessment records	Supply Chain Manager
089	AMOSC MSC/ AMSA MOU/ OSRL MSC valid for life of the EP	AMOSC & OSRL memberships allowing access to mutual aid arrangements for spill response crew and equipment via a Master Services Contracts (MSC) for life of EP AMSA MOU (access to NRT and resources) for life of EP	Current AMOSC & OSRL memberships and MSCs AMSA MOU valid for 5 years from 2017	Country Manager
090	Response personnel competent and trained in accordance with Jadestone Energy Training and Competency Management System (JS-60-PR-Q-0014) and OPEP for life of EP	Assessment of proposed/ rostered response personnel as being competent and trained according to the requirements of response roles defined in Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008)	Response personnel competency and training records	HR Manager

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
091	Jadestone Energy Audit Manual (JS-90-PR-G-00003) includes emergency response and spill preparedness requirements to be audited for life of EP	Audit of Jadestone's emergency response and spill preparedness requirements as scheduled and defined in the Audit Manual	Audit schedule Audit reports	Emergency Response Lead
092	Spill response exercise and training completed in accordance with Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008) to maintain spill preparedness readiness of Jadestone for life of EP	Training and exercising current and completed as required by the Incident Management Team Response Plan	Exercise schedule Exercising close out reports Training records	Emergency Response Lead
093	OPEP risk register maintained to ensure spill response is appropriate to nature and scale of risk for life of EP	Spill response planning and preparedness aligned with nature and scale of risk of EP	Montara OPEP risk register	Emergency Response Lead
094	*Montara Venture* Shipboard Oil Pollution Emergency Plan (MV-70-PLN-G-00002) valid and tested to ensure ability to respond to spills as required by MARPOL	In line with MARPOL Annex 1, support 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	Exercise reports IOPP SMPEP/ SOPEP	OIM
095	Drills and exercises undertaken in accordance with the Montara Incident Response Plan (MV-70-PLN-F-00001)	FPSO drills and exercises are conducted in accordance with the Montara Incident Response Plan (MV-70-PLN-F-00001) and recorded in BASSnet	BASSnet (SAFIR) records	
096	Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008) maintained to ensure ability to respond to spills by Jadestone	Provides current information for Jadestone spill response resources and matches risk as defined in the EP	Annual Performance Report	Emergency Response Lead

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
097	Personnel aware of roles and responsibilities in the event of a response in accordance with Montara Incident Response Plan (MV-70-PLN-F-00001)	Instructs offshore response roles and responsibilities and training requirements.	Exercise records Training and induction records	Operations Manager
098	Montara Drilling Source Control Plan in place one month prior to drilling commencing	Montara Drilling Source Control Plan in place that address loss of well containment actions as defined in the EP that minimise risk to personnel and reduce environmental impact	Montara Source Control Plan	Drilling Manager
099	AMOSC Subsea First Response Toolkit membership is in place for the life of the EP, including appropriate insurance and an Operations, Training and Advice (OTA) Agreement with Oceaneering	Maintain AMOSC Subsea First Response Toolkit membership, appropriate insurance and an OTA Agreement with Oceaneering which allows access to equipment, dispersant stocks and technical support for subsea dispersant application	Current Subsea First Response Toolkit membership, insurance and OTA Agreement records	Country Manager
100	ROV support in place for SFRT activity	Contract in place to provide ROV services for SFRT	Current contract in place	Supply Chain Manager
101	Labour hire contract in place for life of EP to source labour for oil spill response	Labour hire contract in place to provide access to personnel	Labour hire contract	Supply Chain Manager
102	Vessel availability for Subsea First Response Toolkit deployment is monitored monthly via Jadestones nominated vessel broker for life of EP	Monitor the availability of vessels that are suitable for deployment of the Subsea First Response Toolkit for life of EP	Monthly Monitoring reports	Logistics and Materials Lead
103	Maintain contract with Jadestones 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 and Materials Lead

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
104	Monitor external drilling programs for MODU availability for life of EP	Jadestone to have a process for monitoring external drilling programs for MODU availability	Monthly Monitoring reports	Logistics and Materials Lead
105	Monitor status of Registered Operators with Approved Safety cases for rigs for life of EP	Jadestone have a process for monitoring the status of Registered Operators with Approved Safety cases for rigs	Monthly Monitoring reports	Logistics and Materials Lead
106	Contract and Equipment Access Agreement with Wild Well Control (WWC) for life of EP	Contract and Equipment Access Agreement with Wild Well Control are maintained providing technical support and equipment access for a LOWC incident	Contract and Equipment Access Agreement with Wild Well Control	Supply Chain Manager
107	APPEA MOU for mutual assistance to facilitate and expedite the mobilisation of a relief well for life of EP	APPEA MoU for mutual assistance for relief well drilling	Records demonstrate Jadestone is a signatory of the APPEA MoU for Mutual Assistance	Country Manager
108	Vessel availability for containment and recovery activity is monitored monthly via Jadestones 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 Manager

7.9.4 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). The strategic NEBA has been conducted for chemical dispersant operations (refer to the OPEP) indicates an overall positive effect, based on reduced shoreline loading of oil and spatial extent of floating oil above the impact threshold.

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 (2015). 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 (HAZID). 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 7-23** and reflected in **Section 8.7.**

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.

7.9.5 Acceptability assessment

The potential impacts of spill response activities are considered '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 & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Stakeholders & reputation	Stakeholder consultation has been undertaken (**Section 6**), and no stakeholder concerns have been raised with regards to spill response activities. During any spill response, a close working relationship with key regulatory bodies (e.g. DoT, DBCA, AMSA, DER) will occur and thus there will be ongoing consultation with relevant persons during response operations.
Environmental context & ESD	The worst-case credible spill scenario for the operating activities is as a result of a collision between the FSO and another large vessel (e.g. third-party offtake tanker). The release of oil occurs over five hours and the area of dispersion over which the oil travels is between Eighty Mile Beach to the north, and to 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 will have regard to the representative values of the reserves and other information 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 spill response activities to ensure that the objectives of the management plans are not contravened (**Appendix C**). 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 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 Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. The Management Plans for EPBC protected species that identify light, noise and other risks in **Sections 7.1 – 7.8** 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.

8. ASSESSMENT – ACCIDENTAL EVENTS

8.1 Unplanned Flaring

8.1.1 Description of hazard

Unplanned flaring	The field design of the Montara production operation includes reinjection of produced gas. Reinjection of produced gas occurs from the FPSO by way of a gas reinjection compressor sending gas back into the reservoir where the reinjected gas facilitates production from subsea wells in the Skua, Swift and Swallow fields. From time to time however, reinjection of produced gas is unable to occur and produced gas that would otherwise be reinjected is released to the flare. The primary circumstance leading to produced gas being flared rather than reinjected would be due to the reinjection system being unavailable or other gas-fuelled equipment on the FPSO not requiring gas. In the circumstance of gas reinjection not being available, flaring rates may increase by up to two-fold.

8.1.2 Impacts and risks

Aspect	**Impact description**	
Emissions	Emissions due to flaring can reduce air quality in the immediate vicinity of the Facility or vessels present in the Operational Area. While the quantities of gaseous emissions during unplanned flaring are high relative to planned flaring rates, the volumes flared during unplanned production circumstances are expected to quickly dissipate into the surrounding atmosphere. As Montara Facility operations 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. No impacts to social receptors are therefore expected. Unplanned flaring rates are expected to not occur for extended durations (months at most) and as such impacts to air emissions are considered ***negligible.***	
Light	There is a potential for marine fauna individuals (including marine reptiles and seabirds; refer **Section 7.1**) to be impacted by light emissions from unplanned flaring. However, as the Operational area does not contain any significant feeding, breeding or aggregation areas for fish it is more likely there will be individuals traversing the area then large groups of species. As such impacts to marine fauna are considered ***negligible.***	
Likelihood assessment		
Unlikely	A set of control measures and checks have been proposed to ensure that the risks of unplanned flaring have been minimised. Given the controls in place, the likelihood of unplanned flaring resulting in a negligible consequence is considered likely based on the operational and maintenance activities in place. Therefore, the overall risk ranking is considered conservative. The worst-case likelihood assessment with controls in place was **unlikely**.	
Consequence	**Likelihood**	**Ranking**
Negligible	Unlikely	Low

8.1.3 Environmental performance

Hazard		**Unplanned flaring**		
Performance outcome		**Flaring from the *Montara Venture* does not exceed 299,674t CO2 per annum**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
109	Performance Standard Report (MV-70-REP-F-00002) ensures integrity and maintenance requirements maintained	Pipework and pressure vessels will be maintained to Australian Standards	Satisfactory close out of work instruction	Maintenance Supervisor
110		Unplanned flaring does not exceed a continuous period of 1 month	Daily Production Reports	Operations Manager
111	CMMS work instruction	Gas reinjection compressor and turbine maintained and operated to manufacturers recommendations	Satisfactory close out of work instruction	Engineering and Maintenance Manager
112	Spares of critical equipment for the gas reinjection system	Critical spares for the gas reinjection system will be managed to reduce downtime of the system in the event of malfunction, damage or maintenance requirements	Critical spares inventory	Engineering and Maintenance Manager

8.1.4 ALARP assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage unplanned flaring occurrences and durations to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Tolerable as they are within the green category (negligible impacts). No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
All emissions producing equipment is removed	Eliminate	No	N/a	Atmospheric emissions from production and operating equipment including vessels and helicopters is required to undertake the Activity. Equipment cannot be removed completely.
All equipment in the gas reinjection system is allocated a spare in inventory keeping	Substitute	No	No	Purchasing and maintaining equipment spares for the whole gas reinjection system is not practicable from a cost or maintenance perspective. As a compromise spares of critical equipment will be provided for where available and obtainable. Maintenance of critical spares is a consideration in achieving critical spares inventory.
Topside processing of production allows recycle of gas generated between production treatments stages 2 and 3 to allow gas capture at these points and recycle of gas to the first production stage	Engineering	Yes	No	While recycle of gas from production stages 2 & 3 will reduce flared emissions, at this stage cost effectiveness of this modification is not justifiable (approx. cost of $1M).
None identified	Isolation	N/a	N/a	The Activity is located at distance from sensitive receptors and the coastline.
None identified	Administrative	N/a	N/a	Compliance with relevant and appropriate MARPOL requirements
Steam facilitating low opacity emissions currently there is no steam line running to the flare tip because the original engineering design did not include this feature. A steam system would need to be supplied with steam 24 hours per day in the event it was required for combustion emission management (i.e. it needs to be instantaneously operable when required). This would place an operational load on the boiler which is the equipment that would supply steam. The boiler	Engineering	Yes	No	No parties (e.g. air force, navy, border force, local users) have complained or reported dark emissions at Montara. The cost for the improvement versus the benefit that would be achieved is not ALARP.

system may need to be redesigned to enable the steam supply function to the flare tip (the cost for re-engineering the boiler has not been considered in this assessment). The cost for design, installation and commissioning is estimated to be approx. $0.5M cost.				
High pressure water cleaning to create white smoke: as for the steam cleaning system, the flare system at Montara has not included this function within the original design of the facility. The cost that would be incurred due to engineering design, construction and commissioning of a high-pressure water cleaning system at the flare tip is estimated at approx. $0.3M.	Engineering	Yes	No	No parties (e.g. air force, navy, border force, local users) have complained or reported dark emissions at Montara. The cost for the improvement versus the benefit that would be achieved is not ALARP.
Increased flaring: another option is to increase flaring in the event of dark smoke emissions due to lack of oxygen at the flare tip. Increased flaring results in better combustion at the flare tip due to the sonic design of flare and thereby a reduction in the opacity of emissions.	Administrative	Yes	Yes	Not adopted – the increased flaring would be contrary to the intent of the environmental performance outcome of planned flaring operations

8.1.5 Acceptability assessment

The potential impacts due to unplanned flaring are considered acceptable in accordance with Section 4.4, based on the acceptability criteria outlined below. Control measures in relation to operations and maintenance of the gas reinjection system, and operation and maintenance of the flare system, to reduce the occurrence and duration of unplanned flaring, and the environmental consequence of the event is considered negligible.	
Policy & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for the activities.
Stakeholders & reputation	Stakeholder consultation has been undertaken (see **Section 6**), and no stakeholder concerns have been raised with regards to impacts from unplanned flaring on sensitive receptors.
Environmental context & ESD	While there is light associated with unplanned flaring, the impact and risk assessment process indicates that light associated with unplanned flaring will not cause significant effects to marine fauna that may transit the Operational Area. While there is an increase in atmospheric emissions to the airshed due to unplanned flaring, emissions occur immediately around the facility and vessels. The impact and risk assessment process indicate that emissions due to unplanned flaring 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 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 due to unplanned flaring and therefore the activity would not contravene the intent of the Recovery Plan. No Management Plans identified air emissions such as those associated with unplanned flaring as being a threat to marine fauna or habitats. Jadestone has had regard to the representative values of the protected areas within the EMBA, and the respective management plans and other published information. Impacts from light or air emissions from unplanned flaring 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 (Appendix C), and considered acceptable.

8.2 Marine Pest Introduction

8.2.1 Description of hazard

IMS	The Montara FPSO and the WHP are stationary facilities within the Operational area, located greater than 12 NM from the nearest land and in water depths of approximately 80 m. Both facilities were cleared as low risk installations[11] when they first arrived in Australia. Therefore, the FPSO and WHP do not present a biosecurity risk. There is the potential for support vessels or vessels used for RLWI and/ or intervention systems for the Montara Wellhead Platform wells (as described in S3.3.11) to transfer invasive marine pests (IMPs) from either international waters or Australian waters into the Operational Area and for them to establish in the local environment. There is also potential for invasive marine pests to be transferred into Australian Territory and coastal waters via support vessels when commuting to/ from State/ Territory or Commonwealth waters.

8.2.2 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;

[11] Consistent with the Biosecurity (Exposed Conveyances—Exceptions from Biosecurity Control) Determination 2016, an installation may be classed as low/acceptable risk if:

a) Only domestic persons or persons confirmed by the Department of Agriculture and Water Resources to be low risk are on board the installation; and
b) Only the following kinds of goods have ever been on board the installation: i) domestic goods; ii) low risk goods (i.e. fuel or petroleum); iii) goods that are to be deployed to the sea or the seabed; iv) goods that are in the possession of a domestic person who left the installation temporarily and later returned to it; or other equipment and goods determined by the Department of Agriculture and Water Resources to be low risk; and
c) The Director of Biosecurity is satisfied that the level of biosecurity risk associated with the installation is acceptable before the exposure to vessels occurs, as confirmed in a 'low risk letter'; and
d) During the period between receiving the 'low risk letter' from the Director of Biosecurity and the exposure to the vessels occurring, no persons boarded the installation or only domestic persons boarded the installation; and no goods were brought on board the installation or only goods of a kind referred to in paragraph (b) were brought on board the installation.

- 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.

Ballast water is responsible for up to 30% of all IMS incursions into Australian waters, however, research indicates that biofouling (the accumulation of aquatic micro-organisms, algae, plants and animals on vessel hulls and submerged surfaces) has been responsible for more foreign marine introductions than ballast water (DAWR 2017).

There are three key steps involved for a successful Introduced Marine Pest Species (IMPS) incursion:

- Colonisation and establishment of 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.

Introduced marine pests (IMPs) are marine fauna or flora that have been introduced into an area beyond their natural range; they do not occur naturally in that environment. IMPs able to survive outside of their natural range may pose a significant threat to the Australian marine environment. It is estimated that Australia has over 250 established marine pests, and it is estimated that approximately one in six introduced marine species becomes pests (DoE 2015l).

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.

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 (biosecurity@fish.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.

Sensitive Receptor	Impact description	
Benthic habitats	Ballast water discharge and contaminated ships and equipment may have the potential to introduce IMS. It is not likely that any IMS entering the Operational Area would establish on the natural benthic habitat (soft sediments at the seabed). The depth of the Operational Area (80 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 IMPs. However, in the event that IMS establishes on the benthic habitat it could result in an overall change in localised areas to the benthos. In the event that an IMS is introduced into the operational area, there could be a reduction in the physical environment. The consequence was assessed as **Minor-** *Minor effect; recovery in weeks to months; death of individuals* as impacts would be within 1 km of the activity and could result in potential mortality to fauna associated with the benthic habitat.	
Fish and Fisheries	There are increased concerns regarding fishery impacts following the introduction of IMPs into Australian waters. Should IMPs 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 IMPs will be able to establish in water depths of the Operations Area (~80 m). However, if IMPs was established it may have a '**moderate**' impact - *Local effect; recovery in months to a year; impact to localised community*	
Likelihood assessment		
	It is not likely 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 (80 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.	
Consequence	**Likelihood**	**Ranking**
Moderate	Unlikely	Medium

8.2.3 Environmental performance

Hazard		Marine Pest Introduction		
Performance outcome		**No introduction of marine species**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
113	Vessels comply with the Marine Biosecurity Manual (JS-70-MN-G-00001)*. Note: This has been submitted to NOPSEMA December 2018 and Jadestone refers to its contents under Reg 31.	All vessels demonstrate compliance with the biosecurity manual requirements	Documented evidence of compliance	Marine Superintendent

* The biosecurity manual applies to all marine vessel operations in Operational Areas 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 Species (IMS) 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 IMS being introduced to the operational area to As Low as Reasonably Practicable (ALARP).

8.2.4 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 are ALARP. The residual risk ranking for this potential impact is Medium. Good industry practice has been applied for the situation or risk. Additional controls considered but rejected are detailed below. No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
Support vessels to be sourced from Australian waters	Eliminate	No	No	The presence of the FPSO and associated support vessels is required to carry out operations. 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(s) the nearest habitat is the FPSO/ vessel hull or the benthic habitat (soft sediments at the seabed). The depth of the Operational Area (80 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 IMPs.
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 sea chests (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.

8.2.5 Acceptability assessment

The potential impacts of marine pest introduction are considered 'Acceptable' as the residual risk is Medium and ALARP can be demonstrated (refer above), 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.
Policy & management system compliance	**Section 9** 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.
Stakeholder & reputation	Stakeholder consultation has been undertaken (see **Section 6**), and no stakeholder concerns have been raised. Jadestone will continue to liaise with Department of Primary Industries and Regional Development (Fisheries) on current requirements for the management of the risk of marine pest introduction in WA waters.
Environmental context & ESD	It is unlikely that any invasive marine pests entering the Operational Area(s) will establish on the natural benthic habitat (soft sediments at the seabed). The depth of the Operational Area (80 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 EMBA, and the respective management plans and other published information. Impacts from successful establishment of marine pests will not 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 (Appendix C) and considered acceptable.

8.3 Interaction with fauna

8.3.1 Description of hazard

Interaction with fauna	The movement of support vessels, and helicopters in the Operational Area increases the potential for physical or disruptive interaction with marine fauna.

8.3.2 Impacts and risks

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 5-4Table 5-5Table 5-6). Other fauna such as 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.

Marine Mammals

Cetaceans are naturally inquisitive marine mammals that are often attracted to vessels underway; for example, dolphins commonly 'bow ride' with vessels. There have been recorded instances of cetacean deaths as a result of vessel collisions in Australian waters (e.g. a Bryde's whale in Bass Strait in 1992) (WDCS 2006), though the data collected indicates this is likely to be associated with container ships and fast ferries. Collisions between vessels and cetaceans are most frequent on continental shelf areas where high vessel traffic and cetacean habitat occur simultaneously (WDCS 2006).

The Conservation Management Plan for the Blue Whale (DoE 2015) identifies vessel strike as one of the threats to Blue Whale species.

The reaction of whales to the approach of a ship is quite variable. Some species remain motionless when in the vicinity of a ship while others are known to be curious and often approach ships that have stopped or are slow moving, although they generally do not approach, and sometimes avoid, faster moving ships (Richardson et al. 1995).

<u>Marine Turtles and Sharks (Whale Sharks)</u>

Other marine fauna like turtles and whale sharks that are present in shallow waters or surface waters are also susceptible to vessel strike due to their proximity to the vessel (hull, propeller or equipment) and their limited ability to avoid vessels.

Whale sharks may be behaviourally vulnerable to boat strike. They spend a significant amount of time feeding in surface waters (DEH 2005; Norman 1999) and scars have been observed on several whale sharks that have likely been caused by boat collision (DEH 2005). There have also been several reports of whale sharks being struck by bows of larger ships in other regions where whale sharks occur (Norman 1999).

<u>Marine birds</u>

Should individuals of listed or migratory bird species transit through the Operational Area, the worst-case consequence of a bird strike with a helicopter would be localised, with a potentially lethal effect on a single individual with no lasting effect to population or community baseline.

Vessel speed is a strong contributor to the rate of collisions with marine fauna, with increasing vessel speed resulting in a higher collision risk (Hazel et al. 2007; Silber et al. 2010). A study conducted by Laist et al. (2001) on collisions between ships and whales observed that most lethal or severe injuries to cetaceans involved vessels 80 m or longer in length and were associated with vessels travelling at 14 knots or faster.

The Montara support vessels typically travel at speeds under 14 knots during most supply runs as this represents the most economical speed. On rare occasions, higher speeds may be used where urgent delivery of supplies is needed. Supply vessel speeds within the Operational area when approaching the FPSO are low and are required to be less than 5 knots within the 500 m PSZ.

Sensitive Receptor	**Impact description**
Marine mammals	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. As described above vessels within the PSZ will travel no faster than 5 knots, and hence the chance of a vessel-whale collision resulting in lethal outcome is reduced. Cetaceans 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 may also contribute to reducing the likelihood of a vessel strike.

Sensitive Receptor	Impact description
	Three listed threatened and migratory species of cetacean were identified as potentially occurring or having habitat in the Operational area: the sei whale, blue whale andfin whale. Although Vessel strike is identified within relevant conservation and recovery plans. However, there are no known key aggregation areas (resting, breeding or feeding) located within or immediately adjacent to the Operational Area. The Blue Pygmy whale BIA (distribution) overlaps the Operational Area, pygmy blue whales are typically solitary animals or occur in low numbers. Occasional individuals or groups of a number of cetacean species may also be present from time to time. *Should a support vessel strike a marine mammal, the worst-case consequence would be a potentially lethal effect on a single individual with no lasting effect to population. With the controls implemented to reduce impacts to marine mammals, any potential disturbances are expected to be **minor** – Minor effect; recovery in weeks to months; death of individuals).*
Marine reptiles	Turtles and seasnakes are also susceptible to vessel strikes when they come to the sea surface to breathe. While turtles typically avoid vessels by rapidly diving, their response varies significantly in relation to the speed of the vessel and the activity of the turtle. 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). *Six species of listed threatened and migratory marine turtle were identified as potentially occurring in, or relating to, the Operational Area; loggerhead, green, leatherback, hawksbill, olive ridley/ Pacific ridley and flatback turtles (**Section 5.5.4**), and the leaf scaled seasnake. Marine turtles are predominantly oceanic species except in the nesting season when they come ashore. There are no shorelines in close proximity to the Operational area. However, turtles may transit the offshore waters in proximity to the Operational area and may forage on nearby shoals (noted as BIA foraging for some species). Seasnakes are unlikely to be encountered in the operational area due to the distance from reef and shoal habitats.* The Operational Area does not intersect any Habitat Critical for the Survival of marine turtles, with the closest nesting area being 84 km away (green turtle nesting area at Cartier Island boundary (Figure 5-5). *Vessel strike is an identified impact within relevant conservation and recovery plans, given that marine turtles are known to occur in the region and in the vicinity of the Operational Area they are also susceptible to vessel strike. However, vessel strikes are unlikely in the Operational Area where vessel are travelling at low speeds. In the event of a vessel strike, it is expected that there would be an impact to individual(s) and as such there would not be a decrease in the population size at either a local or regional scale.* *The worst-case consequence was assessed as Minor due to the potential mortality to an individual. As a result potential impacts to adults are expected to be **Minor** – Minor effect; recovery in weeks to months; death of individuals).*
Whale sharks	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 most northern part of whale shark foraging biologically important areas (BIAs) overlaps the Operational area and are susceptible to vessel strike. However, only occasional individuals are expected to occur as there are no whale shark aggregations (such as the Ningaloo Reef aggregation) in the region. *The worst-case consequence was assessed as Minor due to the potential mortality to an individual. As a result potential impacts to adults are expected to be **Minor** – Minor effect; recovery in weeks to months; death of individuals).*

Sensitive Receptor	Impact description
Seabirds.	*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. Collisions are therefore assessed as Minor due to the potential mortality to an individual. As a result potential impacts to adults are expected to be* ***Minor*** *– Minor effect; recovery in weeks to months; death of individuals).*
Likelihood assessment	
Likely	Due to the general low vessel speeds, and low number of helicopter flights (and lack of any significant bird habitat) the chance of a vessel collision with marine fauna resulting in a lethal outcome is reduced as individuals are expected to display avoidance behaviour. The risk ranking with controls in place (**Section 8.2.3**) was assessed as **unlikely**. With helicopter presence and the number of birds present at FPSO and helicopter, the likelihood assessment is considered **likely** within the peak roosting and nesting season until implementation of bird management measures are effective in reducing the numbers of birds present.

Consequence	Likelihood	Ranking
Minor	Likely	Medium

8.3.3 Environmental performance

Hazard		Interaction with fauna		
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**
114	Potential for collision with marine fauna reduced by vessels operating at speeds in accordance with Montara Marine Facility Manual (MV-90-PR-H-00001)	Vessels operating within the PSZ must not exceed a speed of five (5) knots.	Vessel Masters provided and required to operate in accordance with the Montara Marine Facility Operating Manual – Sign-off sheet for completed by Vessel Master.	Supply Chain Manager
115	Competency and Training Management System [JS-60-PR-Q-00014] provides personnel with awareness marine fauna interaction requirements	Online induction includes information on speed limits in the PSZ and requirements on interacting with marine fauna	Induction Records (Vessel Masters)	HR Manager
116	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 DCCEEW in line with regulations	Vessel collision incident report Database entry number	HSE Manager

8.3.4 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 risk of collision between vessels and marine fauna or negative interaction with helicopters to ALARP. The residual risk ranking for this potential impact (minor) is considered Low. Additional controls considered but rejected are detailed below. No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost Effective	Justification
Removal of vessels and helicopter use	Eliminate	No	No	Vessel and helicopter presence is required during operations and there are no practicable alternatives. The potential for interaction between support vessels and fauna cannot be eliminated, however the risk is 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 FPSO.
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 FPSO all year round.
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.

8.3.5 Acceptability assessment

The potential impacts of helicopters and vessels on marine fauna during the operation 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 & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Stakeholder & reputation	Stakeholder consultation has been undertaken (**Section 6**), and no stakeholder concerns have been raised with regards to impacts from vessel/ helicopter operations on sensitive receptors.

Environmental context & ESD	The Operational Area overlaps the whale shark BIA. However, risk to megafauna is considered low and acceptable as vessels will travel at low speeds within the Operational Area; minimal vessel activity in the area, and risk of mortality from a low-speed vessel strike is low. In this way, aspects of the EPBC Regulations 2000, Division 8.1 – Interacting with Cetaceans –are addressed. 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, (EA 2003). 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 is 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. Jadestone has had regard to the representative values of the protected areas within the EMBA, 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 marine parks. 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 (Appendix C), and considered acceptable.

8.4 Unplanned Release of Solid Waste

8.4.1 Description of hazard

Solid waste release	Release of solid wastes may occur as a result of overfull and/or uncovered bins, incorrectly disposed items or spills during transfer of waste between the FPSO/WHP and support vessels. A non-hazardous release of solids to the environment has the potential to occur from the following activities: • FPSO, WHP or supply vessel operations; • Lifting; • Accidental discharge of dry bulk products; and • Accidental discharge of waste. Hazardous wastes, such as chemicals and chemical containers, batteries, waste oil, produced sands, medical wastes and oily wastes, will be generated from operations and disposed of onshore in accordance with a Waste Management Plan.

	Wetblasting, if performed, will generate a sludge waste comprising blasting medium (water or garnet if used), rust and particles of old surface coatings (e.g. paint, epoxy). Similarly, the waste product from wetblasting is disposed of onshore.

8.4.2 Impacts and risks

Solid waste items have the potential to pollute marine habitats and injure or kill fauna through ingestion or exposure if released to the marine environment. The effects of discharges of solid wastes are dependent on the nature of the material involved. Marine fauna can become entangled in waste plastics, which can also be ingested when mistaken as prey (Ryan et al. 1988), potentially leading to injury or death. Generally, no toxic effects are expected from non-hazardous solids. Water quality impacts are not expected from the release of solid wastes.

Sensitive Receptor	**Impact description**
Marine fauna	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. Indiscriminate foraging behaviour in turtles has resulted in turtles mistaking plastic for jellyfish (Mrosovsky et al. 2009). Marine fauna (including seabirds) encountered within the Operational Area are expected to be limited to small numbers of transient individuals. There are no known critical habitats within the operational area for EPBC listed species. The operational area overlaps with the northern section of the whale shark foraging BIA; however, only low numbers are likely to be present. The accidental release of waste may result in injury or even death to individual marine fauna but is not expected to result in a threat to population viability. The consequence of an unplanned release of solid waste on marine fauna was assessed as ***Minor*** given the likely objects dropped overboard and the transient nature of marine fauna and lack of foraging habitat within the operational area.
Benthic habitats	Benthic habitats have the potential to be impacted with accidental spills of solid wastes 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. The extent of the seabed damage will be limited to the size of the dropped object and given the size of standard materials lifted overboard, any impact is expected to be very small. Given there are no sensitive or unique marine habitats in the area and the diversity and coverage of epibenthos is low (ERM 2011), benthic communities are expected to rapidly recolonise any damaged area (Currie and Isaac, 2004). Given the relatively small footprint of any dropped object, the widespread distribution and abundance of benthic communities within the operational area, the consequence to benthic communities would be a highly localised, negligible, and reversible change to a very small proportion of the of the overall benthos. The consequence of an unplanned release of solid waste on benthic habitats was assessed as ***Minor*** given the likely objects dropped overboard.
Other marine users	In the event of a buoyant solid waste being accidentally released to the marine environment, it may create a navigational hazard to other marine users. The consequence of an unplanned solid waste on other marine users was assessed as ***Negligible*** given the likely objects dropped overboard.
Likelihood assessment	

<table>
<tr><th>Sensitive Receptor</th><th colspan="2">Impact description</th></tr>
<tr><td>Likely</td><td colspan="2">A set of control measures and checks have been proposed to ensure that the risks of dropped objects, lost equipment or release of solid waste to the environment has been minimised. The likelihood of transient marine fauna occurring in the operational area is limited.
Given the controls in place, the likelihood of releasing non-hydrocarbon solids to the environment resulting in a negligible consequence is considered likely based on the activities undertaken in the operational area assuming the potential for a single loss of solid waste incident during the activity. It is noted that the likelihood of dropped objects and waste dropped during transfers is a lower likelihood but with a higher consequence. Therefore, the overall risk ranking is considered conservative. The worst-case likelihood assessment with controls in place was Likely.</td></tr>
<tr><th>Consequence</th><th>Likelihood</th><th>Ranking</th></tr>
<tr><td>Minor</td><td>Likely</td><td>Medium</td></tr>
</table>

8.4.3 Environmental performance

Hazard		Unplanned discharge of solid waste		
Performance outcome		**Zero unplanned discharge of solid wastes into the marine environment**		
ID	**Management Control**	**Performance standards**	**Measurement criteria**	**Responsibility**
117	Waste generated during operations will be managed in accordance with the Montara Waste Management Plan (MV-70-PLN-F-00004LI)	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	OIM
		Hazardous solid wastes will be managed in accordance with relevant legislation	A waste register will be maintained to show that hazardous wastes are being collected and returned onshore for disposal	OIM
118	Competency and Training Management System (JS-60-PR-Q-00014)*	FPSO crew and support vessel masters complete an induction containing basic information on environmental practices	Induction completion record	OIM/ Vessel Master
119	Montara Lifting Operations Procedure (MV-00-PR-F-00006) implemented for lifts undertaken in the operational area	All personnel involved with lifting equipment operations and maintenance receive adequate training and are competent appropriate to their level of responsibility	Competency matrix	OIM
120		JSA is completed for all lifts and approved under the PTW	Completed PTW documentation	OIM
121		A Lift Plan completed for Complex and/or Engineered Lifts	Approved Lift Plan	OIM
* 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.				

8.4.4 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 unplanned discharges of solid waste to ALARP. The residual risk ranking for this potential impact is considered **Medium** based on a likelihood of **Likely** and consequence of **Minor**. Additional controls considered but rejected are detailed below. No further controls are required and therefore ALARP has been demonstrated.				
Rejected control	**Hierarchy**	**Practicable**	**Cost Effective**	**Justification**
Removal of solid waste generation during activity and eliminate transfers (lifts)	Eliminate	No	No	Solid wastes produced onboard are disposed of onshore and are not discharged to the marine environment. FPSO and vessels will not have enough deck space to store all required equipment, materials, supply needed for activities.
Reduce impact of solid wastes in the event of discharge	Substitute	No	No	Where appropriate, selection of chemicals or materials to achieve low or no environmental effect is made.
N/a	Engineering	N/a	N/a	Not relevant
Reduce or remove solid waste generation and transfers during key sensitive periods	Isolation	No	No	Reducing or removing waste generating 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 FPSO all year round. The activity is located at distance from sensitive receptors and the coastline.
None identified	Administrative	N/a	N/a	None identified. Maintenance management system implemented, compliance with relevant and appropriate MARPOL and legislative requirements, certified equipment.

8.4.5 Acceptability assessment

The potential impacts of unplanned discharges of solid wastes during the activity 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 & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Stakeholder & reputation	Stakeholder consultation has been undertaken (**Section 6**), and no stakeholder concerns have been raised with regards to impacts from solid waste generation or unplanned discharges on sensitive receptors.
Environmental context & ESD	Benthic habitats have the potential to be impacted with solid wastes resulting in potential loss of soft sediment communities and harm to marine fauna. If impacted, benthic habitats and associated biota are well represented in the region and there are no known areas of sensitive habitat within the area that may be affected by accidental release of solid waste. Marine fauna can become entangled in waste plastics, which can also be ingested when mistaken as prey

	potentially leading to injury or death. Generally, no toxic effects are expected from non-hazardous solids 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 North-west Shelf and the transient nature of marine fauna that may be present in 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	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). The 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.

8.5 Unplanned Release of (Non-Hydrocarbon) Liquids

8.5.1 Description of hazard

Unplanned discharge of liquids	Both non-hazardous and hazardous chemicals are routinely transported to and from, stored and used aboard the *Montara Venture* FPSO. There is potential for these chemicals to be accidentally spilled to the marine environment from both the Montara facilities and activity support vessels. A non-hydrocarbon liquid, in particular chemicals, may be released to the environment. The maximum volume of non-hydrocarbon liquid that may be released during routine operations is likely to be small and realistically limited to the volume of individual containers (e.g. IBCs/ drums etc.) stored on-deck (1 m^3). Chemicals, for example solvents and detergents, are typically stored in small containers of 5–25 L capacity and used in areas that are bunded. Leaks and spills of non-hydrocarbon liquids are typically contained within the immediate storage/ use area or on board. Hazardous industrial wastes may include radioactive materials, paint and thinners, waste oil, proprietary cleaning agents and chemicals for chemical injection. Naturally occurring radioactive materials (NORMs) may be encountered as part of the operations and require removal and disposal ashore. Accidental chemical releases may occur during any season at any time given the ongoing nature of Montara operations and based upon existing chemical inventories, the volume of spill is conservatively estimated to be limited to a single discharge of 5m^3 (based upon pour point depressant, with lesser volumes for other chemicals such as biocide, glycol, corrosion inhibitor, scale inhibitor, methanol, and

	reverse emulsion breaker). An unplanned discharge would be an instantaneous release within the operational area. Whilst cumulative effects are not anticipated from a single accidental non-hydrocarbon liquid release, some chemicals may persist in the marine environment.

8.5.2 Impacts and risks

Should non-hydrocarbon liquids be spilled to the marine environment, the potential impact pathways to marine fauna and benthic communities are:

- Ingestion or physical contact with chemical compounds within the water column or sediment; and
- Accumulation and biomagnification of chemicals within the food chain.

The potential exposure to non-hydrocarbon liquids would be dependent on the type, volume of discharge, concentration at discharge, toxicity, persistence and bioaccumulation potential. Also, exposure may vary depending on the dilution and dispersion potential of the chemical, or whether the chemical sinks to the sea floor. Hazardous liquids have the potential to impact local water quality, which in turn may impact on the health and reproductive development of marine fauna (e.g. pelagic fish, cetaceans, marine reptiles and seabirds) and have a flow-on effect through the whole ecosystem including socio-economic receptors.

Sensitive Receptor	Impact description
Water Quality	Environmentally hazardous chemicals and liquid wastes lost to the marine environment may lead to contamination of the water column in the vicinity of the vessel. The potential impacts would most likely be highly localised and restricted to the immediate area surrounding the spill, with rapid dispersal to concentrations below impact thresholds likely to occur in the open area of ocean. Spills of hazardous chemicals are unlikely to have widespread ecological effects given the nature of the chemicals on board, the small volumes that could be released, and the depth and exposure of the location. The consequence of an unplanned release of non-hydrocarbon liquids on water quality was assessed as ***Negligible*** given the likely volumes and types of liquids and the rapid dilution and dispersion that would occur.
Benthic Habitat	While unplanned liquid discharges may cause short term reductions in the change in water quality, these spikes are expected to occur for very short durations and as such any affects to benthic habitats are expected to be temporary as the most common benthic habitat soft sediments, which would recover quickly if impacted. Given the water depth and the high dispersion of any potential marine pollutant in an open-ocean environment, it is considered unlikely that there be an adverse impact on benthic communities. There is no emergent or inter-tidal habitat that could be impacted by a surface spill and the benthic habitat is predominately soft sediments. Any spilled material is unlikely to reach any of the demersal species or benthic habitats at the seabed. Sub-lethal or lethal effects from unplanned discharges at the seabed on marine fauna, is considered unlikely given the expected low concentrations and short exposure times. The consequence of an unplanned release of non-hydrocarbon liquids on water quality was assessed as ***Negligible*** given the likely volumes and types of liquids, the low sensitivity of the benthic habitat and the rapid dilution and dispersion that would occur.
Marine Fauna	Liquid discharges may cause negligible short-term water quality perturbations (see above) and as a result a possible alteration to marine fauna behaviour. The changes to water quality that may result could potentially lead to short-term impacts on marine fauna (e.g. pelagic/benthic fish, epifauna, cetaceans, marine reptiles and seabirds), with chronic impacts not expected owing to the short exposure times likely. The susceptibility of marine receptors to non-hydrocarbon releases will be dependent on the nature of the liquid released, toxicity and other chemical properties such as biodegradation and bioaccumulation potential.

Sensitive Receptor	Impact description
	Contaminated fish stocks and filter feeders such as oysters and mussels can pass on harmful chemicals to humans, if contaminated organisms are consumed. Potential impacts are varied and will relate to the characteristics and volume of the spilt chemical, and the sea state of the receiving environment, and are likely to be limited to the immediate vicinity and unlikely to affect overall population viability. The consequence of an unplanned release of non-hydrocarbon liquids on marine fauna was assessed as ***Negligible*** given the likely volumes and types of liquids and the rapid dilution and dispersion that would occur in the operational area.
Likelihood assessment	
Rare	A set of control measures and checks have been proposed to ensure that the risks of unplanned releases of liquids to the marine environment is minimised. The likelihood of transient marine fauna occurring in the operational area is limited. Given the controls in place, the likelihood of releasing non-hydrocarbon liquids to the environment resulting in a negligible consequence is considered rare based on the activities undertaken in the operational area and the presence of bunding around non-hydrocarbon liquid containers, and drainage systems. Loss of non-hydrocarbon liquids during transfers is also considered rare. The worst-case likelihood assessment with controls in place was **Rare**.

Consequence	Likelihood	Ranking
Negligible	Rare	Low

8.5.3 Environmental performance

Hazard		Unplanned discharge of liquids		
Performance outcome		**Zero unplanned discharge of liquids into the marine environment.**		
ID	**Management Control**	**Performance standards**	**Measurement criteria**	**Responsibility**
122	Hazardous Substances & Dangerous Goods Standards (JS-70-STD-I-00035) is complied with and meets requirements of Marine Order 94	Any hazardous liquid storage on deck must be designed and maintained to have at least one barrier (i.e. form of bunding) to contain and prevent deck spills entering the marine environment.	3 monthly HSE inspection	OIM
123		Safety data sheet (SDS) available for all chemicals to aid in the process of hazard identification and chemical management	3 monthly HSE inspection	OIM
124		Chemicals managed in accordance with SDS in relation to safe handling and storage, spill-response and emergency procedures, and disposal considerations	3 monthly HSE inspection	OIM
125	Chemical Selection, Evaluation and Approval Procedure (JS-70-PR-I-00033)	For hazardous chemicals, the following standards apply to reduce the risk of an accidental release to sea: • Selected chemical substances comply with relevant regulatory requirements and approved activity environment plans; • Selected chemical substances are subject to mandatory risk review and formal approval before procurement; • Transport, storage and handling of chemicals is in accordance with relevant regulations and manufacturer requirements; • Least hazardous chemicals are preferentially selected for use thereby minimising and/ or eliminating potential safety and environmental impacts; • If chemicals required are classified as hazardous and/ or dangerous goods, the control measures for safe transport, storage and handling are deemed adequate; • Selected chemical substances meet technical specifications and are fit for purpose.	3 monthly HSE inspection	OIM

Hazard		Unplanned discharge of liquids		
Performance outcome		**Zero unplanned discharge of liquids into the marine environment.**		
ID	**Management Control**	**Performance standards**	**Measurement criteria**	**Responsibility**
126	Vessels are compliant with Marine Order 93 to prevent any contaminating liquids and chemicals from entering the marine environment	Vessels compliant with Marine Order 93, including: • Vessels are to have a valid International Pollution Prevention Certificate; • The owner and Master of a vessel must report 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; • Vessels are to have a Shipboard Marine Pollution Emergency Plan; • Vessels are to have a Cargo Record Book; and • Vessel tanks must be washed in accordance with the Pollution Prevention Act.	Valid IPPC Valid SOPEP Cargo Record Book	Supply Chain Manager
127	Spill kits 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.	3 monthly HSE inspection	OIM

8.5.4 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 unplanned discharges of non-hydrocarbon liquids to ALARP. The residual risk ranking for this potential impact is considered **Low** based on a likelihood of **Rare** and consequence of **Negligible**. Additional controls considered but rejected are detailed below. No further controls are required and therefore ALARP has been demonstrated.				
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
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 produced sand, 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.
N/a	Isolation	N/a	N/a	The Activity is located at distance from sensitive receptors and the coastline.
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.

8.5.5 Acceptability assessment

The potential impacts of unplanned discharges of non-hydrocarbon liquids during the activity are considered '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 & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Stakeholder & reputation	Stakeholder consultation has been undertaken (**Section 6**), and no stakeholder concerns have been raised with regards to impacts from unplanned discharges of non-hydrocarbon liquids on sensitive receptors.
Environmental context & ESD	While the risk of unplanned liquid waste discharges could occur from the activity and have an impact on the waters immediately nearby, the impact and risk assessment process indicates that unplanned discharges will have a temporary and localised impact on marine waters and will not result in significant impact to marine fauna. 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 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.

8.6 Unplanned Release of Hydrocarbons – Scenarios

8.6.1 Credible spill scenarios

A number of scenarios in which hydrocarbon could be released to the marine environment due to an unplanned event were identified during the Montara Operations ENVID workshop. Table 8-1 summarises these scenarios.

Table 8-1: Credible worst-case hydrocarbon spill scenarios

Hydrocarbon	Release point	Maximum release scenario	EP section
Diesel	At surface	906 m^3 released over 5 hours	**Section 8.8**
Crude oil	Loss of well control – subsea and surface	164,718 m^3	**Section 8.7**

To determine the maximum worst-case credible spill volumes for each identified spill scenario, Jadestone has adopted the AMSA (2015) guideline: *Technical guideline for preparing contingency plans for marine and coastal facilities*. Jadestone considers that in adopting the AMSA guideline the estimated spill volumes are appropriately conservative given that for the scenarios presented there are multiple barriers/ controls in place; meaning the total volumes evaluated are much greater than what would be released in the event of a spill.

8.6.2 Discounted scenarios

One scenario based on refuelling of helicopters on the helideck at *Montara Venture* FPSO was discounted as a credible spill scenario to the marine environment due to the high volatility of aviation fuel and that the refuelling system for helicopters is a fully self-contained system.

8.7 Worst Case Crude Oil Spill

8.7.1 Description of hazard

Crude oil spill	A loss of well control during operations may occur at surface or subsurface due to a number of reasons: • Catastrophic damage to platform and associated wells; • Loss of function downhole of safety critical equipment (loss of barriers); and • Damage to subsea well infrastructure (well valves, wellhead). Hydrocarbons may be released to the marine environment with the most likely release points at either the WHP floor (sea surface) or subsea wellheads (**Table 8-1**).

	In a loss of well control scenario, large quantities of hydrocarbon (worst-case oil release 164,096 m^3) will be released to the marine environment until well control can be re-established. The environmental consequences of a loss of well control are highly variable, dependant on the characteristics of the hydrocarbon released, the dynamics of the receiving environment and the proximity of the release point to sensitive environmental receptors. They may include: • Reduction in water quality; • Direct/indirect toxic or physiological effects on marine biota, including corals; • Direct/indirect loss/disturbance to marine mammals, marine reptiles, birds, fish and sharks/rays; • Hydrocarbon/chemical contact with shoals/banks, reefs and islands at concentrations that result in adverse impacts; • Direct/indirect loss/disturbance of significant habitat; • Disturbance of non-conservation significant populations/ communities; • Disturbance of conservation significant individuals (e.g. change in fauna behaviour/ movement, or injury/ mortality); and • Physical damage and/or disturbance to unique KEF and AMP values.

An ENVID was undertaken for the Montara operation activities and six credible LOWC scenarios resulting in a Montara or Skua crude oil spill to the marine environment were identified (Table 8-2).

Table 8-2: Credible crude oil spills to the marine environment due to LOWC

Sub-surface release	**Scenario**	**Maximum Credible Spill**	**Release duration**
LOWC SKUA 10 (subsea)	1	19,087 m^3	77 days
LOWC H5 (subsea)	2	80,721 m^3	77 days
LOWC SKUA 12(subsea)	7	124,976 m^3	77 days
LOWC H6 (subsea)	8	161,761 m^3	77 days
Surface release	**Scenario**	**Maximum Credible Spill**	**Release duration**
LOWC at H5 topside (WHP)	6	82,879 m^3	77 days
LOWC at H6 topside (WHP)	9	164,096 m^3	77 days

In addition to the loss of well control scenarios, loss of containment scenarios were identified in the ENVID that would result in crude oil being released to the marine environment. These are listed in Table 8-3 below.

Table 8-3: Credible crude oil spills to the marine environment due to a loss of containment event

Sub-surface release	**Scenario**	**Maximum Credible Spill**	**Release duration**
Rupture of subsea flowline (subsea)	3	1,700 m^3	1 day
Pinhole leak of subsea flowline	12	2 m^3	7 days
Surface release	**Scenario**	**Maximum Credible Spill**	**Release duration**
Ruptured cargo tank	4	11,570 m^3	5 hours
Break offtake floating hose	10	3,500 m^3	6 hours

While the loss of containment scenarios result in crude oil released to the marine environment, none of the scenarios is greater than the LOWC scenario from well H6 detailed in Table 8-2. Therefore, the H6 LOWC scenario is the worst case credible crude oil release scenario for the Montara operations activity. In addition, source control and spill response arrangements are provided for all the crude oil release scenarios as listed in Table 8-2 and Table 8-3.

8.7.2 Hydrocarbon properties and weathering behaviour

Two crude oil types were considered in the LOWC scenarios: Montara crude oil and Skua crude oil. The properties of these oils and their weathering behaviour are detailed in their respective assays in the Montara Operations OPEP.

8.7.3 Modelling Approach

To determine the spatial extent of impacts from a potential crude oil spill (surface and subsurface) and the dispersion characteristics of the oil over time, modelling was completed by RPS (RPS 2018). 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 (2008–2017, inclusive). For each season, a large number of replicate simulations (100) were modelled for each season (i.e. 300 simulations 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 dissolved aromatic hydrocarbons 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 dissolved aromatic hydrocarbons) 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 **Section 8.7.4** and **Appendix B** for floating oil, entrained oil and dissolved aromatic hydrocarbons (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.

1. **Probability contours**: the results were presented in terms of statistical probability maps based on the simulations considered, each generated under different environmental conditions. The contours of probability are not representations of a single spill event.
2. **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.

8.7.4 Modelling 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 B** and a summary of the contact thresholds applied is provided in Table 8-4.

Table 8-4: Summary of the contact thresholds applied in the hydrocarbon spill modelling

Floating oil (g/m^2)	Entrained oil (ppb)	Dissolved aromatic hydrocarbons (ppb)
1	100	70
10		

8.7.5 Modelling results of the LOWC scenarios

RPS was commissioned to conduct a quantitative hydrocarbon spill risk assessment to evaluate three of the potential hydrocarbon spill scenarios due to LOWC (release scenarios for wells H6 at surface and at seabed, as well as Skua-10 subsea well at seabed).

Stochastic spill modelling was conducted for the three scenarios for each of three seasons: summer (November to February), winter (April to August) and combined transition (March, September and October).

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. With a number of different release scenarios resulting in different floating oil, entrained oil and dissolved aromatic hydrocarbon affected areas, the results for each hydrocarbon component and scenario were combined to create total EMBAs to accommodate the modelling results.

The worst-case scenario was determined to be Scenario 9 - a long-term (77-day) uncontrolled surface release of 164,096 m^3 of Montara Crude from the H6 well, representing loss of hydrocarbon containment after a loss of well control. No mitigation measures were applied in this modelled scenario.

For information, EMBAs for each of the LOWC scenarios are presented in Figure 8-1, Figure 8-2, and **Figure 8-3**.

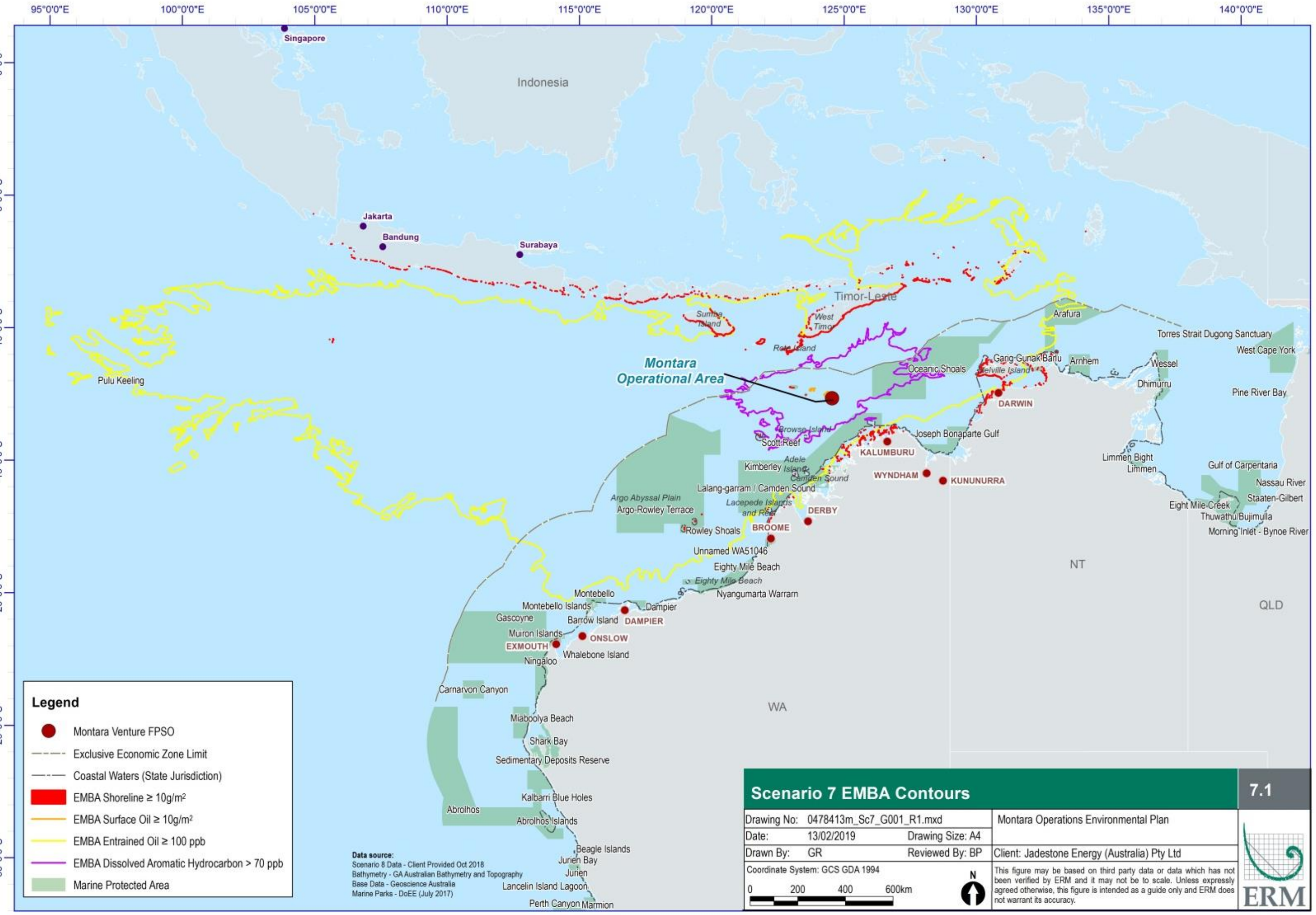


***Figure 8-1**: EMBA for Scenario 7*

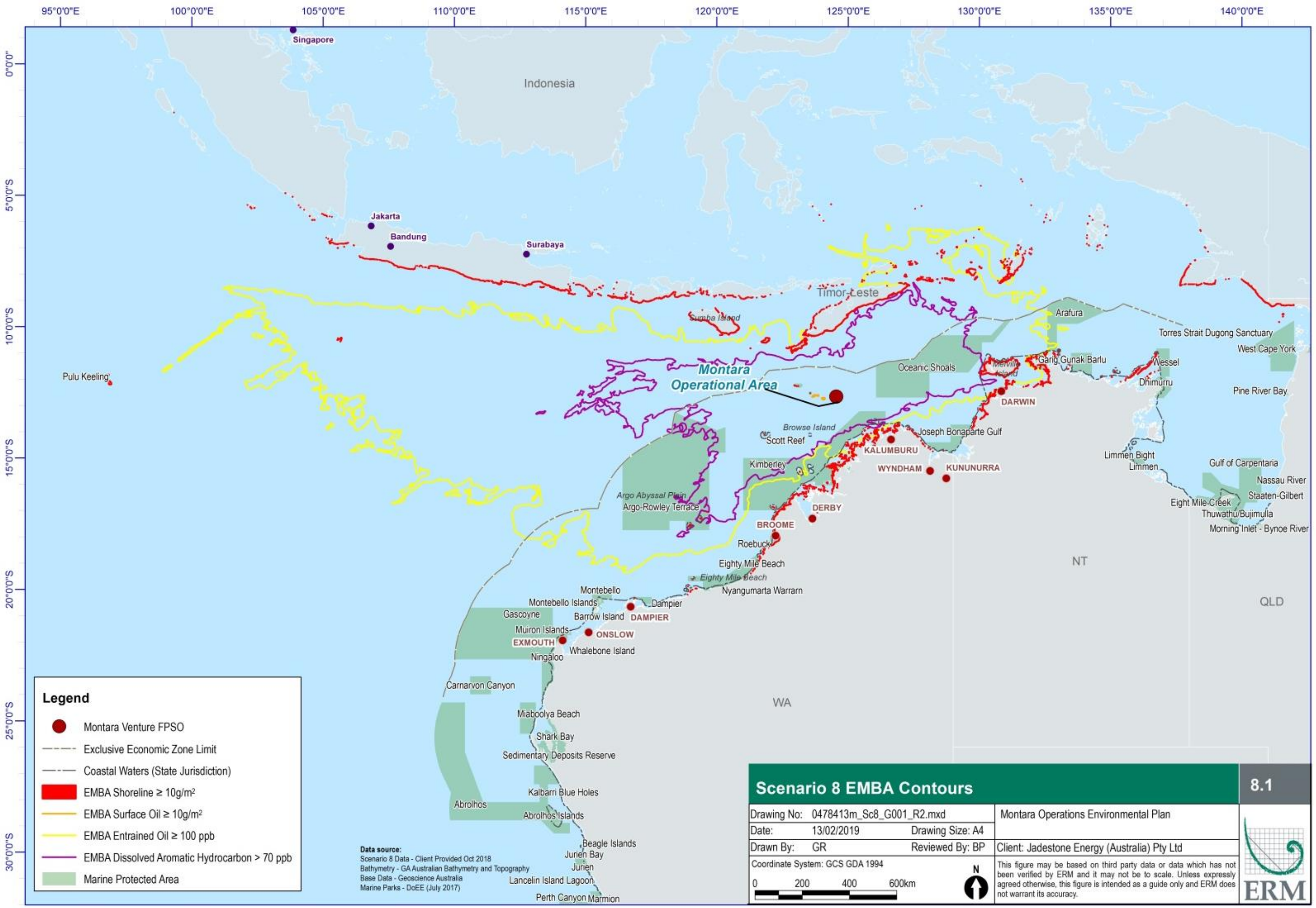


Figure 8-2: EMBA for Scenario 8

Scenario 9 (Worst Case Scenario) summary results

Floating oil results

Results of the worst-case modelling indicate that surface sheens of floating oil (<1 g/m^2) may pass over the following sensitive receptors, with a probability of <1% of reaching these locations:

- Oceanic Shoals AMP after 3 days;
- Ashmore Reef, Cartier Island and surrounding Commonwealth waters KEF after 8 days;
- Seringapatam Reef and Commonwealth waters in the Scott Reef Complex KEF after 29 days; and
- Rowley Shoals after 57 days.

Floating oil at concentrations of 10 g/m^2 were only predicted to reach Ashmore Reef, Cartier Island and surrounding Commonwealth waters KEF after 8 days of commencement of release (at a probability of <1%).

Entrained Oil results

Results of the stochastic modelling indicated that entrained oil concentrations greater than 100 ppb were predicted to reach the following locations to receive the highest volumes (with the highest concentrations):

- Sahul Bank (1459 ppb);
- Karmt Shoal (1374 ppb);
- Barton Shoal (1067 ppb); and
- Margaret Harries Bank (843 ppb).

The AMPs and State Marine Parks predicted to be impacted by entrained oil >100 ppb include:

- Oceanic Shoals AMP;
- Argo-Rowley Shoals AMP;
- Kimberley AMP;
- Ashmore Reef AMP;
- Cartier Island AMP; and
- North Kimberley Marine Park.

The KEFs predicted to be impacted by entrained oil >100 ppb include:

- Continental Slope Demersal Fish Communities;
- Ashmore Reef and Cartier Island and surrounding Commonwealth waters
- Seringapatam Reef and Commonwealth waters in the Scott Reef Complex
- Pinnacles of the Bonaparte Basin KEF
- Carbonate bank and terrace system of the Sahul Shelf KEF; and
- Ancient coastline at 125 m depth contour.

Dissolved Aromatic hydrocarbons

Probability of contact by dissolved aromatic hydrocarbons at concentrations equal to or greater than 70 ppb is predicted to be high at the Continental Slope Demersal Fish Communities KEF (76%) and The Ashmore Reef, Cartier Island and surrounding Commonwealth waters KEF (58%). Transitional months were generally predicted to have lower probabilities than summer and winter.

The maximum dissolved aromatic hydrocarbon concentration forecast for any receptor is predicted as 4,274 ppb at the Oceanic Shoals AMP.

- Contact by dissolved aromatic hydrocarbons at concentrations equal to or greater than 70 ppb is predicted to be high in summer at the carbonate bank and terrace system of the Sahul Shelf KEF (58%) and the Oceanic Shoals AMP (49%). Probabilities in winter are predicted to be high at the Continental Slope Demersal Fish Communities KEF (76%) and The Ashmore Reef, Cartier Island and surrounding Commonwealth waters KEF (58%). Transitional months were generally predicted to have lower probabilities than summer and winter.
- The maximum dissolved aromatic hydrocarbon concentration forecast for any receptor is predicted as 4,274 ppb at the Oceanic Shoals AMP.

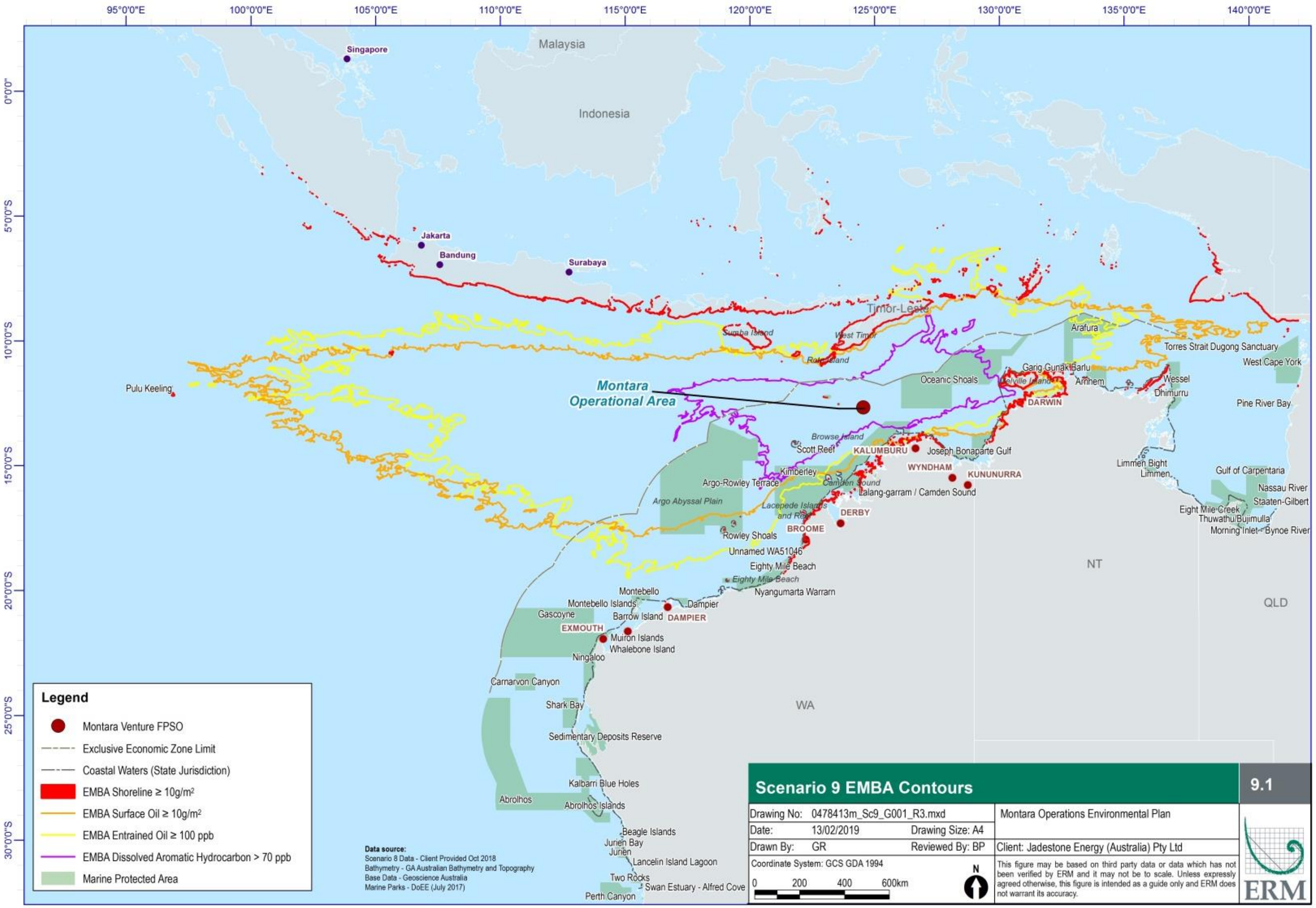


Figure 8-3: EMBA for Scenario 9 (Worst Case)

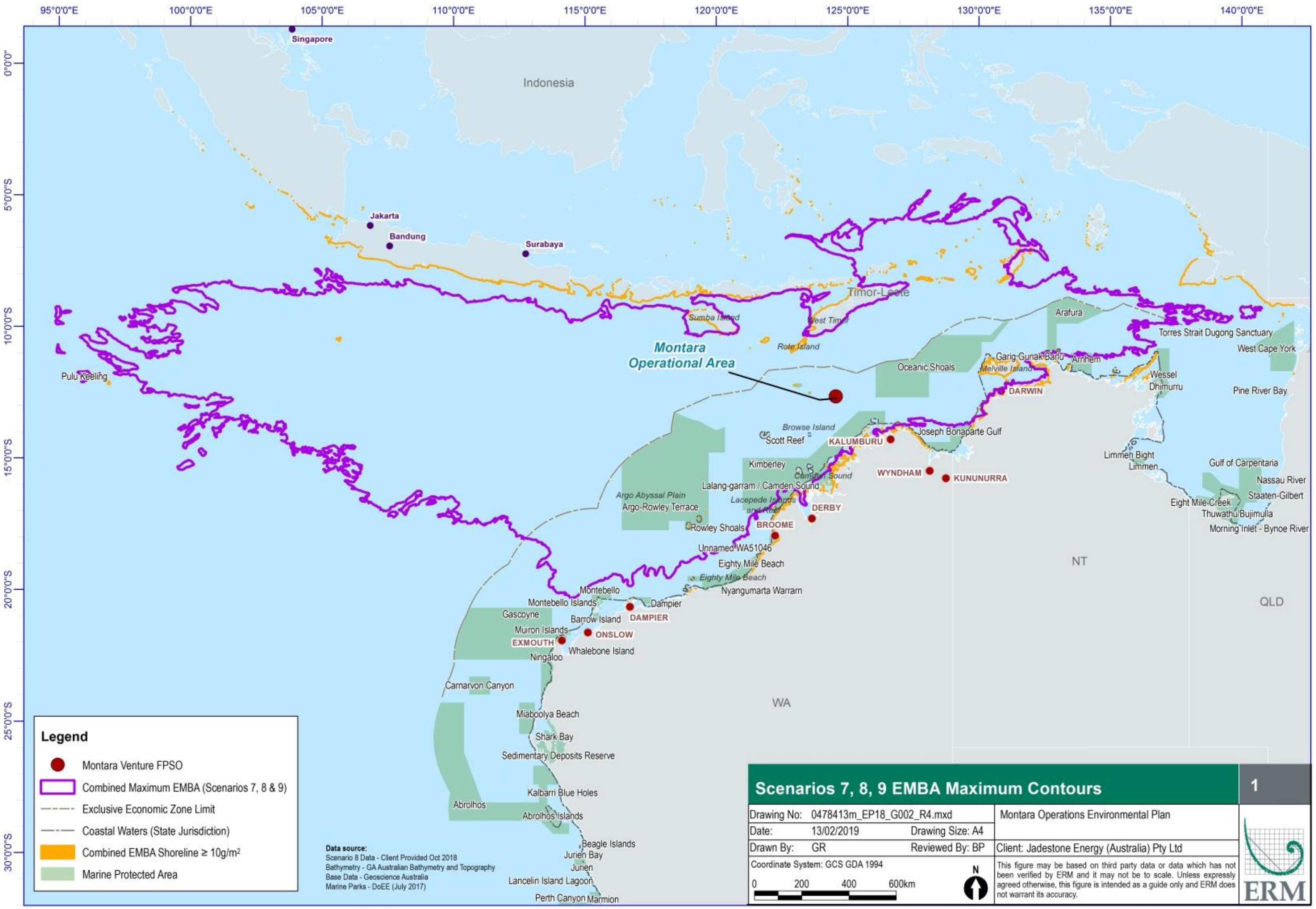


Figure 8-4: TOTAL combined EMBA for Scenario 7,8 and 9

8.7.6 Impacts and risks

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.

Impact pathways and impact threshold concentrations are detailed below for surface (floating) oil, entrained oil and dissolved aromatic hydrocarbons (DAHs). Further details on the thresholds selected are provided in Appendix B.

8.7.7 Exposure pathways

Surface Oil

Coating of marine flora, fauna and habitats or ingestion of oil by marine fauna. 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.

Shoreline habitats have the potential to be coated by stranded oil and shoreline fauna can be exposed to toxic effects from ingestion. There are no thresholds identified at which coating 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.

Surface oil occurring in coastal waters (of 1 g/m^2) and accumulating on shorelines may also reduce the visual amenity of an area diminishing the natural, historic and indigenous heritage values of a place.

Table 8-5 lists key potential impacts to sensitive receptors present in the EMBA.

Entrained oil exposure

Entrained oil has the potential to impact benthic and shoreline habitats and organisms.

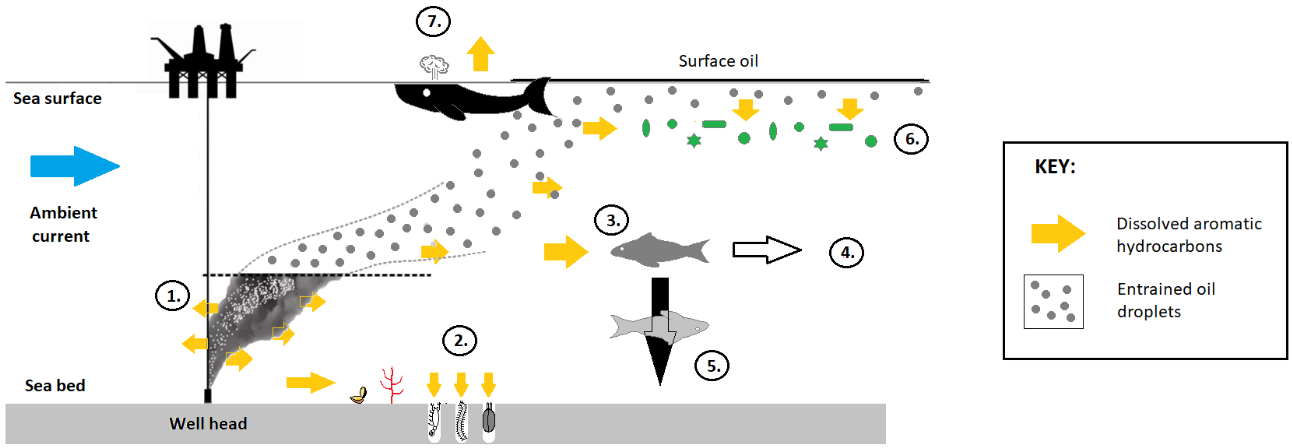
A review of the concentrations of entrained hydrocarbons at which toxic effects have been demonstrated in laboratory studies show wide variation depending on the test organism, duration of exposure, oil type and the initial oil mixture (i.e. nominal loading rates of hydrocarbon versus measured concentrations) (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. Therefore the threshold selected for this activity of 100 ppb is considered to be very conservative.

Potential impacts to marine fauna due to exposure to >100 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; and
- Toxicological effects to invertebrates, including corals, sponges and ascidians.

Potential pathways for biological effects from entrained oil are illustrated in Figure 8-5. It is important to note that the illustration does not directly represent the predicted behaviour of the Montara or Skua crude and is for illustration purposes only.



1. Aromatic hydrocarbons dissolve into the water column.
2. Epibiota and infauna are exposed to dissolved aromatics. Direct absorbtion across membranes and respiratory surfaces. Infauna may draw dissolved hydrocarbons into burrows via generation of a respiratory current.
3. Demersal and pelagic biota (e.g. fish, squid) are exposed to dissolved hydrocarbons. Uptake may occur across surface and respiratory membranes.
4. Sublethal effects may include skin systs/tumours, bioaccumulation of hydrocarbon compounds, impacts to fecundity. Fish are capable of processing and excreting some hydrocarbon compounds. Additional predation may increase bioaccumulation up the food web.
5. Ecotoxic effects of dissolved hydrocarbons at sufficient concentrations and durations of exposure may cause mortality. Dead biota may be scavenged or be a vector of hydrocarbons into marine sediments.
6. Dissolved hydrocarbons can also cause ecotoxic effects in plankton, causing mortality or developmental effects in early life stages of macrobiota.
7. Volatile Organic Compounds (VOCs) pass into the atmosphere as part of the wethering process. Air breathing animals, such as cetaceans or marine reptiles, may be exposed and suffer ecotoxic effects.

(Source: Equinor 2019)

Figure 8-5: Conceptual model of exposure pathways for dissolved aromatic hydrocarbons from a loss of well control spill

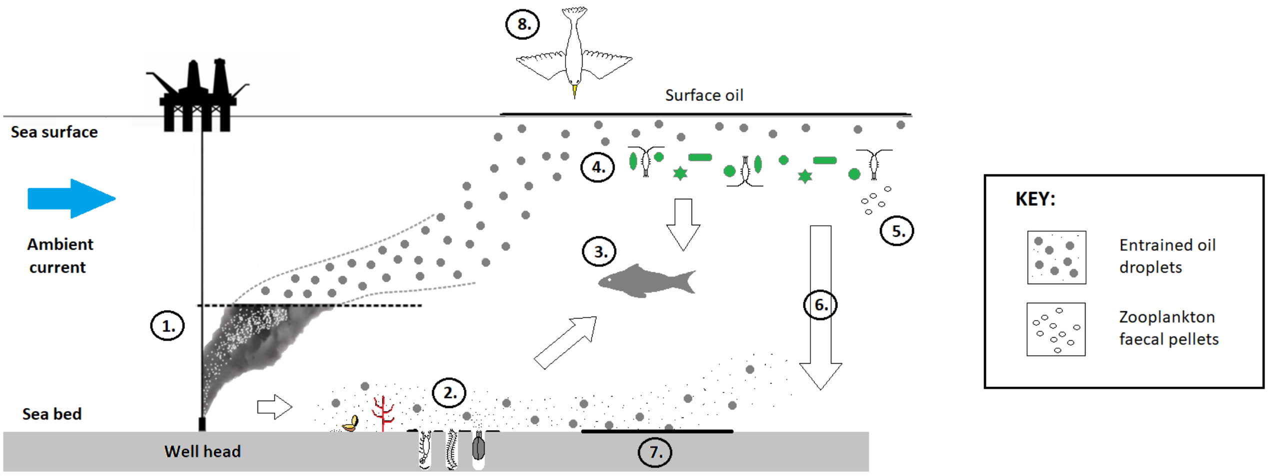
Dissolved Aromatic Hydrocarbons

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 Dissolved Aromatic Hydrocarbons (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 because 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.

Potential pathways for biological effects from entrained oil are illustrated in Figure 8-6. It is important to note that the illustration does not directly represent the predicted behaviour of the Montara or Skua crude and is for illustration purposes only.



1. Oil is split into suspended droplets of oil by the energy of the release from the well head.
2. Exposure of benthic biota to entrained oil droplets and oil absorbed onto organic material causes chemical burns to external and respiratory membranes.
3. Entrained oil also causes chemical burns to sensitive membranes in demersal and pelagic biota, which may cause cysts or tumours.
4. Entrained oil is absorbed onto organic material and grazed on by zooplankton (e.g. copepods).
5. Hydrocarbons are then accumulated into faecal pellets, which may be eaten or form part of "marine snow".
6. "Marine snow", comprising dead organic matter and faecal materials gradually sink to the sea floor. Hydrocarbons are accumulated through additional absorbtion of entrained oil droplets. Sedimentation of "marine snow" one of the processes where spill hydrocarbons can accumulate in sea bed sediments.
7. Hydrocarbons will accumulate in marine sediments where plumes of entrained oil droplets come into contact with the sea floor. This was described as the "bathtub ring effect" following the Deepwater Horizon spill. Accumulated hydrocarbons in marine sediments can have ecotoxic effects to biota at and beneath the sediment surface.
8. Avifauna (birds) and marine mammals (e.g. seals and sealions) can get oiled at or near the water surface. Cleaning of oil from external surface can result in ecotoxic effects from ingestion, or hydrocarbons can be passed on to young during feeding. Seabirds may suffer drowning or hypothermia as oil removes the coating that waterproofs the feathers and keeps the bird dry.

(Source: Equinor 2019)

Figure 8-6: Conceptual model of exposure pathways for entrained hydrocarbons from a loss of well control spill

8.7.8 Level of Impact on Sensitive Receptors within the EMBAs

Table 8-5 lists key potential impacts to sensitive receptors present in the EMBAs. Appendix I summarises the SMPs activated in response to contact to AMPs.

Table 8-5: Potential impacts to sensitive receptors present in the EMBAs

Shoreline habitats (excluding Mangroves)	
Sensitivity There are a wide variety of different types of shorelines found along Australia's western and northern coast and offshore islands. The type of shoreline will influence the volume of hydrocarbon that could be stranded ashore and its thickness before the shoreline saturation point occurs. For instance, a sandy beach may allow hydrocarbon to percolate through the sand, and weathered oil may be buried, thus increasing its ability to hold more hydrocarbon ashore over tidal cycles and various wave actions in comparison to a rocky shore; hence hydrocarbon can increase in thickness onshore over time. Shoreline data was obtained from the OzCoasts Smartline data set sourced via Geoscience Australia. *Floating* Shoreline habitats which have the potential to be smothered 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. While oil will likely be deposited at the surface of the beach there is also the possibility that a proportion of the stranded oil will contaminate sand deeper in the beach profile. This may occur through re-suspension of sediments in the surf zone, the oil melting and moving down through the beach sediments or soluble fractions of the stranded oil percolating through to deeper beach sediments. Oiling of tidal zones and rocky shores may cause coating of organisms present possibly leading to suffocation or loss of purchase on the substrate. While oil may stick to platform surfaces, in high energy areas high water movement and energy will remove oil over time; however, in lower energy areas stranded oil may persist and oil may also be 'hidden' under rubble, ledges and in pockets/crevices. Once oil has been removed from platform surfaces, re-colonisation of the hard substrate surfaces by organisms is often rapid (weeks to months) *Entrained and dissolved* Intertidal and subtidal zones may be exposed to entrained and dissolved 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 crude, the accessibility of PAHs to aquatic organisms is decreased.	
Potential impact from modelled event	
Locations of shoreline habitats (sandy shores, rocky shores and intertidal flats are listed in Appendix C, and could be impacted by surface or entrained and dissolved oil throughout the EMBA. Shoreline loading of oil could have significant impacts at these locations as described above.	
Timeframe to recovery	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.
Consequence	The consequence of a loss of well control event on shoreline habitats was assessed as ***Major*** given recovery may take years.
Mangroves and saltmarsh	
Floating 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 crude oil and the tendency for mangrove root habitat to trap oil. Surface slicks that make their way into a mangrove will make contact with pneumatophores used by mangroves for gas exchange. Crude oil that coats pneumatophores will impede gas exchange that may result in yellowed leaves, defoliation and tree death depending on the extent and degree of oiling. Exposure of mangroves to floating oil may also cause toxicity including damage to cellular membranes leading to impairment of salt exchange, disruption of ion transport mechanisms, and growth of branched pneumatophores in response to tissue death of coated	

pneumatophores. More chronic toxicity impacts include genetic damage have population-scale effects (e.g. reduction/ loss of chlorophyll content in leaves). A high sensitivity of seedlings to oiled sediments would also impact longer term recruitment of the affected population. 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. 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, 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. *Entrained and dissolved* 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). Impacts to mangroves include yellowing of leaves, defoliation, reduced reproductive output and success, mutation and increased sensitivity to other stresses (NOAA, 2010). This is in addition to impacts to the marine organisms utilised mangrove habitat (invertebrates, fish, birds).		
Potential impact from modelled event		
Mangroves could be impacted at the North Kimberley marine park, Port Hedland, Darwin Coast, Tiwi islands and other shorelines along the Australian mainland. These mangroves are identified as KPI values within many of the respective management plans. Floating crude oil could reach salt marsh areas (North Kimberley marine park), which are often landward of mangrove communities, on high spring tides.		
Timeframe to recovery	Depending upon the level of impact, recovery to affected mangrove areas can be on the scale of years to decades (NOAA, 2010).	
Consequence	The consequence of a loss of well control event on mangroves and saltmarshes was assessed as ***Critical*** given recovery may take years.	
Plankton		
Sensitivity *Floating* Presence of surface oil can affect light qualities and the ability of plankton to photosynthesise. Reduced primary productivity could occur while surface oil is present *Entrained and dissolved* There is potential for localised mortality of plankton due to reduced water quality and toxicity. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest. Planktonic communities comprise sensitive receptors to hydrocarbon exposure including single-celled organisms (e.g. phytoplankton) and larval stages of vertebrates and invertebrates. Smaller organisms are more likely to become entrained in a parcel of water; if contaminated with dissolved aromatic hydrocarbons, and organisms are entrained in a parcel of water for 96 hours or more acute/lethal effects may result. Where plankton are exposed to entrained hydrocarbons for a period less than 96 hours and at concentrations that may cause effect, chronic/non-lethal impacts may occur including impaired movement, predatory/avoidance response, respiration. Numerous studies on the influence of oil on plankton communities have been carried out, including a study conducted by Varela *et al.* (2006), which also compared their results with other published studies. Despite limitations (oil type, environmental conditions and planktonic communities) it was not possible to demonstrate any effects on plankton communities and that any changes are within the range of natural ecosystem variability. Variations in the temporal scale of oceanographic processes typical of the ecosystem have a greater influence on plankton communities than the direct effect of spilt oil.		

Potential impact from modelled event	
All areas and species	High abundance of phytoplankton typically occurs around topographical features that may result in upwelling or a disruption to the current flow which may be present around banks and shoals and offshore islands within the EMBA. The EMBA has the potential to overlap with spawning of some fish species given the year round spawning of some species and the ongoing operations activity. In the unlikely event of a spill occurring, fish larvae may be impacted by hydrocarbons entrained in the water column with effects greatest in the upper 10 m of the water column where the majority of plankton concentrate and closest to the spill source.
Timeframe to recovery	Reproduction by survivors or dispersion from unaffected areas (via sea surface currents) would be likely to rapidly replenish any losses from permanent zooplankton (Abbriano *et al.* 2011). Plankton have life cycles based on rapid reproduction with levels of high productivity. It is also in the nature of plankton to be dispersive – it is why many benthic taxa have adopted a pelagic early life history stage to increase dispersion via a vector with a consistent food supply. Field observations from oil spills have shown minimal or transient effects on marine plankton (Abbriano *et al*. 2011). Once background water quality conditions have re-established, the plankton community will take weeks to months to recover (ITOPF 2011), allowing for seasonal influences on the assemblage characteristics.
Consequence	The consequence of a loss of well control event on plankton was assessed as ***Minor*** given recovery may take weeks to months.
Benthic habitat and communities (including deepwater habitats and shallow shoals, corals, intertidal zones)	

Sensitivity

Floating

Contact of floating 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.

Impacts to hard corals could be intensified if a spill was to reach shallow coral areas during the peak spawning seasons 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.

Other benthic habitats are unlikely to be impacted by surface oil given the water depths of them.

Entrained and dissolved

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.

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.

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. Epifauna associated with hard substrates such as ascidians and sponges may experience direct toxicity through ingestion.	
Potential impact from modelled event	
All areas and species	Benthic habitats in the EMBA that may be impacted by entrained oil include soft sediments and benthic fauna, coral reef, sponges, macroalgae and seagrasses.
Timeframe to recovery	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).
Consequence	The consequence of a loss of well control event on benthic habitats was assessed as ***Moderate*** given recovery may take months to a year depending on the habitat type.
Marine Reptiles	
Sensitivity Marine reptiles (including turtles) are potentially directly affected by the toxicity of in-water and surface hydrocarbons through ingestion, volatile organic compounds through inhalation, as well as potentially suffering from effects of physical contact with surface hydrocarbons. *Floating* 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. Depending on species, adult females will lay eggs on the beach above the high tide mark followed by emergence of hatchlings that will make their way to the water. Adult females will often wait in nearshore water before coming up onto the beach, and may revisit the beach a number of times before exiting onto the beach and laying her eggs. Coating (particularly of hatchlings) can lead to reduced mobility and buoyancy-Mortality, drowning, starvation, dehydration, increased predation and behavioural disruption. Other impacts expected: • 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 *Entrained* Turtles and seasnakes may be affected by oil through tainted food source or by absorption through the skin. Turtle hatchlings and turtle/seasnake 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. Whilst turtle nesting beaches may be contacted by crude (floating or accumulated), turtles will always nest above the high tide mark and any oil moving through the beach profile should not come into contact with nests. Entrained and dissolved oil may result in harm to internal anatomy if ingested, irritation or damage to sensitive external	

features such as eyes and skin and damage to respiratory processes if significant inhalation of volatile fumes occurs at the surface. *Dissolved* The majority of publicly-available information detailing potential impacts to turtles and seasnakes 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 (NOAA, 2010b). 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 seasnakes 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 Whilst turtle nesting beaches may be contacted by weathered oil, turtles will always nest above the high tide mark and any oil moving through the beach profile should not come into contact with nests. Entrained and dissolved oil may result in harm to internal anatomy if ingested, irritation or damage to sensitive external features such as eyes and skin and damage to respiratory processes if significant inhalation of volatile fumes occurs at the surface.		
Potential impact from modelled event		
Threatened and migratory marine reptile species may occur within the spill area EMBA as turtles are widely dispersed at low densities across the NWS and in the unlikely event of a spill occurring, individuals traversing open water may come into contact with water column or surface oil. The spill EMBA overlaps with the BIAs for some turtle species and therefore there is the risk of contact with nesting turtles and hatchlings with surface and dissolved oil. The adult nesting females are at risk from surface slicks as they come into nearshore waters and emerge from the beach through the surf zone, and would also come into contact with any stranded oil on the beach. Once emerged from the nests, hatchlings will move down the beach and into the water migrating away from the beach at surface. Hatchlings also would be exposed to stranded oil on the beach and surface slicks in nearshore and offshore waters.		
Timeframe to recovery	Recovery of marine reptiles will depend on the degree of oiling and potential impacts at critical life stages but could result in impacts at a population level resulting in recovery within years e.g. if a spill occurred in turtle hatchling season and significant numbers were affected when leaving turtle nesting beaches.	
Consequence	The consequence of a loss of well control event on marine reptiles was assessed as ***Major*** given impacts may occur at population level with recovery in 1-2 years.	
Fish and Sharks		
Sensitivity *Floating* Near the sea surface, fish are able to detect and avoid contact with surface slicks and as a result, fish mortalities rarely occur in open waters from surface spills (Kennish, 1997; Scholz et al., 1992). Pelagic fish species are therefore generally not highly susceptible to impacts from hydrocarbon spills. However, hydrocarbon droplets can physically affect fish and sharks exposed for an extended duration (weeks to months). Smothering through coating of gills can lead to the lethal and sub-lethal effects of reduced oxygen exchange, and coating of body surfaces may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food leading to reduced growth. *Entrained* 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 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. 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). _Dissolved_ 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.	
Potential impact from modelled event	
Whale sharks could potentially transit through the spill EMBA and the foraging activity occurring in July-November each year. Whale sharks may be vulnerable to surface oil due to their surface feeding nature and may result in coating of gills and ingestion of oil. Entrained and dissolved oil affecting whale sharks, and their food source plankton, can result in impacts as described above. The NWS supports a diverse assemblage of fish and shark species, particularly in shallower water near islands and shoals. Other shark and pelagic fish species may transit the spill trajectory area and be exposed to entrained and dissolved oil. Some fish assemblages within the EMBA are also part of protected areas such as AMPs or KEFs and may also be targeted in the commercial fishing industry.	
Timeframe to recovery	Recovery of fish and sharks will depend on the degree of oiling and potential impacts at critical life stages but could result in impacts at a population level resulting in recovery within months given relatively regular spawning activity that occurs in most fish species. 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.
Consequence	The consequence of a loss of well control event on fish and sharks was assessed as ***Moderate*** given impacts may occur to localised populations with recovery in months to a year.
Marine Mammals	
Sensitivity _Floating_ Physical and chemical effects of hydrocarbons in sea surface waters have been demonstrated through direct contact with organisms, for example through physical coating, adsorption to body surfaces and ingestion (NRC, 2005),lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth and potential illness can result. 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. Physical impacts due to ingestion are applicable to surface slicks; however, the susceptibility of cetacean 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 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/m2) of oil might contact humpback whales as they migrate. Similarly, blue whales may encounter a sea surface plume (>10 g/m2) as they pass through the area during their northern migration in May–August. 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). _Entrained_ 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.	

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. *Dissolved* Marine mammals that may occur within the EMBA for DAHs include 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.		
Potential impact from modelled event		
Marine mammals present within the EMBA include threatened and migratory whales and dolphins, and potentially dugongs. The activity is being undertaken all year round and may overlap with blue whale migration and humpback whale migration and calving as well as dugong calving and breeding, therefore crude oil may contact whales and dugongs during these life stages when the fauna are less likely to move away from the area if undertaking critical breeding activity.		
Timeframe to recovery	Recovery of marine mammals will depend on the degree of potential impacts at critical life stages but could result in impacts at a population level resulting in recovery within years e.g. if a spill occurred in migration or calving season and significant numbers were affected by preventing normal migration and calving activity from occurring. Recovery of individuals may be more rapid once moved away from the area of potential impact due to their smooth hairless skin.	
Consequence	The consequence of a loss of well control event on marine mammals was assessed as ***Major*** given impacts may occur at population level with recovery in 1-2 years.	
Avifauna		
Sensitivity *Floating* 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 Ramsar sites. 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). *Entrained and dissolved* 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 hemolytic anemia, reduced reproduction, and immunosuppression. As most fish survive beneath floating slicks, they will continue to attract foraging seabirds, which typically do not exhibit avoidance behaviour.	
Potential impact from modelled event	
Threatened and migratory seabirds and shorebirds that may occur within the EMBA may have foraging, feeding, breeding and or nesting habitat in the vicinity of the EMBA. The EMBA intercepts with breeding BIAs for several migratory species and therefore foraging and breeding habitat in the area may be impacted by surface and water column oil while foraging (dive and skim feeding). Higher numbers would be expected during breeding periods.	
Risk	
Timeframe to recovery	Recovery of avifauna will depend on the degree of oiling and potential impacts at critical life stages but could result in impacts at a population level resulting in recovery within years e.g. if a spill occurred in turtle nesting season and significant numbers were affected when foraging in the region resulting in impacts carrying over into the breeding season and other breeding habitats.
Consequence	The consequence of a loss of well control event on avifauna was assessed as ***Major*** given impacts may occur at population level with recovery in 1-2 years.
Socio economic	
Sensitivity *Floating* 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. Many of the protected areas have 'wilderness' and 'seascapes' identified as a value, and these would be compromised by the presence of any oil. *Entrained* Impacts to fish may result in tainted flesh and fishery closure resulting in an economic impact on commercial, recreational 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. *Dissolved* 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.	
Potential impact from modelled event	
Impacts to fisheries could occur due to fish death and tainting of flesh resulting in potential fishery closures and loss of income. The potential area of impact may also be closed to fishers during cleanup for health and safety reason, reducing the area and timeframe for fishing to occur and potentially affecting income. Perceived and actual impacts to areas popular for tourism can result in a loss of income to the local region through reduced numbers of visitors.	
Timeframe to recovery	Recovery will depend on the degree of oiling along shorelines and that which is perceived by the public. Recovery of fish is likely to occur within months to years of water quality returning to normal given the regular spawning events that occur. Timeframes for fish tainting to disappear may be similar.

Consequence	The consequence of a loss of well control event on socio-economic receptors was assessed as ***Major*** given impacts on the values of tourism may take 1-2 years to recover and have a national reputational impact.
Protected Areas	
Sensitivity *Floating* Surface oil and/or shoreline loading may be expected at some AMPs affecting shoreline habitats and intertidal zones. *Entrained and dissolved* Entrained hydrocarbons will or may impact the coral and seagrass habitats, as well as other marine park values fauna including dugongs, sea snakes (protected), fish and other marine mammals. Impacts to these receptors are described above.	
Potential impact from modelled event	
AMPs	The following AMPs are present within the EMBA: Cartier Island AMP, Kimberley AMP, Ashmore Reef AMP, Oceanic Shoals AMP, Joseph Bonaparte Gulf AMP, Argo-Rowley Terrace AMP, Roebuck AMP, Mermaid Reef AMP, Eighty Mile Beach AMP, Arafura AMP, Arnhem AMP, Dampier AMP, Montebello AMP, Wessel AMP. Surface oil could be expected to accumulate at some locations including Eighty Mile Beach and Roebuck Bay (amongst others), however entrained hydrocarbons are predicted to contact all of these AMPs. The highest entrained oil concentrations are expected at Oceanic Shoals and Cartier Island, with lesser concentrations at other AMPs. Entrained hydrocarbons could therefore impact on the potential values outlined within **Appendix C** and includes all marine fauna as described within this table, marine habitats and socio-economic receptors. With the deeper AMP features the geomorphological features are unlikely to be affected by entrained hydrocarbons, but the receptors will be affected by the change in water quality and impacts to the food chain. However, shallower features within AMPs such as coral reefs around Ashmore Reef and Mermaid Reef would potentially have long term impacts to the habitats supporting receptors as described within this table for coral reefs and other habitats. 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. Several of the AMPs – including Roebuck Bay 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. Tourism may be impacted by real or perceived reduction in health or mortality of habitats that support tourism activities.
State and Territory Marine Parks and nature reserves	There are seven parks and reserves within the EMBA: Garig Gunak Barlu National Park (NT), Lalang Garram / Camden Sound Marine Park (WA), Rowley Shoals Marine Park (WA), Ord River and Parry Lagoons Nature Reserve (WA), Niiwalarra Islands and Lesueur Island Nature Reserve (WA), Scott Reef Nature Reserve (WA) and Browse Island Nature Reserve (WA). Values associated with these marine parks include marine fauna and coral reefs, mangroves, saltmarshes and sandy beaches. These values may be contacted by entrained and dissolved oil which would potentially impact the receptors as described in this table. The values of these marine parks are described in Section **Appendix C**.
World, National and Commonwealth Heritage Places	The Kakadu National Park is the only world and national heritage place within the EMBA. Receptors within this park include mangroves and wetlands which in turn support migratory birds. Impacts to these receptor types are described in this table from surface, entrained and dissolved oil.
Threatened Ecological Communities	The Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula is the only Threatened Ecological Community within the EMBA. Receptors within this TEC include

	coastal sand dunes and beaches which may result in impacts to fauna utilising the beaches. Impacts to shoreline habitats are described in this table from both entrained and dissolved oil.
Wetlands of International Importance	Wetlands identified within the EMBA include Ashmore Reef National Nature Reserve, Cobourg Peninsula, The Dales, Roebuck Bay, Hosnies Spring, Ord River Floodplain, Pulu Keeling National Park, Kakadu National Park and Eighty Mile Beach. Some of these wetlands represent wetland types near natural condition within the region and may be contacted by surface or entrained oil. Impacts to wetlands, tidal marshes and associated receptors are described within this table.
KEFs	There are no KEFS that would be impacted by surface oil as the KEFs relate to geomorphologic features which are not expected to be impacted by hydrocarbons. Values and sensitivities associated with the KEFs include marine fauna due to the higher diversity of fish species associated with the higher diversity in fish communities or nutrients such as Continental Slope Demersal Fish Communities; or benthic habitats at Ashmore Reef and Cartier Island and surrounding Commonwealth waters. Impacts to marine fauna are discussed above. There are a number of KEFs that are overlapped by the EMBA: including Continental Slope Demersal Fish Communities, Ashmore Reef and Cartier Island and Surrounding Commonwealth Waters, Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex, Canyons Linking the Argo Abyssal Plain with the Scott Plateau, Mermaid Reef and Commonwealth Waters Surrounding Rowley Shoals, Pinnacles of the Bonaparte Basin, Ancient Coastline at 125 m Depth Contour Carbonate Bank and Terrace System of the Sahul Shelf, Shelf Break and Slope of the Arafura Shelf, Carbonate Bank and Terrace System of the Van Diemen Rise, Exmouth Plateau, Tributary Canyons of the Arafura Depression, Glomar Shoals, Gulf of Carpenteria Basin. Potential impacts from entrained and dissolved oil may occur at these KEFs as they are below the sea surface. Impacts to features (such as canyons or pinnacles) in deep waters are not expected to be affected by entrained or dissolved oil due to the nature of these features. However, values associated with shallower KEFs such as reefs and islands and the surrounding waters will be affected by changes in water quality and impacts to receptors within the water as described in this table.
Timeframe to recovery	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). The timeframe for recovery of receptors within these areas are described within this table.
Consequence	The consequence of a loss of well control event on protected areas was assessed as ***Critical*** given recovery to some habitats within these protected areas may take decades to recover.

Consequence	**Likelihood**	**Ranking**
Critical (worst case of all above receptors)	Unlikely	Medium

8.7.9 Priority receptors

For spill response planning purposes, priority receptors were identified from the sensitive receptors using the criteria outlined in Section 4.7.4. In a real event, the IAP, NEBA and planning process takes over; utilising realtime 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.

Seven priority receptors for spill response have been determined from the worst-case modelling results (Table 8-6 and Figure 8-7).

Table 8-6: Priority receptors

Priority receptors	Individual locations included in receptor	Rationale
Ashmore Reef / Cartier Island	• Ashmore Reef and Cartier Island and surrounding Commonwealth waters	• Shoreline loading volumes • Minimum time to contact • High value • 5% probability of contact
International Waters	• Timor Leste • Indonesia	• Shoreline loading volumes • High value • 5% probability of contact
Darwin Coast	• Darwin Coast	• Shoreline loading volumes • time to contact • High value • 5% probability of contact
Jo Bonaparte Gulf NT	• Joseph Bonaparte Gulf Northern Territory	• Shoreline loading volumes • High value • time to contact • 5% probability of contact
Western NT	• Kakadu Coast • Cobourg Peninsula • East Arnhem Land • West Arnhem Land	• Shoreline loading volumes • High value • time to contact • 5% probability of contact
Tiwi Islands	• Melville Island • Bathurst Island	• Shoreline loading volumes • High value • time to contact • 5% probability of contact
Kimberley Coast	• Kimberley Coast	• Shoreline loading volumes • High value • time to contact • 5% probability of contact

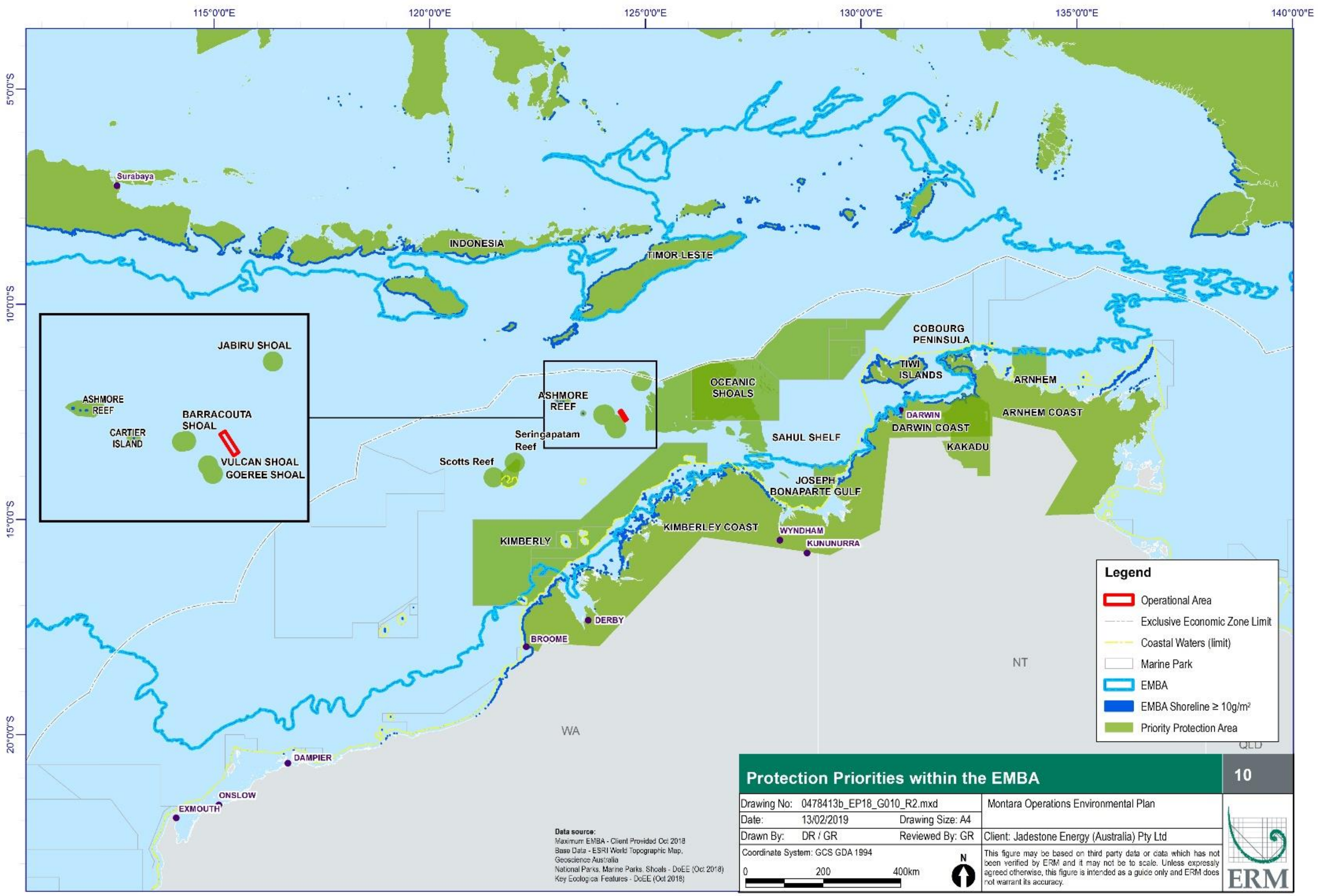


Figure 8-7: ***Priority receptors***

Table 8-6 lists the rationale for the Priority receptor selection (also refer **Section 4.7.4**) and **Appendix H** details the specific key values and modelled contact of the Priority receptors.

A NEBA 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 8-7**).

8.7.10 Net Environmental Benefit Assessment (NEBA)

Net environmental benefit assessment (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 8-7 provides the NEBA for the Priority receptors and the potential impact that 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 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 8-7: Impact of selected spill response strategy on the environmental values of Protection Priorities

Protection Priority	No controls	Source control	Dispersant (surface /	Operational Monitoring	Containm ent and	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife	Scientific Monitoring
Environmental Outcomes	**- Reduce oil volumes from reaching the shore line 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**								
Ashmore / Cartier									
Seabirds									
Mangroves								n/a	
Emergent reefs								n/a	
Turtle									
Coral reefs						n/a	n/a	n/a	
Marine						n/a	n/a	n/a	
Marine						n/a	n/a		
Protected									
Wetlands								n/a	
Socio-									
Darwin Coast									
Seabirds									
Mangroves								n/a	
Coral reefs						n/a	n/a	n/a	
Marine						n/a	n/a	n/a	
Marine						n/a	n/a		
Socio-									
International waters (Timor Leste and Indonesia)									
Seabirds									
Mangroves								n/a	
Emergent reefs								n/a	

Protection Priority	No controls	Source control	Dispersant (surface /	Operational Monitoring	Containm ent and	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife	Scientific Monitoring
Environmental Outcomes	**- Reduce oil volumes from reaching the shore line 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**								
Turtle nesting beaches									
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a		
National Park									
Wetlands							n/a	n/a	
Socio-									
Joseph Bonaparte Gulf NT									
Seabirds									
Mangroves								n/a	
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a		
Protected									
Wetlands								n/a	
Socio-									
Western NT (inc. Kakadu Coast, Coburg Peninsula, East and West Arnhem Land)									
Seabirds									
Mangroves								n/a	
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a		
Protected									
Wetlands								n/a	

Protection Priority	No controls	Source control	Dispersant (surface /	Operational Monitoring	Containm ent and	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife	Scientific Monitoring
Environmental Outcomes	- Reduce oil volumes from reaching the shore line 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								
Socio-									
Turtle nesting beaches									
Tiwi Islands (Melville Island and Bathurst Island)									
Seabirds									
Mangroves								n/a	
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a	n/a	
Socio-								n/a	
Turtle nesting beaches									
Kimberley Coast									
Seabirds									
Mangroves								n/a	
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a		
Protected									
Wetlands									
Socio-									
Turtle nesting beaches									
Legend		Beneficial							
		Possible beneficial impact dependent upon the situation (e.g. Timeframes and metocean conditions to dilute entrained oil)							

Protection Priority	No controls	Source control	Dispersant (surface /	Operational Monitoring	Containm ent and	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife	Scientific Monitoring
Environmental Outcomes	**- Reduce oil volumes from reaching the shore line 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**								
		Negative impact							
	n/a	Not applicable for the environmental value							

8.7.11 Environmental performance

Environmental Risk		**Unplanned release of crude oil**		
Performance Outcome		**No spill of hydrocarbon to the marine environment.**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
	Unplanned release during offtake			
128	Montara Marine Facility Manual (MV-90-PR-H-00001)	All hoses are fitted with dry-break couplings and are buoyant or fitted with floats	Start-up checklist for offtake	OIM
129		Visual inspection of dry break couplings and hoses prior to crude transfer		
130		Permit-to-work documentation is complete and signed off to ensure offtake is undertaken		
131		Static tow in place	Vessel log	Vessel Master
132		Monitoring of hawser	Hawser log	OIM
133	Competency and Training Management System (JS-60-PR-Q-00014)*	Vessel crew qualified in accordance with competency system	Records of crew certificates or third party inspection document	Marine Superintendent
	Unplanned release due to equipment failure			
134	Tests and maintenance completed in accordance with Performance Standards Report (MV-70-REP-F-00002) to ensure emergency shutdown can occur	The SIS are tested according to the assurance plan which is planned and managed using CMMS	Inspection and testing records	OIM
135		Emergency Shutdown (ESD) push buttons located in the central control room and throughout the FPSO/WHP tested and fit for purpose	Audit records confirm standard	
136		ESDVs are regularly tested and fit for purpose	ESDV testing records	OIM
137		Hydrocarbon containing equipment is inspected and maintained and found fit for purpose	Inspection and maintenance records	OIM

Environmental Risk		Unplanned release of crude oil		
Performance Outcome		**No spill of hydrocarbon to the marine environment.**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
138		PSVs undergo external inspection annually and internally inspected	Inspection and testing records	OIM
139	Permit to Work Procedure implemented	A Permit to Work (PTW) system is implemented to assure competent personnel and implementation of relevant procedures during maintenance.	PTW Documentation demonstrates compliance	OIM
140	Wellhead valves maintained and tested as per Performance Standards Report (MV-70-REP-F-00002)	Wellhead Valves are maintained/ tested and found fit for purpose	Maintenance and testing records in CMMS	OIM
141	Subsea equipment inspected in accordance with Subsea Inspection Procedure (MV-16-PR-U-00001)	Subsea equipment shall be inspected in accordance with the schedule, applicable standards, regulatory requirements and procedures described referenced in Performance Standards Reports (MV-70-REP-F-00002)	Inspection records in CMMS	OIM
142	Montara Facility Berthing Handbook (MV-90-PR-G-00002) details designated anchoring locations	AMSA designated anchoring locations is listed as a 3nM radius around facility and marked on Aus Charts	AHS Chart	Marine Superintendent
143	Montara Lifting Operations Procedure (MV-00-PR-F-00006) prevents dropped loads	Lifting with associated risk to topside and subsea infrastructure undertaken as per Montara Lifting Operations Procedure	Completed permit to work with job hazard analysis appended	OIM
	Catastrophic failure			
144	Wells maintained as per Montara Well Operations	Well integrity and maintenance undertaken according to in force Well Operations Management Plan	Completed maintenance and inspection records in CMMS	Operations Manager

Environmental Risk		Unplanned release of crude oil		
Performance Outcome		**No spill of hydrocarbon to the marine environment.**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
	Management Plan (mv-00-PLN-D-00001)			
145	Asset integrity maintenance and inspections undertaken as per Performance Standards Report (MV-70-REP-F-00002)	Asset integrity and maintenance inspections of facilities and critical equipment undertaken as planned	Completed maintenance and inspection records in CMMS	Maintenance Supervisor
–	Refer **Section 7.7** for additional controls and performance standards related to vessel operations			
	Oil spill response			
146	Implement Montara Oil Pollution Emergency Plan (MV-70-PLN-G-00001)	In the event of a tier 2 or tier 3 oil spill implement the Montara OPEP to reduce environmental impacts due to spill	Incident Log	IMT Lead
147	Incident Management Team Response Plan (JS-70-PLN-F-00008)	Implement the Incident Management Team Response Plan in the event of a spill of hydrocarbons to the marine environment	Incident Log	IMT Lead
* 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.				

8.7.12 ALARP assessment

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
Source Control – increase oil spill response capability of FPSO and support vessel beyond a Level 1 response	Reduce volume or speed of spill entering marine environment	Significant cost would be incurred for Jadestone to alter the contractual arrangements with the Montara Venture and support vessel 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 the FPSO and vessels have a level 1 capability. For Jadestone to increase the FPSO or vessel response capability above a Level 1 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.	No
Source Control – Monitor external drilling programs for MODU availability	*Potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.*	The cost is minimal.	Jadestone can monitor the availability of rigs within Australia that may be contracted by other oil and gas operators that overlap with the drilling programs, potentially providing availability of a relief well drilling rig quicker.	Yes
Source control - Monitor status of Registered Operators/ Approved Safety cases for rigs.	*Potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.*	The cost is minimal.	Jadestone can monitor the status of Registered Operators for rigs operating within Australia (and therefore safety case status). This allows for a prioritised selection of rigs in the event of a response with priority given to those with an existing safety case.	Yes
Source control – Jadestone to become a signatory to the APPEA MOU for mutual aid to facilitate	*Potentially reducing the time to drill the relief well, resulting in*	The cost is minimal	The APPEA MoU commits the signatories to share rigs, equipment, personnel and services to assist another operator in the event of a LOWC incident. This would potentially enable Jadestone to source a suitable relief	Yes

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
and expedite the mobilisation of a relief well	*less hydrocarbon to the environment.*		well drilling rig quicker, and would also provide access to additional equipment, personnel and services.	
Source control - standby MODU available in-field during drilling operations instead of having to source and deploy at the time of loss of containment	*Potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.*	The total cost is about $700,000 per day (approx. $63 million during the EPs life over five years). If adopted this cost is paid regardless if there is a loss of containment event or not.	A MODU on standby close to the well location for the duration of the EP in readiness to drill a relief well may remove 10 days from the base case required to source and mobilise the MODU. However, Montara is an operating facility and the MODU would be required to be on standby 24/7 over the five-year life of the EP – this is not feasible for an operating facility. The costs, safety concerns and complexity of having a MODU and maintaining this arrangement for the duration of the EP is grossly disproportionate to the environmental benefit gained.	No
Source control - Position Subsea First Response Toolkit (SFRT) to Darwin, closer to the potential spill location	*Potentially reducing the time to start the application of subsea dispersants, resulting in a reduction of floating oil and shoreline loading*	AMOSC does not agree to the relocation of the SFRT due to the risk to other SFRT members	Relocating the SFRT is not a reasonably practicable strategy as the SFRT is a shared resource. Mobilisation of the SFRT will occur at the same time as mobilisation of a suitable construction class vessel to Darwin. The SFRT cannot be transported to the well location until the vessel is available in Darwin, which is expected to take 7 days. This option has not been adopted as it is not reasonably practicable and the costs and risks to other SFRT members are considered grossly disproportionate to the environmental benefit that might be gained.	No
Source control - Monitor status of available construction class vessels that would be required to deploy SFRT	*Potentially reducing the time to start the application of subsea dispersants, resulting in a*	The cost is minimal	Jadestone can monitor the availability of suitable construction class vessels within the Asia-Pacific Region that may be able to deploy the SFRT, if required. This	Yes

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
	reduction of floating oil and shoreline loading		would potentially provide availability to a suitable vessel to deploy the SFRT quicker.	
Aerial surveillance – additional dedicated aircraft and observers	No environmental benefit for additional dedicated resources	Additional charter costs would be incurred by Jadestone to increase aerial surveillance. 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, chemical dispersant applications and C&R. Increasing aerial surveillance would increase the safety risk. The two-dedicated aerial surveillance is sufficient to validate and inform the IAP process to ensure overall response is commensurate with nature and scale of incident. Therefore, there is no value in increasing dedicated overpasses and therefore the arrangements described in the OPEP are considered ALARP.	No
Vessel surveillance – additional dedicated vessels and observers	No environmental benefit for additional dedicated resources	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. Increasing vessel surveillance would increase the safety risk. 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.	No
Tracking buoys – additional tracking buoys	No environmental benefit for additional dedicated resources	Additional buoys are available through AMSA and	Tracking buoys are one tactic in the operational monitoring strategy. The number of buoys immediately	No

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
		AMOSC within days. There is no additional upfront cost for accessing these secondary buoys.	available is sufficient to cover tracking of oil given the other response activities that will be undertaken. Therefore, there is no value in increasing tracker buoy numbers and therefore the arrangements in the OPEP are considered ALARP.	
Ongoing real time collection of data prior to any spill event.	Greater awareness of the environment	An ongoing surveillance program would be at considerable cost to the project. Depending on the measured parameters this could involve ongoing costs in the order of hundreds of thousands each year.	Ongoing collection of real time environmental data would provide immediate inputs into decision making however this would require the use of aerial resources, satellite resources, ground surveys and marine surveys. The existing contracts in place for aerial surveillance, satellite imagery, trajectory modelling, and shoreline surveys can be activated in a timeframe that provides short, medium, and long-term access to data.	No
SCAT – additional resources to increase number of SCAT	SCAT continues during the response to verify shoreline oiling, clean-up effectiveness, and eventually, to conduct final evaluations of shorelines to ensure they meet clean-up 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). Not all of the shoreline in the EMBA will be contacted. The potentially oiled shoreline is remote and the majority is made up of mangroves, tidal wetlands and no access via land. Aerial and marine deployment of teams and surveys can be done efficiently for those areas able to be accessed. The limiting factor is being able to access those areas. Current capability is 6 teams which can be deployed across the shorelines for accessible locations. The minimum time to contact for SCAT is 17 days, which is enough time for Jadestone to determine the direction	No

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
			of the spill, deploy SCAT and gather information for the IMT. 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 – additional resources to that in the OPEP	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 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. 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	Additional resources include: Dispersant costs of $10,000 per m^3. FWADC aircraft $15,000 per aircraft per day. Vessels $15,000 per day plus fuel costs of $1,600 per day. Additional expert personnel. Chemical dispersant operations are to be conducted in daylight hours only. Indicative costs: Cost of suitable aircraft (e.g. crop duster) USD$350,000	Jadestone undertook an evaluation to determine the most effective resource requirements to reduce the environmental risk from a worst-case spill event to ALARP. Aspects considered were weathering of oil, volume of floating oil, timeframe and spread of spill, best case target area (i.e. thickness of oil), location of sensitive receptors, geographic location of application, location and type of dispersant stocks, volume of dispersant required, number of vessels and aircraft and ancillary resources. Evidence from the Montara oil spill in 2009 from AMSA reported that 'based on experienced personnel during the reponse the use of dispersant was highly effective in assisting the natural process of biodegradation and minimising the risk of oil impacts on reefs and shorelines' (Refer Appendix 4 of the OPEP). If there is a weather condition that prevents the application of dispersant (which is unusual for the environment around the Montara facility), this in itself, creates dispersion.	No

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
	water column. This could have negative flow-on social and economic consequences e.g. recreational and commercial fishing, diving.	Standby for Jadestone specialist personnel $150,000 p.a. Purchasing dispersant stock and maintenance in Darwin $400,000 p.a. Purchasing dispersant vessel and application equipment $300,000.	The results of the best-case capability evaluation for dispersant application is described in the Chemical Dispersant Plan as detailed in the OPEP Section 10.5 and 16.5 shows that Jadestone has access to more than enough dispersant through national and international stockpiles to exceed the required need. The OSRL Global Dispersant Stockpile volume was determined after evaluating global loss of well control events and accepted as being able to meet these events. An analysis was undertaken to determine the most effective mix of aircraft and vessels applying dispersant. Comparisons made between 4, 6 and 8 FWADC aircraft and different vessel numbers indicated that 5 FWADC, 1 Hercules and 4 vessels was the optimum. Jadestone has calculated the amount of dispersant required based upon the volume of oil that is released each day and then liaised with agencies to evaluate the best delivery timeframes. Jadestone is able to begin dispersant spraying on Day 2, ramp up on Day 3 and then meet and exceed the need from Day 5 onwards. This access to more dispersant than needed will allow Jadestone to spray on residual oil to account for the time prior to the need being met. • **Application of Chemical Dispersant from the FPSO**. Storing sufficient resources for dispersant application on the FPSO to spray on the spill at source could result in faster dispersant application at source, until the Chemical Dispersant Plan resources are deployed. In the event of the worst-case spill, the priority is to	

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
			ensure safety of people, manage the integrity of the vessels and enact source control. Once these aspects are managed, then spill response at site can be implemented. A collision capable of causing a spill to the marine environment would result in the FPSO being evacuated except for personnel essential to undertake damage repairs and tasks described in the SOPEP which, from a safety and operational perspective, would be significantly hindered if dispersant spraying was undertaken from the FPSO. The FPSO does not have the capacity to appropriately store/maintain sufficient dispersant stocks and application equipment, the skilled personnel to undertake the spraying, nor the resources to solely allocate to dispersant spraying in the event of a collision. This option is not feasible. The modelling undertaken indicates negligible environmental benefit in terms of reduction of floating oil between Day 1 and Day 5 if chemical dispersant was applied up to 3 days earlier. Therefore, Jadestone consider that the Chemical Dispersant Strategy described in the OPEP is ALARP. • **Dedicated dispersant vessels stationed in the field.** Specially adapted vessels (leased or owned) with dispersant, trained crew and dispersant application equipment permanently stationed at the Montara operations could begin spraying dispersant within 12 hours at the spill site. Although the amount of	

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
			dispersant able to be stored on deck is limited, it would enable dispersion to start until the Chemical Dispersant Plan resources are deployed. In the event of the worst-case spill, the priority is to ensure safety of people, manage the integrity of the vessels and enact source control. Once these aspects are managed, then spill response at site can be implemented. To have vessels spraying dispersant near the incident within 12 hours would hinder the emergency actions and present a safety risk for personnel. The FPSO and WHP have a 500m exclusion zone within which vessels are not allowed to egress without approval and cannot be permanently moored within for legal and safety reasons. Any vessel is required to moor outside the exclusion zone. To have a vessel dedicated to dispersant application moored permanently near the Montara operations 24/7/365 creates an unnecessary safety risk to vessel crew and is grossly disproportionate to the environmental risk. The modelling undertaken indicates negligible environmental benefit in terms of reduction of floating oil between Day 1 and Day 5 if chemical dispersant was applied up to 3 days earlier. Therefore, Jadestone consider that the Chemical Dispersant Strategy described in the OPEP is ALARP. • **Aircraft or vessels on 24/7 standby.** Aircraft or vessels (leased or owned) on 24/7 standby with dedicated crew would result in a faster chemical	

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
			dispersant implementation time (application could begin within 2 days). Aircraft and vessels used for spill response and dispersant application are normally employed in activities such as crop dusting, firefighting and marine services, and adapted for dispersant application when required. Jadestone would require 3 equipped vessels and supporting resources (crew, maintenance, berthing etc) and 5 suitably equipped aircraft and supporting resources (pilots, hangars, maintenance, registration etc). It is not practicable to have dedicated crews, aircraft or vessels in 24/7 state of readiness in Darwin because the frequency of use would result in cost being grossly disproportionate to the environmental risk. In essence, Jadestone would be replicating the FWADC which has been established for industry as a cost effective and fit for purpose preparedness measure. The modelling undertaken indicates negligible environmental benefit in terms of reduction of floating oil between Day 1 and Day 5 if chemical dispersant was applied up to 3 days earlier. Therefore, Jadestone consider that the Chemical Dispersant Strategy described in the OPEP is ALARP. • **Ownership / Storage of Dispersant by Jadestone in Darwin.** Ownership by Jadestone of dispersant stock and storage in Darwin waiting for use by FWADC or vessels. The limiting factor for dispersant application is the availability of aircraft and associated resources	

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
			for application, not the availability of dispersant. If Jadestone had its own dispersant stock, the FWADC is still the preferred delivery mechanism to achieve ALARP; with the fastest application beginning time by 48 hours. By this time, Jadestone has sufficient dispersant stock ready to be deployed by accessing the AMSA and AMOSC stockpiles. The fastest vessel dispersant application can begin is 36 hours (even if Jadestone has its own stock) due to steaming time to location. The required dispersant stocks can be sourced to conduct operations, without the need for Jadestone to acquire their own resources. There is no added environmental benefit to this option, and is not commensurate with the environmental risk. Therefore, Jadestone consider that the Chemical Dispersant Strategy described in the OPEP is ALARP. Jadestone Energy has evaluated the options and consider that it has access to what is required for ALARP via existing arrangements. As a member of an industry-wide oil spill response organisation (AMOSC), a party to an MOU with AMSA and OSRL for oil spill response, Jadestone has access to sufficient response capability to reduce the environmental risk associated with the worst credible spill to ALARP. Real-time planning for where the spill is going is undertaken as part of the Incident Action Planning process and provides a better operational picture for efficient and effective chemical dispersant application. The arrangements for incident management described	

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
			in the OPEP reduce the environmental risks associated with chemical dispersant applications and are considered ALARP.	
Containment and recovery - additional resources to that in the 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 $15000 each per day plus $1,600 per day for fuel Boom hire $12,000 per day for 6 teams. 6 skimmers $6000. Additional personnel $1500 per day	Containment and recovery operations will be focussed at source outside the dispersant operations, and near shorelines on the trajectory of the spill. If this is tracking towards Ashmore/Cartier (the shortest timeframe (12 days refer Section 12 of the OPEP) determined by the modelling), there are not estimated to be big volumes on mainland Australia (or contact at all). Operations will focus on the priority receptors (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 Section 11. 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). Jadestone has the ability to mobilise 45 containment and recovery systems (90 vessels) based on the average daily volume of oil required to be recovered. Given the significant decrease in volume from Week 2 onwards (Weeks 1 and 2 are not representative of the ongoing spill release), Jadestone considers it more effective to be able to ramp up as quickly as possible to meet the average need, which actually exceeds the estimated volume from Week 3 onwards.	No

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
			The volume of oil released from the worst-case LOWC scenario in Weeks 1 and 2 decreases significantly (by an estimated 32%) by Week 3. Jadestone is able to mobilise 24 systems within Week 1 and 45 in Week 2. From Week 3 onwards, Jadestone has access to the required number of vessels, equipment and resources to be able to exceed the need. These additional vessels from Week 3 onwards will be used to recover excess oil from Weeks 1 and 2, and also provide Jadestone with the ability to focus operations on priority receptors if required. In addition, C&R activities will be undertaken in areas outside those that have allowed for natural evaporation of the oil and been subject to chemical dispersant operations. C&R is targeted to discrete patches of oil. For Jadestone to purchase and maintain suitable vessels and equipment to be on standby 24/7/365 is cost prohibitive and disproportionate to the risk. Access to supplies via AMOSC, DoT, AMSA, OSRL, contracted marine providers and marine brokers will address half the volume in Week 1, meet the need in Week 2 and exceed the need from Week 3. Jadestone monitors the availability of larger vessels through existing marine brokers to meet specifications for containment and recovery operations. It is not feasible to pre-deploy containment and recovery equipment as modelling identifies many potential shoreline contact locations, largely remote, subjected to very high tides, mangroves and uninhabited. For	

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
			example, only 33% of the shoreline between Darwin and Broome is beach (OPEP Section 13). Even when the priority receptors are focussed on, the intrusion caused by equipment deployment and maintenance (considering the continuing operational aspect of Montara (24/7/365)) would result in unnecessary additional impact to these locations and potential safety risks for personnel. In addition, the cost of doing this is disproportionate to the benefit. The current level of resources meets for the need as it allows for flexibility in response operations as not all locations will be contacted in a single spill event, exceeds the need from Week 3 onwards and is therefore above to recover excess oil from Weeks 1 and 2, and, is the maximum realistic resource deployment. Containment and recovery arrangements described in the OPEP are considered ALARP.	
Protection and Deflection - additional resources to that in 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 environmental contact and intrusion opportunities and increase safety risks of responders.	Boom hire costs are variable depending on the configuration and type used however they are estimated to be approximately $5000 per day. The cost of additional resources is not considered the limiting factor; the limiting factor is considered to be the availability to use resources at the physical	Protection and deflection have limited application for most of the locations due to very high tidal influences, nature of shorelines, remoteness and lack of anchoring points for boom. Oil doesn’t contact all shorelines instantaneously but reaches various locations over a period, dependant on oceanic currents and wind directions. As such, implementing a greater initial response is not appropriate, however resources are ramped up as they are required. Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event (refer	No

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
		location. If required, additional equipment will be sourced and the additional cost borne by Jadestone.	OPEP Section 12). Jadestone determined the resources required based upon the priority receptors estimated worst-case shoreline volumes and timeframes to contact. Jadestone has access to resources via AMOSC, AMSA, OSRL and DoT, and has the ability to move across locations if this strategy is determined to be feasible and safe to implement in consultation with DoT. Mobilising additional resources too early, may result in excess resources being on-location that are not required. Consequently, this has the potential to cause additional environmental impacts if larger than required storage areas and increased personnel presence result in further sensitising coastal habitats without providing significant benefit. For Jadestone to purchase equipment, store and maintain is cost prohibitive when access via existing stockpiles will meet the need, and the limiting factor is people (who are accessed from outside Darwin). It is cost prohibitive and disproportional to the risk for Jadestone to hire and maintain resources to be on standby 24/7/365 when access to vessels and equipment is granted through contracts and AMSOC/OSRL/DoT/AMSA. Vessels and people will be utilised as determined through the IAP and NEBA. Development of tactical response plans was considered and Jadestone has access to the INPEX Browse Island Oil Spill Incident Management Guide, which guides response for remote shorelines and islands. The shortest time to contact is 12 days and Jadestone has time to	

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
			utilise this Guidance to prepare a response. PTTEP is developing a Concept Plan for the Kimberley which has a minimum contact timeframe of 39 days. Jadestone has enough time available to develop required plans without having a pre-prepared one. Given the remoteness of the locations with shoreline contact modelled, and continuing operational aspect of Montara (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 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 - additional resources to that in 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	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	Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event. Section 13 of the OPEP describes how Jadestone's plan is to focus resources on the priority receptors based upon the worst-case maximum average daily oil ashore, the nature of the shoreline and the recoverable ability of the clean-up teams. The remoteness and character of potentially affected shorelines raises significant logistical challenges	No

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
	increased resources at particular locations dependent upon environmental considerations. For example, a turtle nesting beach during the nesting/hatching season may benefit in having additional resources deployed to clean the beach before nesting/hatching events. There may be benefit in deploying additional machinery in the event of greater opportunities for use, given machinery has the capacity to remove far greater volumes of bulk oil in the right circumstances. The numerous factors and consideration in determining the best approach for shoreline clean-up, the benefit of additional resources will be determined for each Operational Period. However, additional resources on shorelines will increase potential environmental contact and intrusion opportunities, increase safety risks of responders, cause physical	additional cost borne by Jadestone.	associated with mounting a shoreline response and the potential health and safety risks to personnel. The combination of machinery for mechanical and manual removal of oil and personnel requirements have been considered based on opportunities for use and characteristic of shoreline (i.e. may not be appropriate for small offshore islands, tidal flats, remote rocky or mangrove lined shorelines). It is the opportunity for use rather than the availability of machinery and personnel which is considered the limiting factor. For Jadestone to purchase equipment, store and maintain it is cost prohibitive when access via AMOSC Mutual Aid/DoT/OSRL and mainstream suppliers will meet the need, and the limiting factor is people (who have to be accessed from outside Darwin), health and safety issues for shoreline work and suitable vessels. The shortest time to contact a location Jadestone can access for shoreline clean-up is 19 days, which is sufficient time to mobilise people and equipment. Given the remoteness of the locations with shoreline contact modelled, and continuing operational aspect of Montara (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. Allocating shoreline clean-up resources relies on understanding the trajectory of the oil and timeframe for expected contact. It is not practical to pre-position teams ready for rapid	

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
	damage and could be a negative impact.		deployment to reduce the timeframe for shoreline response. In addition, the cost of doing this is grossly disproportionate to the benefit. Jadestone considered increasing the number of resources to support shoreline response, however, the stated number is based upon the nature of the shorelines and the option of natural attenuation if to conduct operations there would be too environmental damaging. Real time modelling and assessment will determine if extra resources are required. If this is the case, then the resources required are able to be obtained within the shortest time to contact timeframes. The current level of resources meets for the need as it allows flexibility in response operations and surge capacity; as not all locations will be contacted in a single spill event. The arrangements described in the OPEP are considered ALARP.	
OWR – additional resources to that described in the OPEP	The OWR level is a Level 5 (refer WAOWRP and NTOWRP) as dugongs may be oiled. OWR aims to prevent/reduce the impact to marine fauna (in particular birds and turtles) and any long-term effects.	Significant additional cost would be incurred if Jadestone were to purchase or hire a facility to base at a staging site, or have OWR expert personnel on standby. Significant additional cost would be incurred if Jadestone provided its own oiled wildlife response	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 strategies that have been considered include: • Additional arrangements to improve mobilisation times of international OWR resources (e.g. additional contracts/arrangements with OWR	No

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
		(personnel, experts, facilities, plans etc).	organisations or pre-mobilisation of international OWR personnel); • Jadestone to have OWR expert personnel on standby to improve response; • Jadestone to commission additional training of Australian based OWR personnel to increase numbers of competent OWR personnel; and • OWR resources purchased and based at Darwin and Broome to increase OWR facilities and process timeframes. Given the local (AMOSC and DBAC) 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 WA and NT. The NTOWRP, WAOWRP and the Kimberley regional plan were developed by the Territory and State environmental agency in conjunction with industry, AMSA, AMOSC, Perth Zoo and academia. Therefore, represents the best-oiled wildlife response plans that NT, WA and Jadestone can utilise. The cost for Jadestone to: - purchase/hire OWR equipment and pre-set up facilities at Darwin and/or Broome; - have OWR expert personnel on standby; - commission additional OWR training in WA; is grossly disproportionate to the risk. The Montara operations are 24/7/365 and significant costs would be	

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
			incurred to undertake these options. The equipment can be purchased/hired easily. The level of oiled wildlife response required for a worst-case impact event is considered to be potentially a Level 5 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. The arrangements described in the OPEP are considered ALARP.	
Waste Management - additional resources to that described in the OPEP	While oil is arriving on shorelines, there is limited benefit from additional resources that might remove waste more quickly as the waste is still being collected. 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	The cost of additional resources is not considered the limiting factor; the limiting factor is considered to be the ability to utilise resources at the physical location. If required, additional resources 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). The limiting factor for waste collection (which is a support service for Jadestone) is the collection of oily waste. As the arrangements in the OPEP are ALARP, the waste contractor is able to resource a plan that meets the nature and scale of the event within realistic timeframes. The arrangements described in the OPEP are considered ALARP.	No

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
	nesting/hatching season may benefit in having additional resources deployed to clean the beach before nesting/hatching events.			

8.7.13 Acceptability assessment

The potential impacts of an unplanned crude release to the marine environment are considered '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 & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of continuously reviewing and updating activities and practices during the operation, including spill response arrangements.
Stakeholder & reputation	Stakeholder consultation has been undertaken (see **Section 6**), including engagement with the Director of Parks, State and National response agencies of DoT and AMSA, Northern Territory government, commercial and recreational fishing industry bodies and fishers. No concerns have been raised with regards to impacts of a crude spill by relevant persons. During any spill response, a close working relationship with key regulatory bodies (e.g. DoT, DBCA, AMSA, DER) will occur and thus there will be ongoing consultation with relevant persons during response operations.
Environmental context & ESD	The worst-case credible crude spill scenario for the Montara operations (scenario 9) is a result of a loss of well control with up to 164,718 m^3 released from within 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	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 (**Appendix C**). 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 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 Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. Protected areas within the EMBA predicted to potentially be impacted by crude above threshold levels have been identified as Priority receptors (**Section 8.7.9**). 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.

Recovery Plan for Marine Turtles in Australia, 2017-2027	The Recovery plan for marine turtles in Australia (DoEE 2017) identifies **Marine pollution as a risk.** The Plan requires that the risk of oil spill impact to marine turtles is evaluated and, if required, appropriate mitigation measures are implemented. This section and the proposed controls are consistent with this advice.
Approved Conservation Advice for Anous tenuirostrus melanops (Australian Lesser Noddy)	The Conservation advice for the Lesser noddy identifies **Marine pollution as a risk:** The advice requires the risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. Houtman Abroholos has been identified as important bird nesting location. This section and the proposed controls are consistent with this advice.
Approved Conservation Advice for Calidris ferruginea (Curlew Sandpiper)	The Conservation advice for the curlew sandpiper identifies **Marine pollution as a risk:** The advice requires the risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. Cartier Island has been identified as important bird nesting location. This section and the proposed controls are consistent with this advice.
Approved Conservation Advice for Calidris canutus (Red Knot)	The Conservation advice for the Red Knot identifies **Marine pollution as a risk:** The advice requires the risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. Cartier Island has been identified as important bird nesting location This section and the proposed controls are consistent with this advice.
Approved Conservation Advice for Calidris tenuirostis (Great Knot)	The Conservation advice for the Great Knot identifies **Marine pollution as a risk:** The advice includes the risk of habitat loss and degradation.. The advice recommends protecting important habitat. This section and the proposed controls are consistent with this advice
Approved Conservation Advice for Advice for Charadrius leschenaultii (Greater sand plover)	The Conservation advice for the Greater Sand Plover identifies **Marine pollution as a risk:** The advice incudes the risk of oil spill impact to the build up in the substrate in impacts on the benthic prey fauna it feeds on. The advice recommends protecting important habitat. This section and the proposed controls are consistent with this advice
Approved Conservation Advice for Advice for Charadrius mongolus (Lesser sand plover)	The Conservation advice for the Lessser Sand Plover identifies **Marine pollution as a risk:** The advice includes the risk of oil spill impact to the build up in the substrate in impacts on the benthic prey fauna it feeds on. The advice recommends protecting important habitat. This section and the proposed controls are consistent with
Approved Conservation Advice for Numenius madagascariensis (Eastern Curlew)	The Conservation advice for Eastern Curlew identifies **Marine pollution as a risk:** The advice requires the risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. Cartier Island has been identified as important bird nesting location. This section and the proposed controls are consistent with this advice.
Approved conservation advice for green sawfish (Threatened Species Scientific Committee 2008b)	The Conservation advice for Green sawfish identifies **Marine pollution as a risk:** The advice requires measures to reduce adverse impacts due to pollution to be considered; and to reduce likely impact on green sawfish.

Approved Conservation Advice for Limosa lapponica bauera (Bar-tailed Godwit	The Conservation advice for Bar-tailed Godwit identifies **Marine pollution as a risk:** The advice requires the risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. Cartier Island has been identified as important bird nesting location. This section and the proposed controls are consistent with this advice.
Approved Conservation Advice for *Limosa lapponica menzbieri* (Northern Siberian Bar-tailed Godwit)	The Conservation advice for Northern Siberian Bar-tailed Godwit identifies **Marine pollution as a risk:** The advice requires the risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. Cartier Island has been identified as important bird nesting location. This section and the proposed controls are consistent with this advice.
Approved Conservation Advice for Pristis pristis (largetooth sawfish)	The Conservation advice for largetooth sawfish identifies **Habitat degradation** and **Marine debris as risks**: The advice requires measures to reduce adverse impacts of habitat degradation and/or modification to be considered; and to reduce marine debris likely to impact on largetooth sawfish.
Approved Conservation Advice for Glyphis garricki (northern river shark)	In a LOWC scenario, habitat important for the large tooth sawfish would be identified and given high priority for protection. Any spill response activities (**Section 7.9**) that generate marine debris are also managed to reduce further potential environmental impacts. This is consistent with the conservation advice.
Wildlife conservation plan seabirds (Commonwealth of Australia 2020)	*In a LOWC scenario, habitat important for the migratory birds would be identified and given high priority for protection. Any spill response activities (**Section 7.9**) are also managed to reduce further potential environmental impacts to migratory habitats. This is consistent with the conservation advice for Common Sandpiper (Actitis hypoleucos) and Sharp-tailed Sandpiper (Calidris acuminata) and the wildlife conservation plan for seabirds (2020).*

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.* *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).* *There are 14 AMPs within the EMBAs, including:* • *Cartier Island AMP* • *Kimberley AMP* • *Ashmore Reef AMP* • *Oceanic Shoals AMP* • *Joseph Bonaparte Gulf AMP* • *Argo-Rowley Terrace AMP* • *Roebuck AMP* • *Mermaid Reef AMP* • *Eighty Mile Beach AMP* • *Arafura AMP* • *Arnhem AMP* • *Dampier AMP* • *Montebello AMP* • *Wessel AMP* *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 the proposed Activity was completed as part of the Consultation process (**Section 6**).* *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.

8.8 Worst Case Diesel Spill

8.8.1 Description of hazard

Diesel spill	Release of diesel may occur from a support vessel due to vessel collision within the Operational Area or from a dropped object event. The worst-case diesel spill scenario is due to collision with the FPSO resulting in damage to a fuel oil tank resulting in release to sea. The maximum worst-case credible spill volume of diesel has been calculated as 906 m^3 based on the largest fuel oil tank on the FPSO.

A HAZID was undertaken for the Montara operations and the below credible scenarios resulting in a diesel spill were identified.

8.8.2 Spill volume

The volume of 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, 906 m^3 for largest FPSO fuel tank, and 5 m^3 during transfer of diesel between support vessels. For the purposes of determining potential impacts, the larger volume of 906 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.

Table 8-8: ***Credible diesel releases to the marine environment***

Scenario	Maximum Credible Spill	Credibility justification
Scenario 5 – Release of diesel from FPSO or vessel due to vessel collision/ dropped object	Based on AMSA (2015) 'other vessel collision' – volume of largest fuel tank = **80m³** (based on a typical operations support vessel); 906 **m³** (based on FPSO fuel tank)	A maintenance support vessel would typically carry a maximum total fuel cargo of 495 m^3 in tanks and the largest fuel tank containing diesel on the FPSO is 906 m^3.
Scenario 11– Leak or rupture of bunkering hose during support vessel to diesel transfer	Based on AMSA (2015) 'Production platform refuelling – continuous supervision' Transfer rate x 15 minutes (continuous supervision) = 20 m^3/hr for 15 minutes = **5m³**	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.

8.8.3 Diesel characteristics

Characteristics for marine diesel were extracted from the ASA oil database for similar operational temperatures. 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%.

For further information, the Montara Operations OPEP and relevant appendices as referenced therein.

In the marine environment diesel will behave as follows:

- Diesel will spread rapidly in the direction of the prevailing wind and waves;
- Evaporation is the dominant process contributing to the fate of spilled diesel from the sea surface and will account for >50% reduction of net hydrocarbon balance;
- Diesel will entrain under the water surface particularly when wind speed and resultant wave action increase;

- The evaporation rate of diesel will increase in warmer air and sea temperatures such as those at the Operations location; and
- 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.

8.8.4 Modelling Approach

A diesel spill scenario of 906 m^3 was modelled by RPS for the Montara operations field to determine the dispersion behaviour of the released hydrocarbon within the marine environment.

The modelling considered the release of 906 m^3 within the Montara Operations 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 stochastic modelling methods used to evaluate the weathering and distribution of the 906 m^3 diesel spill are as per those described in **Section 8.8.3.**

Provided below are details specific to the 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.

8.8.5 Diesel Modelling results

Floating oil results

Results of the stochastic modelling indicated that surface sheens of floating oil (<1 g/m^2) may pass over the following sensitive areas, with a probability of <1% of reaching these locations:

- Vulcan Shoal after 35 hours;
- Goeree Shoal after 62 hours;
- Carbonate Bank and Terrace System of the Sahul Shelf after 68 hours; and
- Eugene McDermott Shoal after 74 hours.

Floating oil at concentrations of 10 g/m^2 were only predicted to reach Vulcan Shoals within 36 hours of commencement of release (at a probability of <1%). Oil was predicted to accumulate at Browse Island at a loading rate of 0.4 g/m^2.

Entrained Oil results

Results of the stochastic modelling indicated that entrained oil concentrations greater than 100 ppb were predicted to reach the following locations (with the highest concentrations):

- Vulcan Shoals (1,772 ppb);
- Carbonate Bank and Terrace System of the Sahul Shelf (1,344 ppb);
- Barracouta Shoals (733 ppb); and
- Goeree Shoal after (846 ppb).

The AMPs predicted to be impacted by entrained diesel >100 ppb include:

- Oceanic Shoals AMP;

- Ashmore Reef AMP; and
- Cartier Island AMP.

The KEFs predicted to be impacted by entrained diesel >100 ppb include:

- Continental Slope Demersal Fish Communities;
- Ashmore Reef and Cartier Island and surrounding Commonwealth waters; and
- Ancient coastline at 125 m depth contour.

Dissolved aromatic results

Dissolved aromatic hydrocarbons at concentrations of 70 ppb or greater were not predicted to contact sensitive receptors evaluated. In fact, the highest dissolved aromatic hydrocarbon concentration predicted to contact a sensitive receptor location was 23 ppb at Vulcan Shoals. Refer to Figure 8-8to Figure 8-10for the environment that may be affected due to a diesel spill of 906 m^3.

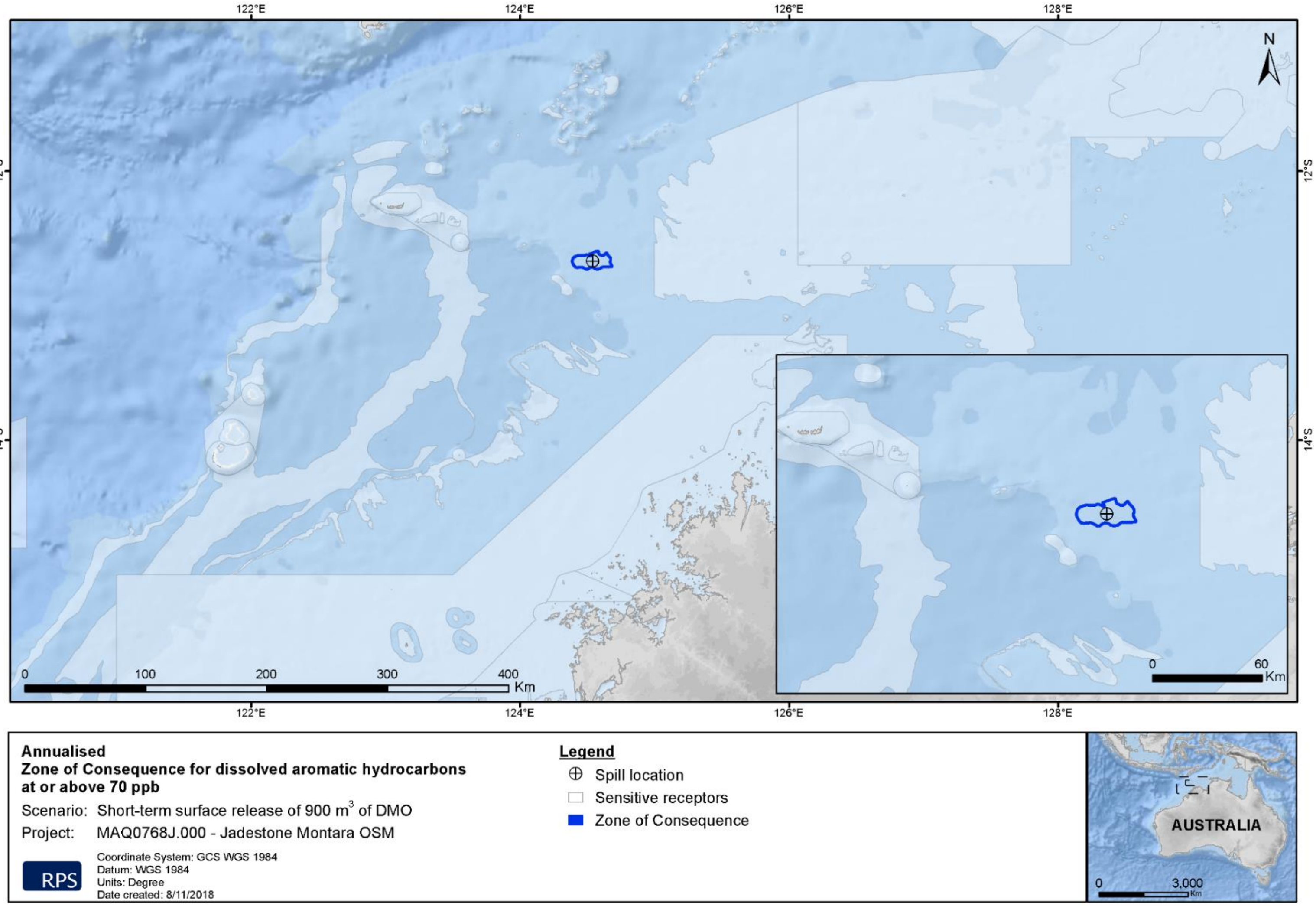


Figure 8-8: ***Modelled spill trajectories for all seasons for dissolved aromatic hydrocarbon concentrations ≥70 ppb resulting from surface release of 906 m³ diesel at the Montara field***

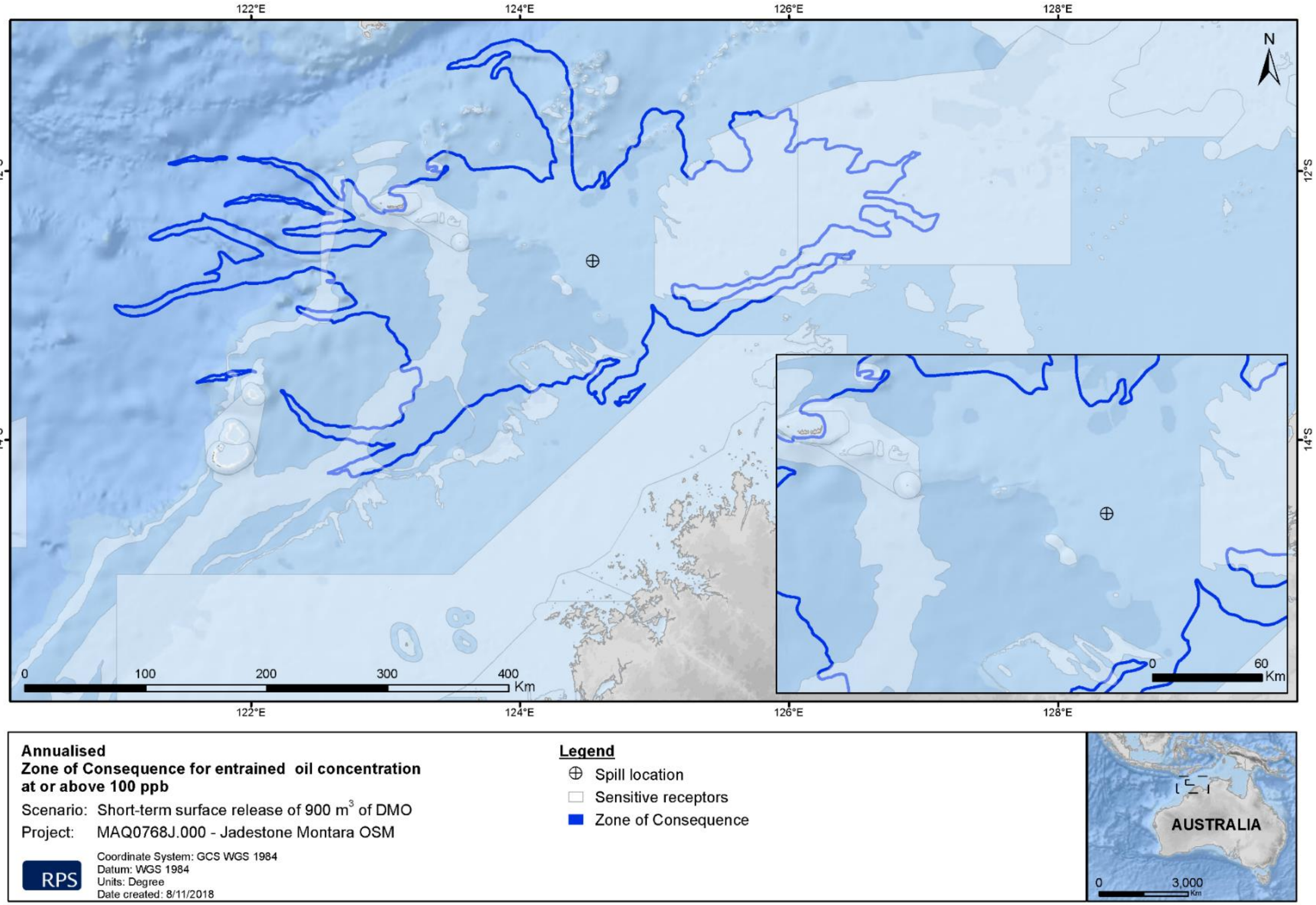


Figure 8-9: ***Modelled spill trajectories for all seasons for entrained oil concentrations >100 ppb resulting from surface release of 906 m³ diesel at the Montara field***

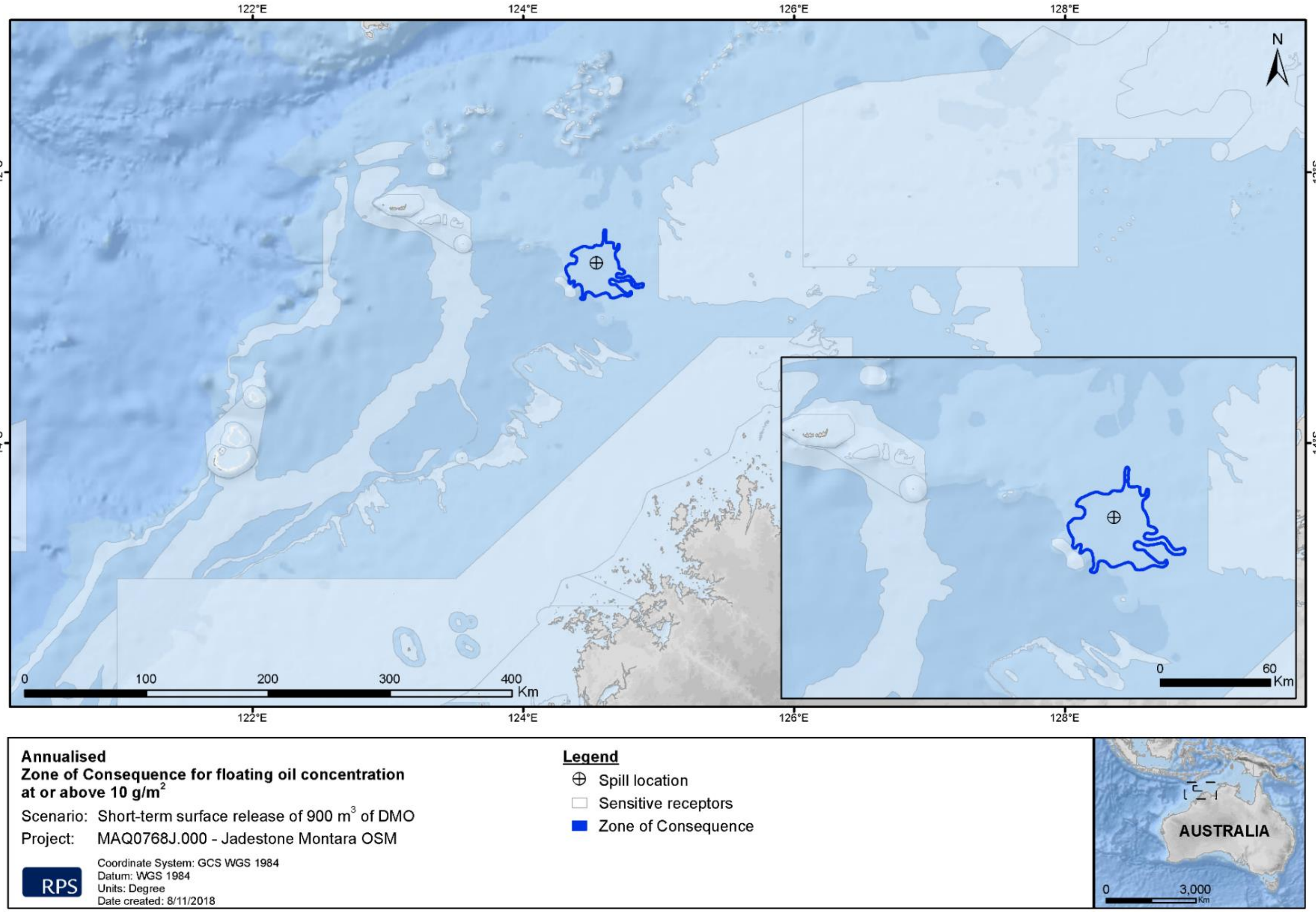


Figure 8-10: Modelled spill trajectories for all seasons for floating oil concentrations ≥10 g/m² resulting from surface release of 906 m³ diesel at the Montara field

8.8.6 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. 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 diesel spill, the heavier components of diesel can remain entrained or at sea surface for an extended period. Given the properties of 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.

A summary of impacts and risks to sensitivities and values within the marine environment is provided in **Table 8-9**. For further information on the habitats, marine organisms and socio-economic receptors refer to **Appendix C**.

Table 8-9: Potential Impacts to sensitive receptors from diesel spill

<table>
<tr><th rowspan="2">Receptors</th><th colspan="3">Potential Impacts from a diesel spill</th></tr>
<tr><th>Floating and/or shoreline</th><th>Entrained</th><th>Dissolved</th></tr>
<tr><td rowspan="2">Plankton</td><td colspan="3">Potential impacts from diesel spill
There is potential for localised mortality of plankton due to reduced water quality and toxicity. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest.</td></tr>
<tr><td colspan="3">Impact assessment to receptors within the EMBA
High abundance of phytoplankton typically occurs around topographical features that may result in upwelling or a disruption to the current flow which may be present around banks and shoals. The EMBA has the potential to overlap with spawning of some fish species given the year round spawning of some species. In the unlikely event of a spill occurring, fish larvae may be impacted by hydrocarbons entrained in the water column with effects greatest in the upper 10 m of the water column where the majority of plankton concentrate and closest to the spill source. However, following release, the diesel will rapidly evaporate, disperse and degrade in the offshore environment, reducing the concentration and toxicity of the spill. Given duration of fish spawning periods, lack of suitable habitat for aggregating fish populations near the surface, combined with the quick evaporation and dispersion of diesel, impacts to overall fish populations are not expected to be significant.</td></tr>
<tr><td>Benthic habitat and communities
(Including deepwater habitats and shallow shoals)</td><td>n/a – benthic habitats not present at surface</td><td colspan="2">Potential impacts from dissolved and entrained oil
Benthic habitats at shoals may be affected by marine diesel. This may result in toxic effects to both the habitat (in the case where the habitat is biological such as coral reefs) and associated flora and fauna. The degree of impact will depend on several variables, including the duration of exposure to DAHs and other diesel components. Sea grasses and macroalgae may experience a phytotoxic effect caused by absorption of DAHs from the water column. The hydrocarbon molecules can concentrate in membranes of aquatic plants, inhibiting photosynthetic efficiency (Runcie et al., 2004). Recovery of habitats experiencing chronic effects are expected within weeks to months of return to ambient water quality.
Direct contact to shallow hard corals by entrained diesel could lead to impacts such as short or long-term sub-lethal effects including reduced feeding capacity and growth, reduced reproductive output and increased mucous production (IPIECA, 1992). In the worst case instance irreversible tissue necrosis and death could occur.
Epifauna associated with hard substrates such as ascidians and sponges may experience direct toxicity through ingestion.</td></tr>
</table>

<table>
<tr><th rowspan="2">Receptors</th><th colspan="2">Potential Impacts from a diesel spill</th><th></th></tr>
<tr><th>Floating and/or shoreline</th><th>Entrained</th><th>Dissolved</th></tr>
<tr><td></td><td colspan="3">Impact assessment to receptors within the EMBA
There are a number of shoals within the EMBA for the worst-case diesel spill: Goeree Shoal, Eugene McDermott Shoal, Barracouta Shoals and Vulcan Shoal. These shoals have a diversity of benthic habitats and associated fish and invertebrate assemblages which could be affected by entrained or dissolved oil. The shoals have a number of representative habitats including corals, sponges, seagrass</td></tr>
<tr><td rowspan="2">Marine mammals</td><td>Potential impacts from surface oil
Physical and chemical effects of diesel in sea surface waters have been demonstrated through direct contact with organisms, for example through physical coating, adsorption to body surfaces and ingestion (NRC, 2005).
Lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth and potential illness.
Whales and dolphins are smooth skinned, hairless mammals, so hydrocarbons tend not to adhere to their skin and the potential impacts of oiling on them is limited.</td><td colspan="2">Potential impacts from dissolved and entrained oil
The high volatility of the diesel will result in the rapid evaporation and loss of the more toxic aromatic components of the diesel, resulting in a reducing toxicity threat to marine fauna with time. Surface respiration could lead to accidental ingestion of hydrocarbons or result in the coating of sensitive epidermal surfaces. For marine mammals that may be exposed to the more toxic aromatic components of the marine diesel, chemical effects are considered unlikely since these species are mobile and therefore not be constantly exposed for extended durations that would be required to cause any major toxic effects.
Clogging of baleen structures and toxicological effects from ingestion, although recorded, is sparse in the literature (Geraci and St. Aubin, 1985).
The susceptibility of marine mammal species to physiological effects through ingestion of surface and water column hydrocarbon varies with the feeding mechanism of each species:
• Whales with a baleen mechanism filter nutrient-rich waters containing food such as plankton and small fish over the baleen (a sieve type structure) before subsequently moving the food to the oesophagus using the tongue;
• Baleen whales that skim surface waters and the water column (e.g. southern right whales) are more likely to be affected by surface hydrocarbons than other whales that ‘gulp’ feed such as the humpback whale; and
• Toothed whales are also less susceptible to impacts owing to gulp feeding behaviour (Geraci and St. Aubin, 1985).</td></tr>
<tr><td colspan="3">Impact assessment to receptors within the EMBA
Marine mammals present within the diesel EMBA include threatened and migratory whales and dolphins, and potentially dugongs. The activity is being undertaken all year round and may overlap with blue whale migration and humpback whale migration and calving, therefore diesel may</td></tr>
</table>

<table>
<tr><th rowspan="2">Receptors</th><th colspan="3">Potential Impacts from a diesel spill</th></tr>
<tr><th>Floating and/or shoreline</th><th>Entrained</th><th>Dissolved</th></tr>
<tr><td></td><td colspan="3">contact whales during these life stages. However, given the rapid evaporation of diesel it is unlikely that significant numbers would be impacted. The absence of key feeding, resting or breeding areas for other threatened and migratory species and rapid evaporation and dissipation of diesel means significant numbers are unlikely to be impacted.</td></tr>
<tr><td rowspan="2">Marine Reptiles</td><td>Potential impacts from surface oil
Marine turtles may be impacted by surface hydrocarbons through exposure during surface respiration, particularly where volatiles are being emitted in areas where fresher oil is weathering. Surface respiration could lead to accidental ingestion of hydrocarbons or result in the coating of sensitive epidermal surfaces.</td><td colspan="2">Potential impacts from dissolved and entrained oil
Whilst turtle nesting beaches may be contacted by weathered marine diesel, turtles will always nest above the high tide mark and any diesel moving through the beach profile should not come into contact with nests. Entrained and dissolved oil may result in harm to internal anatomy if ingested, irritation or damage to sensitive external features such as eyes and skin and damage to respiratory processes if significant inhalation of volatile fumes occurs at the surface</td></tr>
<tr><td colspan="3">Impact assessment to receptors within the EMBA
Threatened and migratory marine reptile species may occur within the diesel spill area EMBA as turtles are widely dispersed at low densities across the NWS and in the unlikely event of a diesel spill occurring, individuals traversing open water may come into contact with water column or surface diesel. The diesel spill EMBA overlaps with the BIAs for some turtle species and therefore there is the risk of contact with nesting turtles and hatchlings with surface and dissolved oil.</td></tr>
<tr><td>Fish, Sharks, Rays</td><td>Potential impacts from surface oil
Near the sea surface, fish are able to detect and avoid contact with surface slicks and as a result, fish mortalities rarely occur in open waters from surface spills (Kennish, 1997; Scholz et al., 1992). Pelagic fish species are therefore generally not highly susceptible to impacts from hydrocarbon spills.
However, hydrocarbon droplets can physically affect fish and sharks exposed for an extended duration (weeks to months). Smothering through coating of gills can lead to the lethal and sub-lethal effects of reduced oxygen exchange, and coating of body surfaces may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food leading to reduced growth.</td><td colspan="2">Potential impacts from dissolved and entrained oil
In offshore waters near to the release point, pelagic fish are at risk of exposure to the more toxic aromatic components of the marine diesel. Pelagic fish in offshore waters are highly mobile and comprise species such as tunas, sharks and mackerel. Due to their mobility, it is unlikely that pelagic fish would be exposed to toxic components for long periods in this spill scenario. The more toxic components would also rapidly evaporate and concentrations would significantly diminish with distance from the spill site, limiting the potential area of impact. Rays are typically found on benthic habitats and may be present around shoals in the area and likely below the area of water column affected by a diesel spill.</td></tr>
</table>

<table>
<tr><th rowspan="2">Receptors</th><th colspan="3">Potential Impacts from a diesel spill</th></tr>
<tr><th>Floating and/or shoreline</th><th>Entrained</th><th>Dissolved</th></tr>
<tr><td></td><td colspan="3">Impact assessment to receptors within the EMBA
Whale sharks could potentially transit through the spill trajectory area, however this is considered unlikely given the small area affected by the diesel spill and its distance from known aggregation areas. Owing to the rapid evaporation expected and dispersion, impacts to the whale shark would be expected to be minimal.
The NWS supports a diverse assemblage of fish and shark species, particularly in shallower water near islands and shoals. Other shark and pelagic fish species may transit the spill trajectory area but impacts would be anticipated to be negligible as most species will be well below the affected area of the water column.</td></tr>
<tr><td rowspan="2">Avifauna</td><td>Potential impacts from surface oil
Estimates for the minimum thickness of floating oil that will harm seabirds (through ingestion from preening of contaminated feathers or loss of thermal protection of their feathers) range from 10 g/m^2 (O'Hara and Morandin, 2010) to 25 g/m^2 (Koops et al. 2004). Seabirds have the potential to become oiled through interactions with surface waters in the spill area or through secondary ingestion of toxins as a result of feeding on affected prey. Potential impacts to seabirds are from contact, ingestion and/ or oiling of feathers. In addition, diesel can erode feathers causing chemical damage to the feather structure that subsequently affects ability to thermo regulate and maintain buoyancy on water.
Seabirds may also come into contact with marine diesel around shorelines as it percolates through the beach profile during feeding, breeding and roosting activities. This may result in chemical impacts to feathers and exposed skin from the diesel.</td><td colspan="2">Potential impacts from dissolved and entrained oil
As most fish survive beneath floating slicks, they will continue to attract foraging seabirds, which typically do not exhibit avoidance behaviour.
Potential impacts to avifauna due to 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.</td></tr>
<tr><td colspan="3">Impact assessment to receptors within the EMBA
Threatened and migratory seabirds and shorebirds that may occur within the EMBA may have foraging, feeding, breeding and or nesting habitat in the vicinity of the EMBA.</td></tr>
</table>

Receptors	Potential Impacts from a diesel spill		
	Floating and/or shoreline	Entrained	Dissolved
	The EMBA intercepts with breeding BIAs for several migratory species and therefore foraging and breeding habitat in the area may be impacted by surface and water column while foraging (dive and skim feeding). Higher numbers would be expected during breeding periods. Due to the quick evaporation and dispersion of diesel, significant impacts are not anticipated.		
AMPs	*Potential impacts from surface oil* Surface oil is not expected to occur at shorelines of AMPs.	*Potential impacts from dissolved and entrained oil* Entrained and dissolved hydrocarbons will or may impact the coral and seagrass habitats, as well as other marine park values fauna including dugongs, sea snakes (protected), fish and other marine mammals. Impacts to these receptors are described above.	
	Three AMPS are present within the diesel EMBA: Oceanic Shoals AMP, Ashmore Reef AMP and Cartier Island AMP.		
State Marine Parks	There are no State marine parks within the diesel EMBA.		
World, National and Commonwealth Heritage Places	There are no World, National and Commonwealth Heritage Places within the diesel EMBA.		
Threatened Ecological Communities	There are no threatened ecological communities within the diesel EMBA.		
Wetlands of International Importance	There are no wetlands of international importance within the diesel EMBA.		
KEFs	*Potential impacts from surface oil* There are no KEFS that would be impacted by surface oil as the KEFs relate to geomorphologic features which are not expected to be impacted by hydrocarbons.	*Potential impacts from dissolved and entrained oil* Values and sensitivities associated with the KEFs include marine fauna due to the higher diversity of fish species associated with the higher diversity in fish communities or nutrients such as Continental Slope Demersal Fish Communities; or benthic habitats at Ashmore Reef and Cartier Island and surrounding Commonwealth waters. Impacts to marine fauna are discussed above.	

Receptors	Potential Impacts from a diesel spill		
	Floating and/or shoreline	Entrained	Dissolved
	Impact assessment to receptors within the EMBA There are three KEFs which are overlapped by the diesel EMBA, these include: • Continental Slope Demersal Fish Communities; • Ashmore Reef and Cartier Island and surrounding Commonwealth waters; and • Ancient coastline at 125 m depth contour		

8.8.7 Environmental performance

Environmental Risk		Unplanned release of diesel		
Performance Outcome		**No spill of hydrocarbon to the marine environment.**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
148	Montara Marine Facility Manual (MV-90-PR-H-00001)	All hoses are fitted with dry-break couplings and are buoyant or fitted with floats	Bunkering checklist	Maintenance Supervisor
149		Visual inspection of dry break couplings and hoses prior to diesel transfer to ensure they are in good condition		
150		Permit-to-work documentation is complete and signed off to ensure refueling is undertaken in accordance with the refueling procedure		
151		Bunding, sumps and drains are inspected prior to bunkering or transfer		
152		Bunding/ drip trays under all skids and potential leak sources on WHP and FPSO are inspected prior to bunkering or transfer		
153		Testing of emergency shutdown mechanism on the transfer pumps prior to bunkering or transfer		
154		No night time bunkering or transfer is permitted, unless a risk assessment is undertaken and additional mitigation measures are implemented (as identified as being necessary), and signed off by the Operations Supervisor		
155		Maintain radio contact with vessel during bunkering or transfer operations		
156	Shipboard Oil Pollution Emergency Plan	Compliance with MARPOL 73/78 Annex I (Prevention of pollution by oil) and Marine Order 91 (Marine pollution prevention – oil) (as appropriate to vessel class), including valid SOPEP for managing spills	Records demonstrate vessels have valid SOPEP	Marine Superintendent
157		Vessels to have stocks of spill response kits/bins available and accessible onboard to respond to a spill as per their SOPEP	Records demonstrate spill response bins/kits are readily available and stocked	OIM / Vessel Master

Environmental Risk		Unplanned release of diesel		
Performance Outcome		**No spill of hydrocarbon to the marine environment.**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
158	Implement Montara Oil Pollution Emergency Plan (MV-70-PLN-G-00001)	In the event of a tier 2 or tier 3 oil spill implement the Montara OPEP to reduce environmental impacts due to spill	Incident Log	IMT Leader
159	Competency and Training Management System (JS-60-PR-Q-00014) *	Personnel trained and assessed competent in accordance with their role requirements	Records of competency	OIM Vessel Master HR Manager
–	Refer **Section 7.7 and 7.9** for additional controls and performance standards related to vessel operations			
*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.				

8.8.8 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 an unplanned release of 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**	**Practicable**	**Cost effective**	**Justification**
N/A	Eliminate	N/A	N/A	The use of diesel for fuel for vessels and machinery cannot be eliminated, vessels and machinery are required for the operations and diesel is therefore required. Other energy sources are not readily available to power all equipment and vessels.
Substitute diesel for another hydrocarbon type	Engineering	N/A	N/A	Machinery is designed for using 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	Administrative	N/A	N/A	Through the application of specific controls and procedures, and maintenance of machinery, no further administrative controls were identified.

8.8.9 Acceptability Assessment

The potential impacts of an unplanned diesel release to the marine environment are considered '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 & management system compliance	Jadestone's HSE Policy objectives are met. **Section 9** demonstrates that Jadestone's HSE Management System is capable of continuously reviewing and updating activities and practices during the operation, including spill response arrangements.
Stakeholder & reputation	Stakeholder consultation has been undertaken (see **Section 6**), 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 diesel spill by relevant persons. During any spill response, a close working relationship with key regulatory bodies (e.g. DoT, DBaC, AMSA, DER) will occur and thus there will be ongoing consultation with relevant persons during response operations.
Environmental context & ESD	The worst-case credible diesel spill scenario for the Montara operations is a result of a vessel collision within the Operational Area. The release of oil occurs over five hours and floating oil may contact Browse Island. Entrained oil is predicted to contact the KEF Carbonate Bank and Terrace System of the Sahul Shelf and a number of shoals. Sensitive receptors at risk include seabirds, shorebirds, marine fauna, intertidal and shoreline habitats. The potential impact is considered acceptable after consideration of:

	• Potential impact pathways; • Preservation of critical habitats; • Assessment of key threats 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 will have regard to the representative values of protected areas and other published information or conservation advice and endeavor to ensure that priority is given to the social and ecological values, of any AMPs, or State Marine Parks impacted by diesel. 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 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 Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. 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.

9. 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;
- 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 9.1**);
- Key roles and responsibilities (**Section 9.2**);
- Training, competencies and ongoing awareness (**Section 9.3**);
- Monitoring, auditing, management of non-conformance and review (**Sections 9.4** and **9.5**);
- Incident response including Oil Pollution Emergency Plan (**Section 7.9** and **OPEP**);
- Record keeping (**Section 9.4.3**); and
- Stakeholder consultation (**Section 6**).

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.

9.1 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 the activities associated with operation of the Montara facilities in a structure that is illustrated by **Figure 9-1**.

The management system sets a structured framework that provides governance across company processes for all organisational activities, with defined accountabilities and performance requirements for employees and contractors to deliver activities aligned to the vision and requirements of Jadestone Energy, including those identified in this EP. At the highest level, environmental performance expectations are communicated by the Jadestone HSE Policy.

The structure of the management system is organised to describe the business activities by objective functions (**Figure 9-2**).

Figure 9-1: Business management system structure

Figure 9-2: 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 operation of the activity. The relevant functions are:

- Operational excellence;
- Value discipline;
- People;

- Stakeholder management;
- Risk management;
- Develop;
- Produce; and
- Provide goods and services.

Below is a summary of the mechanisms by which these functional areas contribute to HSE management and performance during the activity.

9.1.1 Operational Excellence

'Operational Excellence' provides the systems, tools and processes which ensure that all learning experiences that have the potential to improve operational 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 9-3**.

The Operational Excellence function addresses the key points of:

- Capturing of lessons learnt;
- Review of lessons learnt; and
- Incorporation of knowledge in future work.

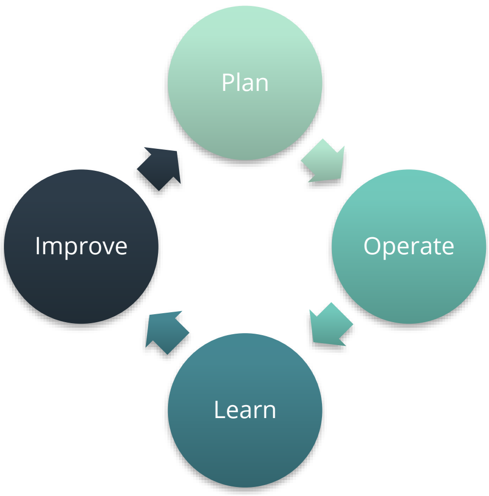


Figure 9-3: Operational and excellence business functions

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.

Any actions arising from the assessment of information are incorporated into CMMS. Processes, procedures and systems are improved based on the historical lessons learnt and applied in subsequent phases.

9.1.2 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.

9.1.3 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.

9.1.4 Stakeholder Management

Sub-regulation 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 activity. **Section 6** 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 9-1**).

Table 9-1: Standard consultation actions

ID	Activity	Frequency and method	Responsibility
160	Provision of updates on activity progress	Updates to Jadestone website on the Montara Operations activity provided as needed	Country Manager HSE Manager
161	Close out of communication commitments made during pre-start consultation including: • Provide response organisations with a copy of the OPEP; • Summary Notification to DMIRS of NOPSEMA EP acceptance • Consultation with DNP regarding SMP design	• Email DMIRS stakeholder contact within 3 months	Country Manager HSE Manager
162	Email DPIRD and AHO stakeholder contact	• Within 4 weeks of commencement date	HSE Manager
163	Review of relevant persons list	• Annually unless triggered earlier	Country Manager
164	Provision of broader information relating to Jadestone environmental policy	• Website updates as required	Country Manager
165	Notification of AMSA Joint Rescue Coordination Centre (JRCC)	• 48-24 hours from commencement of operations	Emergency Response Lead

In addition, Jadestone will undertake additional triggered consultation as outlined below, should an unplanned event occur (**Table 9-2**).

Table 9-2: Triggered consultation actions

ID	Trigger	Action	Responsibility
166	Feedback received from relevant person	Follow consultative process outlined in the Consultation for Environmental Approvals procedure	Country Manager
167	Deviation to Montara operations from those originally provided in consultation	Notification to relevant persons via email Email DPIRD stakeholder contact a minimum of 4 weeks prior to commencement of any varied activity. Notify AMP Director General any change to risk within AMPs	Country Manager
168	Change to risk profile in operational area	Notification to government agencies via email to key contact.	Country Manager
169	Change to risk profile in EMBA	Notification to government agencies via email to key contact. Notify AMP Director General any change to risk within AMPs	Country Manager

ID	Trigger	Action	Responsibility
170	Oil spill event	• Notification to response agencies and government agencies by phone. • Attempt to electronically notify all relevant persons listed in Montara EP Consultation plan within 72 hours of spill. • 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. • 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 and contact details for the response coordinator.	IMT Leader
171	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
172	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
173	Change to Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2009 consultative requirements	Review of Consultation Plan	HSE Manager
174	Change to Montara operating jurisdiction such that other legislative instruments stipulate new or additional consultative requirements	Review of Consultation Plan	HSE Manager
175	An element of Jadestone's continuous improvement process identifies the consultation procedure needs to be amended	Review of Consultation Plan	HSE Manager
176	Change to infrastructure that affects PSZ	Notify the Australian Hydrographic Service of activities and infrastructure for inclusion in Marine Notices	HSE Manager

9.1.5 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 production delivery. 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 approvals (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 9.4.2**.

At the activity level, the risk management function includes all the planned activities and accidental events. Risk identification and assessment is a continuous process that identifies all the physical control measures necessary to manage the 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 9.1.1**).

The Risk Management function is accountable for approval of facility level risk assessments and risk reduction measures; and by so doing, providing a view of risk that is independent from production delivery.

9.1.6 Produce

The Produce function delivers safe and reliable operations as well as environmental performance.

The Produce function works closely with the Operational Excellence and Risk Management functions to evaluate operational performance, including environmental performance, and reduce risk through delivery of continuous improvement activities. Produce is responsible for asset optimisation, reliability, integrity and maintaining compliance. It thus interacts with most functions.

The Produce function delivers environmental management at the activity level via the Computerised Maintenance Management System (CMMS) including detailed work instructions and tasks allowing the activity to meet the environmental performance requirements of this EP. These instructions and tasks are monitored and reviewed to ensure appropriate close out of tasks is achieved as well as ensuring the required outcomes/ performance have been achieved.

9.1.7 Provide Goods and Services

HSE performance in all activities associated with operation 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 Health, Safety and Environmental (HSE) performance throughout the life cycle of an individual’s appointment, from their selection through to post-completion performance evaluation. The Personnel 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.

9.2 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 operation 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 sub-section is information on:

- **Section 9.3.1 Organisational Chart**: outlines the key roles involved in operation of the Montara facilities;
- **Section 9.3.2 Role responsibilities**: summarises the responsibilities of each key role involved in operation of Montara facilities;
- **Section 9.3.3 Communication requirements**: outlines how personnel fulfilling key roles are made aware of their responsibilities as described in the EP; and
- **Section 9.3.4 Assessment of Competency and Training**: outlines how Jadestone assesses and evaluate the competencies and training requirements of personnel responsible for achieving the commitments with this EP.

9.2.1 Organisational Structure and Responsibilities

The Montara operation is governed by the hierarchy of positions on the FPSO. The organisational structure is presented in **Figure 9-4**.

Each position has a position description outlining their HSE role and responsibilities, accountabilities and reporting lines (**Table 9-3**). It is the responsibility of all Jadestone personnel to ensure that the requirements of the HSE Policy are applied in their area of responsibility and that personnel are suitably trained and competent in their respective roles. Mandatory training requirements are mapped out in a competency matrix. Further information is provided in the Competency and Training Management System (JS-60-PR-Q-00014).

It is the responsibility of all Jadestone personnel to ensure that they have read and understood the requirements of the HSE Policy. All personnel are suitably trained and competent in their respective roles.

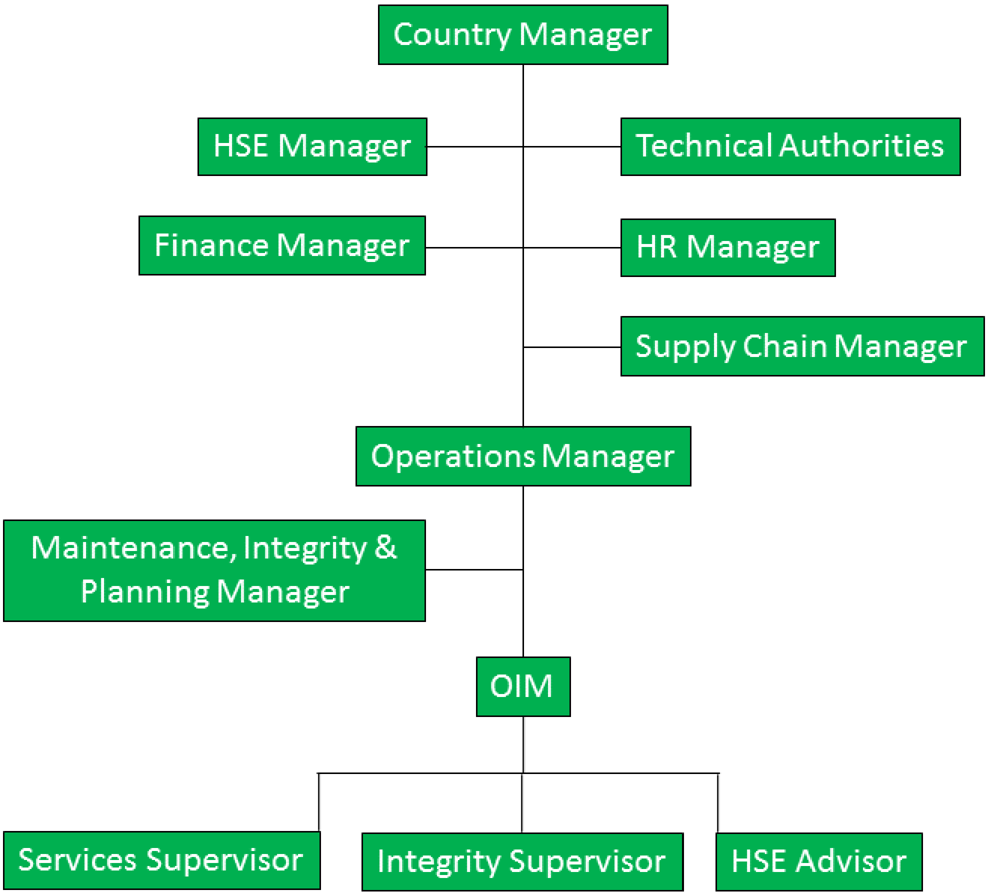


Figure 9-4: Montara operations organisation chart

Table 9-3: Responsibilities of Key Roles

Role	Key Responsibilities
Country 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.
Operations Manager	• Primary responsibility for offshore operations and for meeting environmental performance and compliance requirements, including provision of adequate operations resources for delivery of EP commitments. • Liaises with regulatory authorities as required. • Responsible for ensuring that audits and reviews of the Environment Plan are conducted.
Maintenance, Integrity and Planning Manager	• Responsible for coordinating all maintenance and integrity works and maintaining the technical integrity of the facilities. • Manage HSE hazards and risks related to maintenance activities by ensuring procedures and risk reduction processes have been employed for all activities under their control. • Ensure that regular planned maintenance is carried out to meet the requirements embodied within the CMMS. • Ensures maintenance personnel are competent in their respective tasks.
Supply Chain Manager	• Overall responsibility for implementation of the contractor management framework, including communication of EP requirements to contractors at the appropriate stages of contract management cycle.
Offshore Installation Manager (OIM)	• Responsible for day to day operations at the facility. • Ensures completion of routine performance reporting for the activities. • Responsibility for the implementation and compliance with the requirements of the EP and the Jadestone's HSE Policy. • Ensures that risk management processes are employed to manage HSE hazards and risks at the facility. • Communicates the importance of appropriate levels of training, competency and environmental awareness to all personnel. • Ensures the importance of appropriate levels of training, competency and environmental awareness are communicated to facility personnel and that the training matrix is fully implemented. • Ensures all personnel undertake appropriate Montara inductions and are aware of their HSE responsibilities. • Ensures sufficient resources are made available for offshore environmental management to meet the requirements of the Environment Plan. • Ensures all relevant HSE incidents are reported in accordance with internal incident reporting and investigation procedures. • Conducts regular workplace inspections.

Role	Key Responsibilities
	• Implements corrective and preventative actions arising environmental inspections, audits, incidents and hazard reports. • Overall responsibility for HSE and emergency response management at the facilities. • Ensure that adequate skills are maintained for effective incident response. • Ensure regular drills and exercises are conducted and all personnel actively participate. • Ensure Facility HSE meetings are conducted as required by the BMS. • Communicates HSE hazards and risks to the workforce and the importance of following good work practices.
Integrity Supervisor	• Manage HSE hazards and risks related to maintenance activities by ensuring procedures and risk reduction processes have been employed for all activities under their control. • Authorises work permits in accordance with BMS and PTW procedures. • Ensures persons appointed to roles in PTW have undergone the required training. • Identify risks associated with maintenance tasks and ensure control measures are established and implemented. • During an incident forms part of the Incident Response Team.
HSE Manager	• Ensures review of daily, weekly and monthly reporting, as applicable, from the FPSO and support vessels. • Ensures environmental department liaison with the OIM to deliver compliance with all aspects of this EP. • Plans and schedules environmental audits of the activities. • 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 incident reporting and investigation procedure. • Ensures that proposed changes to environmental management activities are subject to Management of Change and approved prior to application.
HSE Advisor	• Works with the HSE Manager and OIM to support environmental management and delivery of EP commitments. • Contributes to inspections, audits and reviews of the Environment Plan.
Facility personnel and contractors	• 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.

9.2.2 Communication of Responsibilities

The primary mechanism for ensuring personnel involved in the operation of the Montara facilities are aware of the environmental commitments as listed in this EP are via: provision of environmental performance commitments lists via the CMMS; management of service providers and suppliers (refer to **Section 9.2.4** below); and online induction prior to attending the Montara field.

All personnel working at the Montara operation are required to complete an online induction that contains environmental components prior to arrival at the facility. 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.

9.2.3 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 operations 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.

9.3 Monitoring, Auditing, Management of Non-conformance and Review

As required under sub-regulation 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 7** and **8** 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 the CMMS, inspection program, auditing and exercising of response arrangements. In particular, routine commitments in the EP have been loaded into the CMMS that directs work activities for onshore and offshore personnel. 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 9.3.3**.

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.

9.3.1 Routine Monitoring

The purpose of assurance and audits is to record performance data and routinely check conformance with environmental performance standards and achievement of environmental performance outcomes defined by the EP. Routine assurance and audit activities are scheduled, and records kept in the CMMS.

Emissions and discharges to the environment are monitored to assess the environmental performance of the operation on an ongoing basis. **Table 9-4** details the quantitative records that are maintained for all emissions and discharges during routine operations or emergencies within the Operational Area as per Regulation 14(7) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*.

Table 9-4: Quantitative records to be maintained for monitoring of birds, discharges and emissions

Measurement	Frequency	Monitoring Strategy	Record
Oily sludge is disposed of at shore	Weekly	Oily sludge is monitored as per MARPOL	Oil record book
Dosing of production chemicals, including biocide in cooling water system, are recorded	Every 12 hours/ daily	Biocide levels in cooling water system, and chemicals in production system, are maintained as per the operations plan	Prod Tech log sheet
Volume of chemical used	Monthly	Volumes used determined from change in inventory	Monthly report
Food waste from the FPSO will be recorded	Weekly	Putrescible waste as monitored per MARPOL	Garbage record book
Produced water OIW concentration, discharge volume, and oil loads are recorded	Every discharge	Monitoring designed to accommodate batch discharge operations	P2 Daily report
Produced water turbidity	Weekly	Turbidity monitoring tracks acceptable limit of discharge stream	Prod Tech log sheet
Characterisation of PW finds contaminant concentrations meet 99% species protection concentration after applying a dilution rate of 1:322	Annual	NATA accredited lab analyses PW samples a range of parameters.	Independent laboratory report
Whole effluent toxicity testing confirms area of impact not exceeded	Every 3 years (first test in 2020)	WET testing results less than 2017 results used to determine mixing zone (i.e. 1:322 dilution)	Independent laboratory report
Weekly OIW inline spec service	Weekly	OIW inline spec serviced weekly by Production Technician	Maintenance report
OIW inline spec calibration	Biannual	Calibration of inline spec according to manufacturer's recommendations	Calibration report
Quantity (kms^3) Gas emissions	Continuous	Metering on the FPSO	P2 Greenhouse Gas reporting Daily report
Monitoring of localised bird population on FPSO and WHP	Annual	Collation of numbers of seabirds during peak breeding season. Assessment of bird management strategy success	Bird monitoring report by ornithologist

Measurement	Frequency	Monitoring Strategy	Record
Monitoring of bird numbers on FPSO	Monthly	Number of birds and location on FPSO Species identified where feasible	Bird record sheet
Monitoring of bird numbers on WHP	Prior to commencement of major campaigns on WHP	Number of birds and location on WHP Species identified where feasible	Bird record sheet
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 facility when transferred via vessel to shore then to licensed waste facility. This is done fortnightly (supply run). Vessel also records volumes on manifest	Invoicing process checks vessel manifest against waste disposal records of service provider, and evidence of disposal	Monthly waste reports Annual EP compliance report Manifests are records of garbage wastes, recyclables and dangerous goods disposed.
All waste associated with oil spill response tracked to disposal	Weekly	Disposal monitored as per Controlled Waste Regulations	Waste consignment records

9.3.2 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.

Audits will performed in accordance with Jadestone's Audit Manual (JS-90-PR-G-00003). Auditing is Jadestone management's primary tool for:

- Determining whether management systems are suitable, available where required, implemented and effective in accomplishing the documented policies and objectives of the organisation;
- Verifying conformance with legal and contractual requirements;
- Obtaining and maintaining confidence in the capability of suppliers; and
- Contributing to the improvement of the Business Management System (BMS).

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. External parties may be invited to participate as team members on audits.

The EMS Audit Program (JS-70-PR-I-00039) identifies the scope of annual audits over five years to ensure that all of the environmental performance outcomes and environmental performance standards have been evaluated for compliance during the lifetime of the in force operational EP. The EMS Audit Program is referred to in developing the annual HSE Audit Plan. As well as regular, planned audits of the EMS, unplanned audits may also be added to the audit program. Checklist templates (i.e. scopes) for environmental audits that may be undertaken are provided in the Audit Manual (JS-90-PR-G-00003), including for quality (in line with ISO 9001 requirements) and the environmental management system (which makes provision for deeper dives on the EP.

An outline of Jadestone's auditing schedule is provided in **Table 9-5**.

Table 9-5: Annual audit schedule

Type	Scope	Minimum per year
Planned	Compliance with EPOs and EPSs	One
	Drill down on close-out of corrective actions and/or areas of compliance focus (e.g. produced water, oil spill response)	One
	Contractor management	One
	Independent audit by third-party (Independent Competent Person, ICP)	One
Reactive	As determined by performance / non-compliances identified during internal/ external inspections, reviews, audits and incident investigations	One to two

9.3.3 Non-compliances and Corrective Actions

Non-conformances from audits, inspections, incidents, regular monitoring or response testing are communicated immediately to the OIM and tracked and monitored by the HSE Manager until closed

Opportunities for improvement and corrective actions from daily operations, reviews, audits, inspections, monitoring and testing activities are documented and tracked to closure by Jadestone's action tracking system.

9.3.4 Reporting

Table 9-6 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.

9.4 Continuous Improvement (Operational Excellence)

9.4.1 Review of environmental performance

The owner of the Operational Excellence business function, with input from other business functions with responsibilities relating to the EP (e.g. operations, maintenance, supply chain), conducts an annual review of environmental performance and the effectiveness of the EP implementation strategy (i.e. BMS). This includes a review of the effectiveness of control measures in reducing impacts and risks to ALARP and acceptable levels, and may result in improvements being identified, evaluated and implemented.

Outcomes of the Annual Performance Review are recorded and contribute to the EP Annual Performance Report (**Section 10.1**).

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 Annual Review is also an opportunity to ensure new information is incorporated into the EP and will consider the following:

- Existing information in relation to any component of the receiving environment described in this EP including, but not limited to, biologically important areas, KEFs, and threatened species;
- Available scientific literature;
- New issues raised by stakeholders;
- Relevance of existing and identification of new stakeholders; and
- Australian Marine Park status (including any changes in status or management) and relevant IUCN principles.

The results of the review and any identified improvements or recommendations will be incorporated into processes and procedures used for the operation, or the EP, 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 4**).

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 9.5.6**).

Table 9-6: 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. **Activities that require notification include any new infill wells.**	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 10-1**.	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, or 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 environmental performance outcomes and standards in the EP have been met. At a minimum, reports shall include: • An overview of the operations and activities undertaken at the Facility; • 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 outcomes 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).	The annual reporting period for the activity is 12 June to 11 June. Jadestone will submit annual performance reports within 3-months of the end of the reporting period.	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

9.4.2 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 to activities trigger 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. It also directs and instructs activity owners on the environmental regulatory requirements relating to a change in operations.

The 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 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 (JS-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 drawings 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 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 by Regulation 17, a revision/resubmission of the EP to NOPSEMA will occur.

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.

9.4.3 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 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.

9.5 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 *Montara Venture* FPSO and are made accessible to all personnel. The relevant incident response procedures and manuals are detailed in the OPEP.

The incident response procedures and 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 OPEP details the schedule for testing the preparedness of response organisations in the OPEP.

10. REPORTING

10.1 Routine Reporting

Table 10-1 details the approach to routine environmental performance reporting to the regulator. Reports will be of sufficient detail to demonstrate whether specific environmental performance outcomes and standards have been met.

10.2 Incident Reporting

Table 10-1 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 Reporting Procedure (JS-60-PR-F-00016) which incorporates reporting timeframes for incidents depending on their environmental impacts is provided to the FPSO and reviewed on an annual basis.

Table 10-1: Routine and incident reporting requirements

Requirements	Timing
Routine Reporting	
Annual Environmental Performance Report The Annual Performance Report for Montara Facility Operations will assess compliance with the EP performance objectives, standards and procedures and performance criteria and will include: • An overview of the operations and activities undertaken at the Facility; • Summary of environmental incidents; • Summary of any Management of Change (MOC), if applicable; • Summary of audits conducted; • Summary of bird management measures implemented • Available population monitoring data (including monthly, and any annual data available, noting the breeding/nesting season is nominally April-September)	Annual Performance report is to be submitted to NOPSEMA within 3 months of end of annual reporting period.
Annual Review of Environment Plan. The review will include an assessment of: • Environmental performance (adequacy of environmental management tools against number of reportable and/or recordable incidents). • Continued relevance of performance outcomes and performance standards. • Review of existing performance standards and measurement criteria (giving consideration to updated or new standards). • Inspection and checklist approaches. • Monitoring data and trends; • Any additional consultation required; • Lesson learnt; • Results of audits; and • Adequacy of auditing and monitoring	Annual review of the Environment Plan triggered by the annual environment performance report process. If the Environment Plan requires revision then in accordance OPGGS Regulations will be resubmitted to NOPSEMA.

Requirements	Timing
Recordable Environmental Incident Monthly Report A written report will be provided to NOPSEMA of any breaches of a performance outcome 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; • 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; • Introduction of an IMS; • Harm or mortality to an EPBC listed marine fauna (except for eggs euthanised through implementation of bird management measures, if adopted, this will be reported through the Annual Performance Report; • Gaseous releases of more than 300kg (~255m^3 at Standard Ambient Temperature and Pressure); and • 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.	Verbal report to NOPSEMA as soon as practicable but not later than two 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 Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008)
AMSA Oil pollution incidents in Commonwealth waters must be reported to AMSA.	Within 2 hours of incident having been identified: Tel: 1800-641-792
DCCEEW DCCEEW will be notified of the following incidents: • Harm or mortality to EPBC listed marine fauna attributable to the activity as provided for in: https://www.dcceew.gov.au/environment/biodiversity/threatened/listed-species-and-ecological-communities-notification • Euthanisation of eggs will be reported on an annual basis when preparing the annual performance report for the EP. • Spills of hydrocarbons or environmentally hazardous chemicals more 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.	Within 2 hours of incident having been identified: Tel: 1800-110-395 Tel: 02-6274-1372 compliance@environment.gov.au

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.

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