Sea Eagle-1 and Tahbilk-1 Vessel Based Activity Environment Plan

TM-50-PLN-I-00004

Rev 2

FACILITY	TM - Montara Field
REVIEW INTERVAL	60 Months

Rev No	Date	Approval		
		Owner	Reviewer	Approver
		Drilling & Wells Manager	Environment Lead	Country Manager
0	22-Sep-21	G. Hattersley	L. Muir	O. Hobbs
1	01-Dec-21	G. Hattersley	L. Muir	D. Lamb
2	08-Apr-22	G. Hattersley	J Van Rensburg	H. Hoeyland
		G. Hattersley	J Van Rensburg	H. Hoeyland

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REVISION HISTORY

Revision	Date	Author / Editor	Amendment
0	22/09/21	L Muir	Prepared for assessment by NOPSEMA
1	01/12/21	Jadestone Energy/L Muir	Submission to NOPSEMA in response to assessment RFFWI
2	08/04/22	Jadestone Energy/L Muir	Submission to NOPSEMA in response to assessment OMR

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Acronyms and Abbreviations

Abbreviation	Description
AFMA	Australian Fishers Management Authority
AFZ	Australian Fishing Zone
AHO	Australian Hydrographic Office
AHS	Australian Hydrographic Service
AIMS	Australian Institute of Marine Science
AIS	Automatic identification system
ALARP	As low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Parks
AMSA	Australian Maritime Safety Authority
ANZECC / ARMCANZ	Australian and New Zealand Environment and Conservation Council / Agriculture and Resource Management Council of Australia and New Zealand
API	American Petroleum Institute (gravity)
APPEA	Australian Petroleum Production and Exploration Association
ARPA	Automatic Radar Plotting Aid
ASBTIA	Australian Southern Bluefin Tuna Industry Alliance
BIA	Biologically important areas
BMS	Business management system
BOD	Biological oxygen demand
BRUVS	Baited remote underwater video stations
CAMBA	China-Australia Migratory Bird Agreement
CFA	Commonwealth Fisheries Association
CoEP	Code of Environmental Practice
CMMS	Computerised Maintenance Management System
CWI	Company Well Inventory
DAHs	Dissolved aromatic hydrocarbons
DAWE	Department of Agriculture, Water and the Environment
DAWR	Department of Agriculture and Water Resources (now DOA)
DBCA	Department of Biodiversity, Conservation and Attractions
DEC	Department of Environment and Conservation (now DBCA)
DEWHA	Department of the Environment, Water, Heritage and the Arts (now DAWE)
DMIRS	Department of Mines, Industry Regulation and Safety (previously Department of Mines and Petroleum, DMP)
DNP	Director of National Parks

Abbreviation	Description
DOA	Department of Agriculture
DoD	Department of Defence
DoEE	Department of the Environment and Energy (now DAWE)
DoF	Department of Fisheries (now DPIRD)
DoT	Department of Transport
DPaW	Department of Parks and Wildlife (now DBCA)
DPIRD	Department of Primary Industries and Regional Development (previously Department of Fisheries)
DSD	Department of State Development
DSEWPaC (now DoEE)	Department of Sustainability, Environment, Water, Population and Communities
EEZ	Exclusive Economic Zone
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	Ecologically sustainable development
FDP	Field Development Plan
FPSO	Floating production storage and offtake (facility)
FRC	Fast response craft
FWADC	Fixed Wing Aerial Dispersant Capability
GEMS	Global Environmental Modelling Services
GHG	Greenhouse gases
HC	Hydrocarbon
HLO	Helicopter landing officer
HP	High pressure
HPU	Hydraulic power unit
H2S	Hydrogen sulphide
HRDZ	Hydrocarbon Related Diagenesis Zone
HSE	Health safety and environment
IAP	Incident Action Plan

Abbreviation	Description
ICAO	International civil aviation organisation
ICCS	Interface central control system
ICD	Inflow control devices
IMCRA	Integrated marine and coastal regionalisation of Australia
IMO	International Maritime Organisation
IMPs	Invasive marine pests
IMR	Integrity, maintenance and repair
IMT	Incident Management Team
IOGP	International Association of Oil & Gas Producers
IOPP	International Oil Pollution Prevention (Certificate)
IPIECA	International Petroleum Industry Environmental Conservation Association
ISPP	International Sewage Pollution Prevention (Certificate)
ITF	Indonesian Throughflow (current)
ITOPF	International Tanker Owners Pollution Federation Limited
IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
JAMBA	Japan-Australia Migratory Bird Agreement
JEE	Jadestone (Eagle) Energy Pty Ltd
JRCC	Joint Rescue Coordination Centre
KEFs	Key ecological features
Kl	Kilolitre
Km	Kilometre
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
LOR	Limit of reporting
LOWC	Loss of well control
LP	Low pressure
LSA	Low specific activity
LTS	Listed threatened species
MAHs	Monocyclic aromatic hydrocarbons
MAOP	Maximum allowable operating pressure

Abbreviation	Description
MARPOL	International Convention for the Prevention of Pollution from Ships (legislation)
MCR	Marine Conservation Reserve
MDP	Montara Development Project
mg/L	Milligrams per litre
MGPS	Marine growth protection system
mm	Millimetres
MMA	Marine Management Area
mmscfd	Million standard cubic feet per day
MNES	Matters of national environmental significance
MODU	Mobile offshore drilling unit
MoU	Memorandum of understanding
MP	Marine Park
MPRA	Marine Parks Reserves Authority
MSDS	Material safety data sheet
NCB	North Coast Bioregion
NEBA	Net environmental benefit assessment
NES	National environmental significance
NM	Nautical mile
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NORMs	Naturally occurring radioactive materials
NSF	Northern shark fishery
NSW	New South Wales
NT	Northern Territory
NTOWRP	Northern Territory Oiled Wildlife Response Plan
NWMR	North-West Marine Region
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

Abbreviation	Description
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
OSCAR	Oil Spill Contingency and Response
OSCP	Oil Spill Contingency Plan
OSMP	Operational and scientific monitoring plan
OSRL	Oil Spill Response Limited
OTA	Operations, Training and Advice
OWR	Oiled wildlife response
PAHs	Polycyclic aromatic hydrocarbons
PHG	Pre-hydrated gel
PLONOR	Pose little or no risk
PMS	Planned Maintenance System
PMST	Protected matters search tool
POB	Persons on board
PPD	Personal protection device
ppb	Parts per billion
ppm	Parts per million
PRS	Production reporting system
PSD	Particle size distribution
PSZ	Petroleum safety zone
PTS	Permanent threshold shift
PTTEP AA	PTT Exploration and Production Australasia
PW	Produced water
QLD	Queensland
RAMSAR	Wetlands of International Importance
RMS	Route mean square
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
ROV	Remote operated vehicle
SBFTF	Southern Bluefin Tuna Fishery
SCAT	Shoreline Clean up and Assessment Technique
SCM	Subsea control module
SCSSV	Surface controlled subsurface safety valve
SDS	Safety data sheet

Abbreviation	Description
SDU	Subsea distribution unit
SIL	Safety integrity level
SIMOPs	Simultaneous operations
SMP	Scientific monitoring program
SMPEP	Shipboard Marine Pollution Emergency Plan
SO2	Sulphur dioxide
SOLAS	Safety of Life at Sea
SOPEP	Shipboard oil pollution emergency plan
SPL	Sound pressure level
SRB	Sulphur reducing bacteria
SRFT	Subsea First Response Toolkit
SSS	Side-scan sonar
STP	Sewage treatment plant
SWL	Safe working load
TBT	Tributyltin
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
VBA	Vessel based activities
VBSA	Vessel based support activity
VDU	Vacuum distillation unit
VOC	Volatile organic compounds
WA	Western Australia
WAF	Water accommodated fraction
WAOWRP	Western Australian Oiled Wildlife Response Plan
WHCP	Wellhead hydraulic control panel
WHP	Wellhead platform
WIAMS	Well Integrity Assurance Management System
WOMP	Well Operations Management Plan
WSTF	Western Skipjack Tuna Fishery
WTBF	Western Tuna and Billfish Fishery

Abbreviation	Description
WWC	Wild well control

ENVIRONMENT PLAN SUMMARY

This Jadestone Sea Eagle-1 and Tahbilk-1 Vessel Based Activity (VBA) Environment Plan Summary has been prepared from material provided in this Environment Plan (EP) and associated Oil Pollution Emergency Plan (OPEP). The summary consists of the following as required by Regulation 11(4):

EP Summary material requirement	Relevant section of EP containing EP Summary material
The location of the activity	Section 2.1
A description of the receiving environment	Section 3 and Appendix B
A description of the activity	Section 2
Details of the environmental impacts and risks	Section 6 and 7
The control measures for the activity	Section 6 and 7
The arrangements for ongoing monitoring of the titleholders' environmental performance	Section 8.3
Response arrangements in the oil pollution emergency plan	Section 8.5 and Oil Pollution Emergency Plan
Consultation already undertaken and plans for ongoing consultation	Section 4 and Appendix C
Details of the titleholders nominated liaison person for the activity	Section 1.2

1. INTRODUCTION

1.1 Background

Jadestone Energy (Eagle) Pty Ltd (Jadestone Energy) plans to undertake monitoring of two temporarily abandoned wells, Sea Eagle-1 and Tahbilk-1 which are intended to be used for future hydrocarbon exploitation, in the Montara field via vessel-based activities. Sea Eagle-1 was drilled and temporarily abandoned in 2008, and Tahbilk-1 in 1990. These wells have been accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) as being temporarily abandoned. To support the well integrity status as being ALARP, a subsea well monitoring subsystem combined with annual remote operated vehicle (ROV) inspections is planned in accordance with the accepted Well Operations Management Plan (WOMP), Doc Number M-50-PLN-W-00003 Rev 0 accepted on 06/04/21.

Both wells were shut in and temporarily abandoned with no gauges or pressure monitoring, therefore barrier checking must be performed indirectly. To date annual ROV Surveillance has been used to visually check for any indications of mechanical damage (or change), or emission of fluids or gas that would indicate a barrier has degraded. To date, no indications of external interference or barrier degradation have been noted. Going forward, annual ROV surveys will continue, and a passive monitoring system will be installed on the wellhead. If a hydrocarbon leak develops between ROV inspections, the monitoring system will release a beacon which will connect to a remote operating centre via satellite creating an alert notification to Jadestone who will then investigate.

All activities are within the Commonwealth waters of the Timor Sea, off northern Western Australia (Figure 1-1). The activities described are collectively referred to as the Vessel Based Activities (VBA).

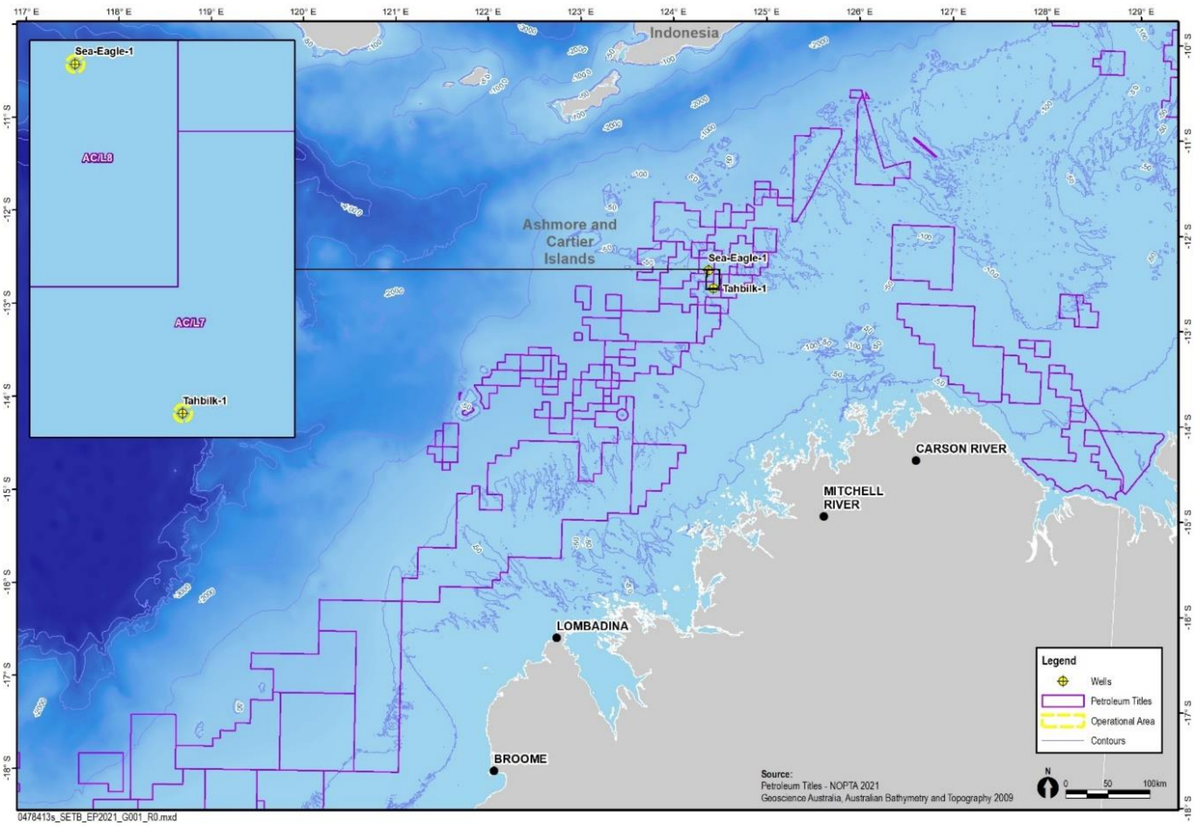


Figure 1-1: Location of the Wellheads, Subsea Fields AC/L7 and AC/L8

1.2 Future plans and decommissioning under Section 572 of the OPGGS Act

At this stage there is no plan for the decommissioning of the Sea Eagle-1 and Tahbilk-1 wells as Jadestone currently foresee their contribution to future exploitation activities. Therefore, this EP describes the ongoing monitoring and maintenance of the wellheads to allow for future re-use of the infrastructure.

1.2.1 Sea Eagle-1 future use

Sea Eagle-1 was initially proposed in the AC/L8 Updated Skua-Swift Field Development Plan (FDP) that was submitted to the Department of Resources Minerals and Energy Titles Division in December 2011 [ref: 241008]. The FDP pointed out that the Swift Field is comprised of two separate oil pools: the Swift pool to the north and the Swallow pool to the south. The FDP also outlined that the Swift Field development will involve four development wells, of which one of those wells being Sea Eagle-1, would be drilled during the second phase of development. While preparing the FDP, it was recognised that risks remained towards the Sea Eagle-1 well location due to a hard geological attribute (Hydrocarbon Related Diagenesis Zone, HRDZ) that was degrading seismic continuity and quality and therefore volumes and connectivity. To address these risks, Sea Eagle-1 was proposed to form part of the second development phase as this would allow for more time to investigate the exact nature of the southern extent of the Swallow pool and optimise well placement (task now complete).

The Sea Eagle-1 bottom hole location was targeted at volumes that were simulated to be undrained by the Swallow-1 well that would form Phase 1 of the development. Swallow-1 was initially anticipated to have a relatively short production life and once depleted, Sea Eagle-1 would be completed and assume the production flow path through the subsea infrastructure presently being used by Swallow-1. Sea Eagle was later drilled into the reservoir in 2008 and a new 9-5/8" casing run. The well was what is today classed as temporarily abandoned and ready to receive the completion. The 9-5/8" casing that was installed has not been drilled through and as a result not been exposed to any damage or wear. After installation, it was left filled with inhibited seawater. In this area, formation fluids external to the casing are not known to be corrosive and the casing was well cemented. Therefore, the condition of the casing should be good and there is no reason to believe the well's age at the time of intended completion will compromise well integrity.

Since drilling, Operatorship of the well has changed to become Jadestone's. In Q2 2020 Jadestone acquired new seismic data across the entire Montara field area where one objective was to de-risk the volumes and commercial viability of Sea Eagle-1. Sea Eagle-1 work has progressed and is sufficiently mature that the following has been concluded:

1) The Swallow-1 well continues to flow at an economic rate and it is expected to continue until the 2027-2028 time period.
2) There is currently no capacity in the subsea system for the Sea Eagle-1 well to be tied in and doing so would back out existing production from Swallow-1 and impact production from other subsea wells.
3) Sea Eagle-1 is ideally located for hydrocarbon exploitation.
4) Hydrocarbons targeted by the Sea Eagle-1 can be economically developed provided the existing and originally intended strategy of using the existing wellbore and Swallow-1 infrastructure is used. If this strategy is not followed, future development of the field will be compromised and uneconomic.

5) Jadestone intend to complete the Sea Eagle-1 well once the Swallow-1 well becomes unable to produce or is uneconomic

1.2.2 Sea Eagle-1 Utilisation or decommissioning Commitments

Jadestone Energy plan to develop and commercially produce from the existing Sea Eagle-1 well in the 2027-2028 time period or sooner. Jadestone commit to that by the time this EP's validity has expired (5 years following acceptance), the well will either be sanctioned for development with the permissioning cycle started or permissioned for decommissioning (additional approvals will be submitted).

1.2.3 Tahbilk-1 future use

Tahbilk-1 was first identified for use in the AC/L-7 Updated Montara Field Development Plan (ref: 237977) that was submitted to the Department of Resources Minerals and Energy Titles Division in 2011. Tahbilk-1 along with Padthaway, Bilyara and the Montara oil field gas cap were all recognised as holding potentially commercial quantities of gas that could be exploited with offshore processing in a reasonable commercial environment. A pipeline to an onshore facility was assessed and found to be uncommercial and offshore pathways would be required. Condensate produced from the gas is significant and would be exported as a separate stabilised liquid product. At the time, the main development option was for floating LNG and timing for investment would coincide with the late life production of the Montara Field oil leg being depleted and field ready for gas cap blowdown. A condition of commercial viability is that all gas resources need to be combined. Hence, Tahbilk-1 would be developed with the other resources unless an alternate form of gas handling infrastructure is introduced.

Since Jadestone's acquisition of the AC/L-7 title area in 2018, work has commenced on re-evaluating and refreshing the greater Montara area with a view towards developing the pending gas resources. The HRDZ layer above the Tahbilk reservoir is present and especially strong; it covers a large area over Tahbilk and previously reprocessed seismic has been unable to resolve the high frequency seismic signals which are needed to better resolve the reservoir and potential hydrocarbon volume. The seismic data acquired in Q2 2020 was intended to resolve this issue and the work plan is shared in the next sub chapter.

In terms of exploiting Tahbilk gas, Tahbilk-1 well use is a pre-requisite for commercial viability. The well is in a good location and a sidetrack is not required. Even if the estimated resources in place err to the high case, they would not be enough to justify a new wellbore. In line with the original FDP work, the well is adequately placed and the pathway to monetisation is a tieback to offshore infrastructure. In terms of infrastructure, gas development plans for Tahbilk and the greater Montara area gas exploitation are evolving. A third party Operating Company is expected to sanction an offshore gas development in 2022. This development is located in blocks nearby to AC/L-7. Jadestone has had engagements with the Operator and making development more a matter of timing and de-risking of volumes. It also presents a better environmental outcome by doing more with less.

Tahbilk-1 is a vertical well and was left in a state where it was anticipated to be re-entered and completed for production and this forms the development case. As a vertical well, casing wear is negligible and formation fluids that surround the well are not known to be corrosive. Inhibited drilling fluid was left inside the well limiting risks of internal corrosion.

1.2.4 Tahbilk-1 work commitments

To progress the final decision to develop or permanently abandon Tahbilk-1, an integrated subsurface study which includes Geophysical Studies Seismic interpretation, Petrophysical Evaluation, Geological Static

Modelling and Dynamic Modelling are required and planned over a 2 year period (May 2022 to May 2024). The study will properly delineate the discovered Non-Associated Gas (NAG) resources in Tahbilk Field, reducing uncertainty defining the commercial way forward. An integrated gas development between the discovered NAG Fields; Tahbilk, Padthaway and Bilyara will be coupled with the plan for gas cap blowdown from Montara Field with tie-in to infrastructure previously mentioned. An overview of the studies are provided below with a work schedule provided in Figure 1-2.

a. Geophysical Studies - Seismic interpretation

A new Cygnus 3D Seismic data was acquired back in 2020 which gives a better-quality image for Jadestone asset including the discovered gas fields surrounding Montara field. This gives us the opportunities to further evaluate the 3 gas discoveries and reduce the level of uncertainty that the earlier seismic data could not. The processing of this new Cygnus 3D data was optimized to image the reservoir better below the HRDZ distortions.

The Seismic interpretation studies will start in May 2022 and will include seismic well tie, fault interpretation, horizon interpretation and velocity modelling. The studies will take approximately 9 months from May 2022 to January 2023 and will be conducted using PETREL software geophysical modules.

b. Petrophysical Evaluation

NAG was discovered in Tahbilk-1 well in the good quality, blocky Cycle IV Montara formation. Although there is only 1 well penetration in Tahbilk field, there are many well penetrations of Cycle IV Montara Formation across Montara producing fields and nearby gas discovery fields. Since the amount of data acquired in Tahbilk-1 is limited, it is crucial to integrate the data acquired in similar formation especially for the reservoir characterization, rock typing, and saturation height function evaluation which required core data analysis. RCA and SCAL data are available from Montara and Bilyara fields with similar reservoir quality.

The petrophysical interpretation work will start in February 2023 and will include probabilistic modelling, core calibration, applied model and integration with G&G, PT analysis for contact determination and PP model for verification. The studies will take approximately 4 months from February 2023 to May 2023 and will be conducted using Techlog software.

c. Geological Static Modelling

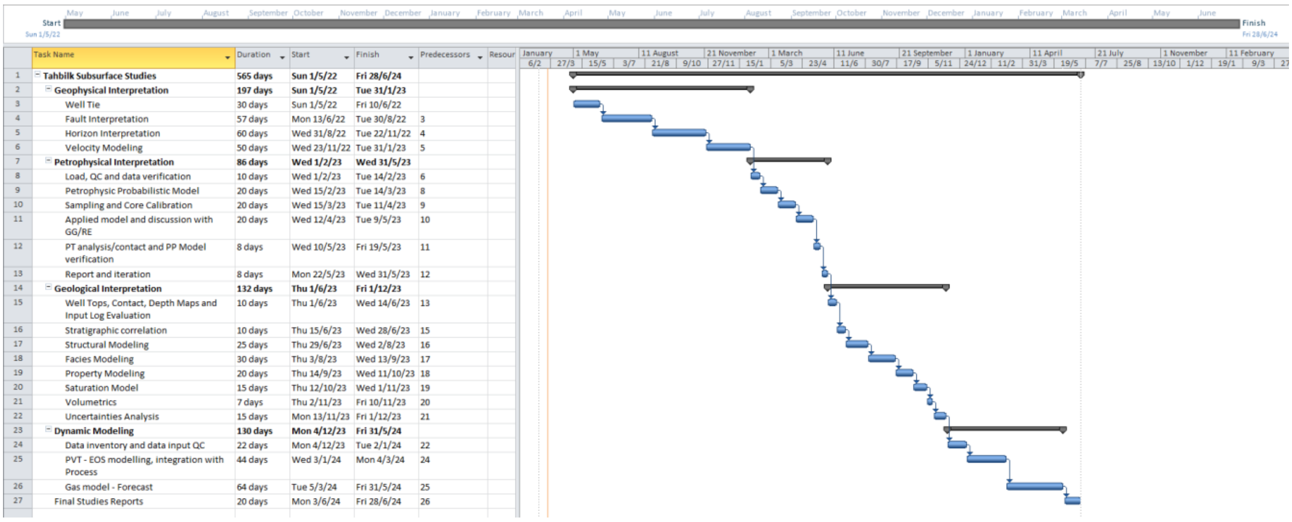
The final petrophysical and geophysical input will be incorporated into the static model which will involve data input QC, structural modelling, facies modelling, property modelling and volumetric and uncertainties analysis. This process will take approximately 7 months starting June 2023 to November 2023.

d. Dynamic Model/Flow Assurance

The final process is the dynamic modelling process which will take approximately 6 months from December 2023 to May 2024. The static model will first be imported and initialized, and the data input will be checked. The dynamic model is then used to evaluate Tahbilk gas development scenarios that include producing gas from Tahbilk from the existing Tahbilk-1 well in an integrate development with the proposed infrastructure previously mentioned.

e. Commercial Negotiations for Infrastructure Use

Access negotiations to the previously referred infrastructure can commence upon completion of the integrated subsurface study. This process is anticipated to take approximately 18 months once commenced. Access negotiations can commence when the receiving Asset Owner is ready for such negotiations and this may not be until later in the EP validity period. Once negotiations complete, there would be a clear indication of timing for when Tahbilk-1 can be completed or if there is no business opportunity and the well needs to be permanently abandoned.



	Task Name	Duration	Start	Finish	Predecessors	Resour
1	**Tahbilk Subsurface Studies**	**565 days**	**Sun 1/5/22**	**Fri 28/6/24**		
2	**Geophysical Interpretation**	**197 days**	**Sun 1/5/22**	**Tue 31/1/23**		
3	Well Tie	30 days	Sun 1/5/22	Fri 10/6/22		
4	Fault Interpretation	57 days	Mon 13/6/22	Tue 30/8/22	3	
5	Horizon Interpretation	60 days	Wed 31/8/22	Tue 22/11/22	4	
6	Velocity Modeling	50 days	Wed 23/11/22	Tue 31/1/23	5	
7	**Petrophysical Interpretation**	**86 days**	**Wed 1/2/23**	**Wed 31/5/23**		
8	Load, QC and data verification	10 days	Wed 1/2/23	Tue 14/2/23	6	
9	Petrophysic Probabilistic Model	20 days	Wed 15/2/23	Tue 14/3/23	8	
10	Sampling and Core Calibration	20 days	Wed 15/3/23	Tue 11/4/23	9	
11	Applied model and discussion with GG/RE	20 days	Wed 12/4/23	Tue 9/5/23	10	
12	PT analysis/contact and PP Model verification	8 days	Wed 10/5/23	Fri 19/5/23	11	
13	Report and iteration	8 days	Mon 22/5/23	Wed 31/5/23	12	
14	**Geological Interpretation**	**132 days**	**Thu 1/6/23**	**Fri 1/12/23**		
15	Well Tops, Contact, Depth Maps and Input Log Evaluation	10 days	Thu 1/6/23	Wed 14/6/23	13	
16	Stratigraphic correlation	10 days	Thu 15/6/23	Wed 28/6/23	15	
17	Structural Modeling	25 days	Thu 29/6/23	Wed 2/8/23	16	
18	Facies Modeling	30 days	Thu 3/8/23	Wed 13/9/23	17	
19	Property Modeling	20 days	Thu 14/9/23	Wed 11/10/23	18	
20	Saturation Model	15 days	Thu 12/10/23	Wed 1/11/23	19	
21	Volumetrics	7 days	Thu 2/11/23	Fri 10/11/23	20	
22	Uncertainties Analysis	15 days	Mon 13/11/23	Fri 1/12/23	21	
23	**Dynamic Modeling**	**130 days**	**Mon 4/12/23**	**Fri 31/5/24**		
24	Data inventory and data input QC	22 days	Mon 4/12/23	Tue 2/1/24	22	
25	PVT - EOS modelling, integration with Process	44 days	Wed 3/1/24	Mon 4/3/24	24	
26	Gas model - Forecast	64 days	Tue 5/3/24	Fri 31/5/24	25	
27	Final Studies Reports	20 days	Mon 3/6/24	Fri 28/6/24	26	

Figure 1-2: Work breakdown structure of the integrated subsurface study

1.2.5 Tahbilk-1 Utilisation or Decommissioning Commitments

Jadestone Energy plan to de-risk and develop to commercially produce from the existing Tahbilk-1 well. By the end of this EP's Validity period, in 2027, one of the following criteria will be met.

1. The well will be permissioned for Permanent Abandonment.

2. If not already concluded, a commercial agreement will be in negotiation between Jadestone and the third-party Operator with a view to sanction for development.

The expected date for a decision is Q2 2027 and it is anticipated that the commercial agreement would be in place, however this is dependent on third party operator timelines as well. Therefore, prior to the expiry of this EP, it is expected that the permissioning cycle will have started for decommissioning or development (additional approvals will be submitted).

1.3 Operator and Titleholder Details

Jadestone Energy is engaged in exploration, appraisal and pre-development activities in South East Asia, with a portfolio of ten 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 (Eagle) Pty Ltd is the sole titleholder of production licences AC/L7 and AC/L8 with operational control of the VBA.

Jadestone Energy's Australian office is located at:

The Atrium Building

Level 2, 168 St Georges Terrace

Perth WA 6000.
ACN 627 006 679 (Jadestone Energy (Eagle) Pty Ltd)

Jadestone Energy's contact for the Sea Eagle-1 and Tahbilk-1 VBA is:

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

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

1.4 HSE Policy

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

1.5 Legislative Framework

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

Offshore Petroleum and Greenhouse Gas Storage Act 2006

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

Environment Protection and Biodiversity Conservation Act 1999

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

HEALTH, SAFETY & ENVIRONMENT POLICY

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

PHILOSOPHY

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

EXECUTION

Within the HSE Policy, Jadestone has committed to:

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

RESPONSIBILITY

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

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

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

A. Paul Blakeley OBE
President & Chief Executive Officer

April 2020

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

Ecologically Sustainable Development

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

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

Jadestone Energy has incorporated the principles of ESD into the decision-making framework described in Section 5 and in the development of control measures and environmental performance outcomes proposed in Sections 6 and 7. Jadestone Energy believes that the commitments made within this EP demonstrate that the environmental management of the activity will be conducted in accordance of the principles of ESD.

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

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

A summary of conventions, standards, guidelines and policies relevant to the VBA is provided below in Table 1-1.

1.6 This Environment Plan

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

The objectives of this EP are to ensure that:

- All activities associated with the Activity are planned and conducted in accordance with Jadestone Energy's Health, Safety and Environmental (HSE) Policy in Section 1.4;
- Potential adverse environmental impacts and risks associated with the proposed activities, during both routine and non-routine operations, are continually reduced to as low as reasonably practicable (ALARP) and of acceptable levels; and
- That the environmental performance outcomes (EPO) and environmental performance standards (EPS) outlined in this EP are met.

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

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

Table 1-1: Summary of Applicable International Conventions, Industry Standards, Guidelines and Policy Documents

Guideline	Description
Australian and New Zealand guidelines for fresh and marine water quality (online guidance tool, 2018 revision)	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.
Australian Ballast Water Requirements, Version 7, 2017	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*.
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. An 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).
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.
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.
EPBC Act-related guidelines	Relevant guidelines/policies and marine bioregional plans are considered in the management of impacts and risks
International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention) 2004	The International Convention for the Control and Management of Ships Ballast Water and Sediment entered 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.
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 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.
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.
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.
International Convention on the Control of Harmful Anti-fouling Systems on Ships 2001	This convention prohibits the use of harmful organotin 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 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.
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.

Guideline	Description
Marine Bioregional Plans	Marine bioregional plans are identified and considered in Section 3. 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. 16 KEFs intersect with the EMBA: • Ancient coastline at 125m depth contour; • Ashmore Reef and Cartier Island and Surrounding Commonwealth Waters; • Canyons linking the Argo Abyssal Plain with the Scott Plateau; • Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula; • Carbonate Bank and Terrace System of the Sahul Shelf; • Carbonate Bank and Terrace System of the Van Diemen Rise; • Commonwealth waters adjacent to Ningaloo Reef; • Continental Slope Demersal Fish Communities; • Exmouth Plateau; • Glomar Shoals; • Mermaid Reef and Commonwealth waters surrounding Rowley Shoals; • Pinnacles of the Bonaparte Basin; • Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex; • Shelf break and slope of the Arafura; • Submerged coral reefs of the Gulf of Carpentaria; and • Tributary canyons of the Arafura Depression.
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.
NOPSEMA OPGGS Act-related guidelines	NOPSEMA guidelines applicable to the VBA include: • NOPSEMA Guidance note: Environment plan content requirements (N04750-GN1344, September 2020); • NOPSEMA Guidance note: Notification and Reporting of Environmental Incidents (N-03000-GN0926 Rev 4, 28 February 2014); • NOPSEMA Guidance note: Petroleum activities and Australian Marine Parks (N-04750-GN 1785, June 2020); • NOPSEMA Guidance Note: Oil Pollution Risk Management (N-04750-GN1488, Draft, July 2021) • NOPSEMA Guideline: Environment Plan decision making (N-04750-GL1721, June 2021) • NOPSEMA bulletin: Oil Spill modelling (Bulletin #1, April 2019) • National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia, 2009); • Australian Ballast Water Management Requirements (Rev 7, Department of Agriculture and Water Resources 2017). • Australian and New Zealand guidelines for fresh and marine water quality (ANZECC/ARMCANZ 2000) Relevant guidelines/ policies are considered in the management of impacts and risks.
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 is one World Heritage property that intersects with the EMBAs: The Ningaloo Coast. The Commonwealth Heritage List is a list of natural, Indigenous and historic heritage places owned or controlled by the Australian Government. There are six Commonwealth Heritage places that intersect with the EMBA; Ashmore Reef National Nature Reserve, Bradshaw Defence Area, Christmas Island Natural Areas, Mermaid Reef – Rowley Shoals, Ningaloo Marine Area-Commonwealth Waters 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. Two National Heritage properties intersect with the EMBA: The Ningaloo Coast and the West Kimberley.
Ramsar wetland ecological character descriptions	There are no Ramsar wetlands that have coastal boundaries intersecting with the EMBAs.

Guideline	Description
Species Profile and Threats Database (DoEE 2019) https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl	This database has been used in Section 3 and Appendix B 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. Results of searching this database are found within Appendix D and Appendix E.
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. As an APPEA member, Jadestone Energy adheres to this Code of Environmental Practice when undertaking offshore activities.
The Conservation Values Atlas (DoEE 2019) https://www.environment.gov.au/topics/marine/marine-bioregional-plans/conservation-values-atlas)	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 3 and considered in the assessment of impacts and risks in Sections 6 and 7. 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.
United Nations Convention on the Law of the Sea (UNCLOS) (1982)	Part XII of the convention sets up a general legal framework for marine environment protection. The convention imposes obligations on State Parties to prevent, reduce and control marine pollution from the various major pollution sources, including pollution from land, from the atmosphere, from vessels and from dumping (Articles 207 to 212). Subsequent articles provide a regime for the enforcement of national marine pollution laws in the many different situations that can arise. Australia signed the agreement relating to the implementation of Part XI of the Convention in 1982, and UNCLOS in 1994.
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.
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.

2. ACTIVITY DESCRIPTION

2.1 Location

The Montara field lies approximately 690 km (373 nautical miles) east of Darwin in a water depth of approximately 80 m (Figure 1-1) in Commonwealth waters of the Timor Sea (Table **2-1**).

This EP encompasses monitoring activities for Sea Eagle-1 within Production Licence AC/L8 and Tahbilk-1 within production Licence AC/L7.

Table 2-1: Location of activities

Site	Sea Eagle-1	Tahbilk-1
Licence/Permit	AC/L8	AC/L7
Actual Water Depth	78	89
Wellhead height above sea floor (2020 ROV inspection)	Top of Debris Cap 3.1m above seabed	Top of Debris Cap 4.3m above seabed
Wellhead Details	Wellhead and Debris Cap Only	TGB + PGB in place
Debris at location	None noted	Small amount of debris next to the WH (possibly cement)
Location	12° 32' 45.22'' S 124° 26' 47.56'' E	12° 43’ 57.93” S 124° 30’ 14.32” E

The locations of key environmental sensitive receptors in closest proximity to the drilling activities Operational Area are provided in Table **2-2**.

Table 2-2: Locations of key sensitive receptors in relation to the *Montara Field*

Sensitive receptor	Approx. distance from the Operational Area (km)
Goeree Shoal	28
Vulcan Shoal	28
Eugene McDermott Shoal	40
Barracouta Shoal	39
Cartier Island	106
Hibernia Reef	126
Ashmore Reef	149
Cassini Island	181
Browse Island	187
Long Reef	188
Mainland Australia	211
Rote Island (Indonesia)	239
West Timor	244

Sensitive receptor	Approx. distance from the Operational Area (km)
Seringapatam Reef	288
Sandy Islet (Scott Reef)	322
Scott Reef	322
East Timor	339
Savu Island (Indonesia)	351
Flores Island (Indonesia)	486
Sumba Island (Indonesia)	474

2.2 Wells and Wellheads

The wellheads are comprised of steel with metal-to-metal ring gaskets. If debris was noted near each well location during the 2020 ROV inspection it has been noted and included in Table **2-1**. The 14" SWIFT manifold pipeline with piggyback and umbilical line is approximately 50 m to the W-NW of the Sea-Eagle-1 wellhead. Another ROV survey was undertaken in 2021, images are provided in Figure 2-1 and Figure 2-2.

2.2.1 Re-use of the existing infrastructure

In the case of both wells, when they are re-entered for development, a series of well integrity checks and verifications will be performed. If these establish there is a well integrity issue, that issue will be rectified and if it is not possible to rectify, the ultimate outcome would be full well abandonment, subject to separate approvals. Both wells appear to be in good condition, are maintained and presently deemed to be suitable for re-use as described below.

Sea Eagle-1: Based on the last reported ROV survey, the well appears to be in good condition with a light coating of marine growth. There are no indications of corrosion or of trawler interaction or other artefacts that would suggest a compromised conductor. The well is presently connected to an anode skid to further protect the steel from any degradation. When the passive monitoring system is installed, this will provide an opportunity to view the internal condition of the wellhead, confirming overall condition which should provide adequate assurance that the well is development ready. At this point in time, there is no evidence that suggests the well is not development ready.

Tahbilk-1: Based on the last reported ROV survey, the well appears to be in reasonable condition. The guide base has experienced some corrosion however this is not structural or pressure containing and drawing an analogy that the guide base represents the wellhead would be incorrect. The survey noted that the wellhead connection appears to be secure and intact with some surface corrosion observed. The wellhead does have an anode skid connected to it as a means of mitigating any further corrosion. There are no indications of trawler interaction or other artefacts that would suggest a compromised conductor. When the passive monitoring system is installed, this will provide an opportunity to view the internal condition of the wellhead, confirming overall condition which should provide adequate assurance that the well is development ready. At this point in time, there is no evidence that suggests the well is not development ready.

2.2.2 Well Maintenance

Both Sea Eagle-1 and Tahbilk-1 wells are in a temporarily abandoned state. Jadestone maintains these wells through a combination of surveillance activities and connection of an anode bank. These remain as potential candidates for field development purposes, Jadestone is committed to ensuring they are maintained in good condition and repair.

Surveillance has historically been in the form of annual ROV inspection and with the acceptance of this EP, inclusion of a passive remote well monitoring system which is described in Section 2.4. This surveillance program ensures that the well's barriers can be monitored to the best extent possible, that no geological breaches have occurred and that the wellhead is not subsiding and in the very unlikely situation of a barrier degrading within the proposed EP validity timeframe that an early notification system would be activated.

Both wells have been connected to anode banks to prevent corrosion and ensure the well has adequate structural integrity to receive pressure control equipment or a subsea production tree and be used for field development purposes, or permanently abandoned. The cathodic protection loss rate is also monitored in the annual ROV surveys to ensure adequate protection is present.

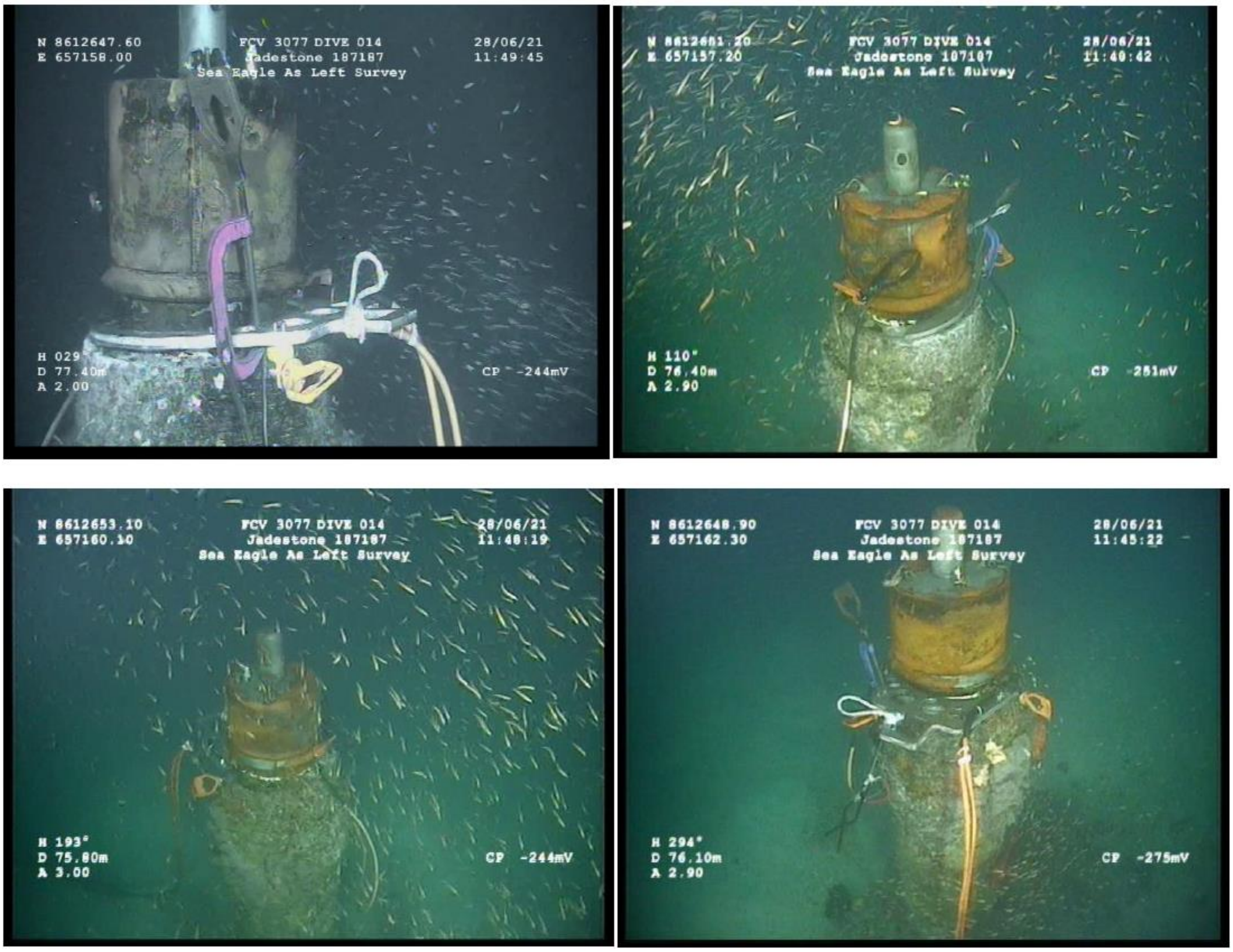


Figure 2-1: Images of Sea Eagle-1 wellhead including anode bank connection (Jadestone Energy, 2021a)

Figure 2-2: Images of Tahbilk-1 wellhead (Jadestone Energy, 2021b)

2.3 Annual ROV Survey

2.3.1 Annual ROV Survey objectives

An annual ROV survey is undertaken from a vessel at the Sea Eagle-1 and Tahbilk-1 wellheads. The objective of the survey is to verify that the wells barrier envelope is intact, that no damage has been caused by third parties, that well conditions have not changed (e.g. subsidence) and that anode corrosion banks are working as intended and that the well has suitable cathodic protection.

The surveys may be undertaken within the same vessel-based activity campaign at each wellhead or at different times depending on the last ROV inspections completed and vessel availability. The objectives of the annual ROV survey are:

- Locate and confirm co-ordinates of well head site centre point.
- General visual inspection of the of the well heads, well monitoring system and anodes.
- 4 photograph stills of the main cardinal points
- Measure approximate height of well head above seabed.
- Assess and record condition of corrosion cap and anodes.
- Conduct a 50m x 50m grid survey with the well head site at the centre noting any areas of debris or significant seabed disturbance.

- Visually check for any indications of mechanical damage (or change), or emission of fluids or gas that would indicate a barrier has failed.
- Verify that marine growth is not obstructing functional elements of the well monitoring system

2.4 Remote monitoring system

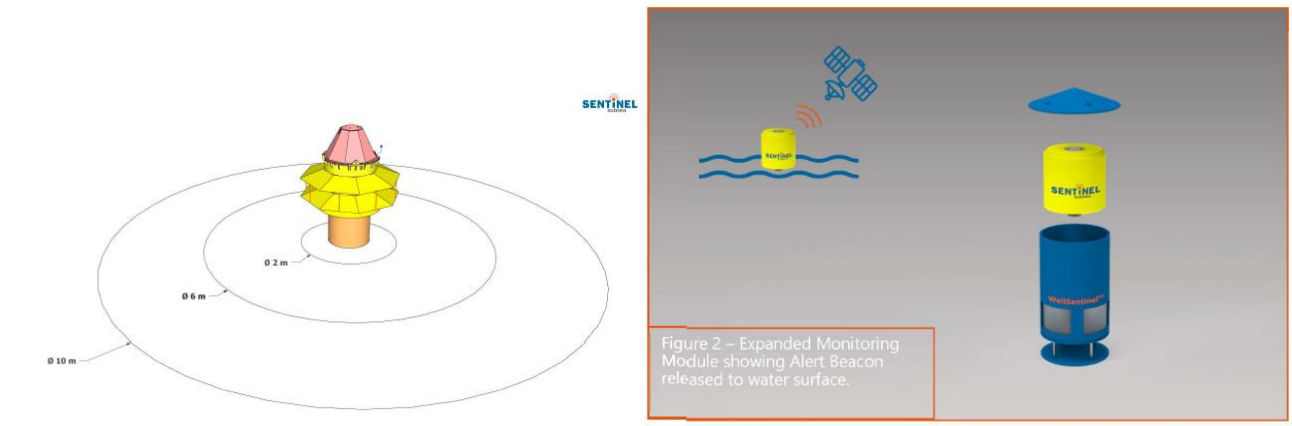
2.4.1 System Description

Well integrity will be monitored by a passive system called WellSentinel™. The system works by having a buoyed communication module held in place by a hydrocarbon sensitive release mechanism. A gathering system directs escaped hydrocarbon material onto a chamber where the release mechanism loses strength and releases the buoyant communication module. When the module reaches surface, it connects to a satellite network which triggers an alert in an operations monitoring centre (EngageSubsea) who then notify Jadestone.

A vessel inspection is then required as soon as practicable, to investigate the well conditions and collect the beacon. The system has been designed to be able to capture hydrocarbons within a 3m radius of the well. This is achieved by water currents sweeping hydrocarbons into the catchment areas using a Frond design.

System maintenance is defined by the battery life within the satellite communicator housed within the communication module. Battery life is 20 years. Jadestone plan to visually inspect the system during annual ROV inspection and verify that gathering ports and deployment areas are not fouled with marine growth. In addition, the system will have an ability to inject corrosion inhibitors into the wellhead monitoring cap to mitigate any metal degradation.

Figure 2-3: WellSentinel™ monitoring module



2.4.2 Monitoring system installation

The monitoring system at Sea Eagle-1 and Tahbilk-1 will be planned to be installed via an ROV Support Vessel (ROVSV) with subsea crane/lifting capability. A basic outline of the steps for installation is provided below:

- Vessel / ROV arrive on site and perform as found survey;
- Using an ROV, disconnect anode skid clamps from well;
- Remove existing corrosion cap (non-pressure retaining) with the vessel's crane;
- Clean and inspect wellhead connection and seal area with the ROV;
- • Conduct pre-deployment checks;
- Install the WellSentinel™ system with the vessel's crane;
- Re-install anode skid clamps with the ROV;
- Conduct as left survey with the ROV;

The expected duration of this activity is 1 – 2 days at each well location. As the activity does not involve the removal or interaction of well barriers, the risk towards loss of containment is unchanged from the current well status. Removal of the existing non-pressure retaining corrosion cap and installation of a new WellSentinel™ cap does not change the spill risk. It should also be noted that as timing allows, this scope of work would be planned to be undertaken in conjunction with any planned ROV activities to minimise the environmental footprint of the activity.

2.4.3 Monitoring System equipment on Title

Upon completion of the well monitoring system, a tree cap will be removed from each well and replaced with a WellSentinel™ system tree cap. No other equipment is required and nothing is installed on the seabed.

2.4.4 Monitoring system inspection and maintenance

WellSentinel™ is a relatively new technology that has been developed in Scotland in partnership or collaboration with Robert Gordon University. Jadestone's understanding is the only maintenance schedule associated with the equipment is to change the satellite communicator batteries after 10 years of service. The 10 years extends beyond the validity of this EP. As part of the ongoing annual ROV survey, the system will be visually inspected and based on this outcome, it may be recovered to surface for maintenance. If it were recovered, may take approximately 3 days per well:

- Recover the WellSentinel™ to surface;
- Clean any marine growth of debris;
- Replace the satellite communication unit battery;
- Ensure hydrocarbon migration ports are clear of debris and clean;
- Replace the hydrocarbon contact release link mechanism;
- Refresh corrosion inhibitor within the wellhead;
- Re-install the WellSentinel™.

This activity may occur simultaneously from the same vessel undertaking annual ROV surveys, or separately.

2.5 Timing and Duration

2.5.1 In-field Observations

Until the monitoring system has been installed the Montara in-field logistics vessel or a helicopter will be routed past each wellhead to monitor for any indication of hydrocarbons at surface. This will take place at least once every 12-week period, will occur for less than 0.5 days and be included in BASSNET as a work instruction, where observations are noted.

2.5.2 Wellhead monitoring system installation

During installation of the wellhead surveillance monitoring system, one vessel will be on location for approximately 1-2 days working 24 hrs/day. This is expected to occur in 2022 once final assurance activities are complete and the equipment has been manufactured.

2.5.3 Annual ROV surveys

All wellheads are currently operating under an annual ROV inspection and monitoring regime.

Monitoring of the Sea Eagle-1 and Tahbilk-1 wells will be performed annually via ROV on the wellheads.

Annual ROV monitoring takes approximately 24 hours per well for a visual inspection using one vessel. It is anticipated that a vessel with a work class ROV will be required.

2.5.4 EP Validity

The EP validity period for the vessel-based activities, is five (5) years from EP acceptance. Once accepted, Jadestone Energy will be permitted to undertake the described activities.

2.6 Petroleum Safety Zone (PSZ)

There is currently no PSZ around any of the wellheads subject this EP, however the wellheads are marked on nautical charts and will continue to be going forward. During vessel-based activity in the field (e.g. monitoring system installation, annual monitoring, maintenance and data retrieval), a 500 m PSZ will be implemented around the vessel(s) and communicated via Notice to Mariners. A notice to mariners will not be issued for the vessel monitoring undertaken at least once every 12 weeks as the duration of the activity is <0.5 days and will be opportunistic in the field and will not require establishment of a PSZ.

A cautionary zone of 2.5 nautical miles (NM) radius is maintained around subsea structures including the wellheads. 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.

2.7 Operational Area

The Operational Area is defined as a 500m zone around each of the wellheads (Figure 1-1).

When the vessels are outside the Operational Area and remain within Australian waters (e.g. transiting to or from location or holding position outside the PSZ), they fall under the regulatory jurisdiction of the Australian Maritime Safety Authority (AMSA) under the *Navigation Act 2012*. Accordingly, this EP does not cover activities performed by the vessels while outside the Operational Area; however, this EP does cover oil spill response activities outside the Operational Area.

2.8 Hydrocarbons

Montara crude and marine diesel are described briefly below. More detail is provided in Section 7.6.2, 7.7.3 and in the OPEP Appendix A5.

2.8.1 Montara crude oil

Montara crude is considered a Group II persistent hydrocarbon, as per the grouping classification presented by AMSA (2015). The oil is characterised by a low viscosity (3.164 cST @30°C cP) and a medium density of 830 kg/m^3 (API 39.0). Based on oil assay data available, approximately 33% (by volume) of the Montara crude would be considered persistent hydrocarbons under international oil property benchmarks.

2.8.2 Diesel

Marine diesel will be used to fuel the vessels used during this activity. Marine diesel is typically 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%. Viscosity is 4.0cP (at 25^{o}C) and density of approximately 829.1kg/m^3 at 25^{o}C.

2.9 Vessel and Helicopter Operations

2.9.1 Installation and assurance activities

To install the system, a Dive or ROV support vessel with a capable subsea crane will be required. Examples of suitable vessels are Sapura Jane, Skandi Singapore and Fugro Etive. In the event that any activities required for the 5-yearly assurance check during this EP validity, a similar vessel will be required. These vessels are installation vessels with helidecks, offshore cranes and larger fuel tank capacities. Of these vessels, the largest is the Fugro Etive which is 93m long and ~5,000 tonnes. The largest fuel tank has a capacity of 241m^3.

2.9.2 Monitoring and Maintenance Vessels

Vessel based activities will be provided by a support vessel which will operate out of Darwin. One vessel will be required to undertake the planned monitoring and maintenance activities. The vessel will require a work class ROV and is likely to be similar to the Samson Explorer, a multi-purpose vessel that is 35 m long, 341 tonnes and has a total fuel capacity of 50m^3. The vessel needs to have suitable equipment for ROV deployment, and as the activity duration is 24 hours per well, a larger vessel is not necessary.

2.9.3 Helicopters

Helicopter support will be provided by Babcock. A shared Sikorsky S-92 helicopter and flight crew, along with shared technical back-up helicopter, will be based at Mungalalu–Truscott air base to support the activity as required. A helicopter may be used to conduct regular in-field observations of the surface waters above the wellhead to detect sheen which may be an indication of a loss of containment.

If required, routine helicopter operations would be during daylight hours and helicopter flight time between Mungalalu-Truscott and the Montara field is 70 minutes. Helicopter refuelling will not be undertaken on vessels.

2.10 Out of Scope

Activities that are not covered by this EP are:

- Nearby shipping activity, third-party offtake tankers, and Operational support activities outside the Operational Area;
- Anchoring of vessels (other than in an emergency);
- Support vessels associated with the Activity outside the Operational Area (where they will adhere to applicable maritime regulations, and Commonwealth and State environmental management obligations);
- Plug and abandonment activities on the wells;
- Re-entry of wells; and
- Decommissioning and removal of infrastructure - which is required to be undertaken in accordance with a separate approvals process under the OPGGS Act and Regulations.

3. EXISTING ENVIRONMENT

3.1 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); and
- The Environments that May Be Affected (RISK EMBAs) – the geographical area encompassing the environment that has the potential to be affected by the unplanned events associated with the activities described (Section 2) depending upon the level of exposure.

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

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

Details of the environmental values and sensitivities in the Operational Area are described here in Section 3 and listed in Appendix D. The environmental values and sensitivities in the RISK EMBA has been used to inform the assessment of the unplanned events in particular, loss of well control (LOWC), diesel spills, oil spill response planning and oil spill risk assessment. Full details of the environmental values and sensitivities in the RISK EMBA is contained in Appendix B and E, and not discussed any further here.

Distances quoted throughout this report have been measured from the Montara Field. The Operational Area of this report includes the wellheads of Tahbilk and Sea Eagle which lie 4.4km and 18km respectively from the Montara wellhead platform in the Montara field.

3.2 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 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 149 km and 106 km north-west, respectively, from the Montara field;

- A number of key ecological features (KEFs) have been identified in the region (Section 3.4.6). The Continental Slope Demersal Fish Community 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 within the Northwest Shelf Transition provincial bioregion, summarised in Table **3-1**.

Table 3-1: Provincial bioregions in Operational Area

Area	Description
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.

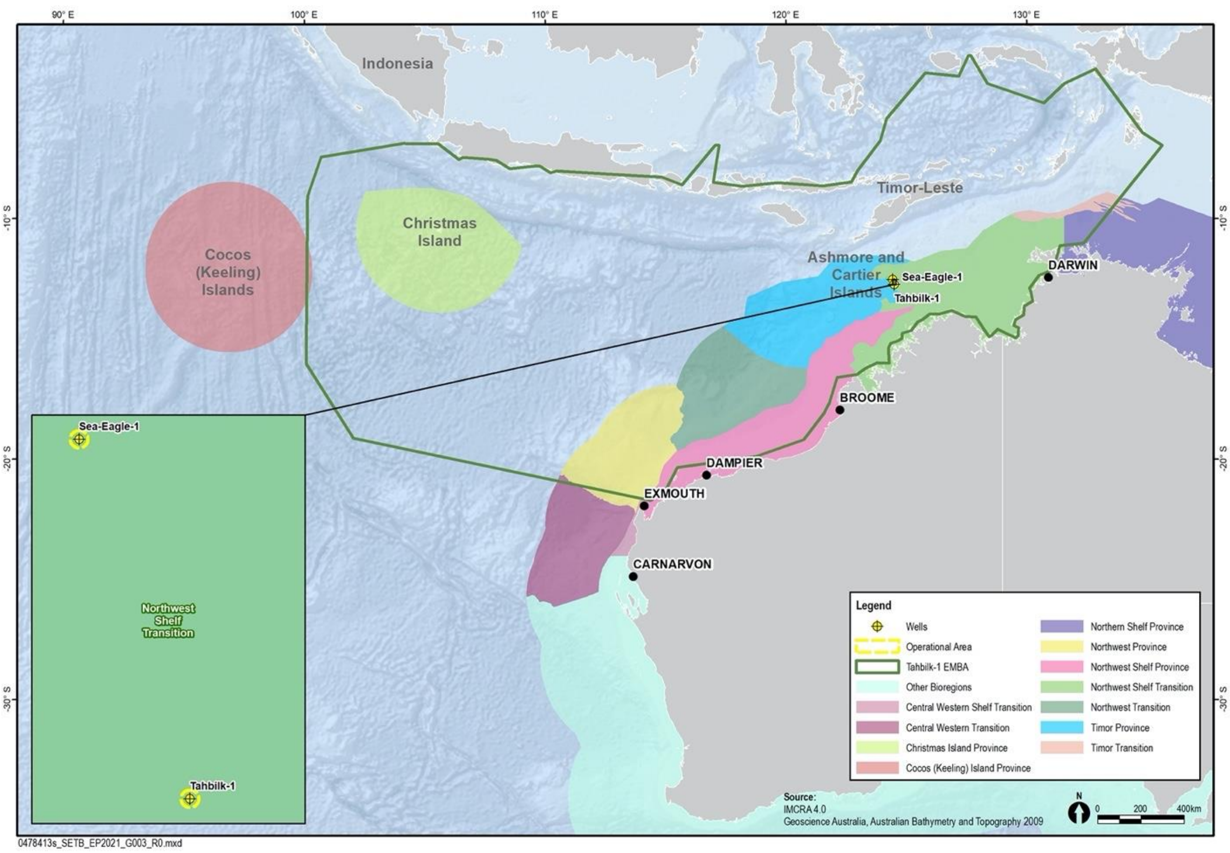


Figure 3-1: Provincial Bioregions relevant to the Operational Area and RISK EMBA

3.3 Physical Environment

3.3.1 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 RISK 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 3-2).

Table 3-2 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
Annual	31.0	25.3	828.9	67

3.3.2 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 3-2).

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). 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.

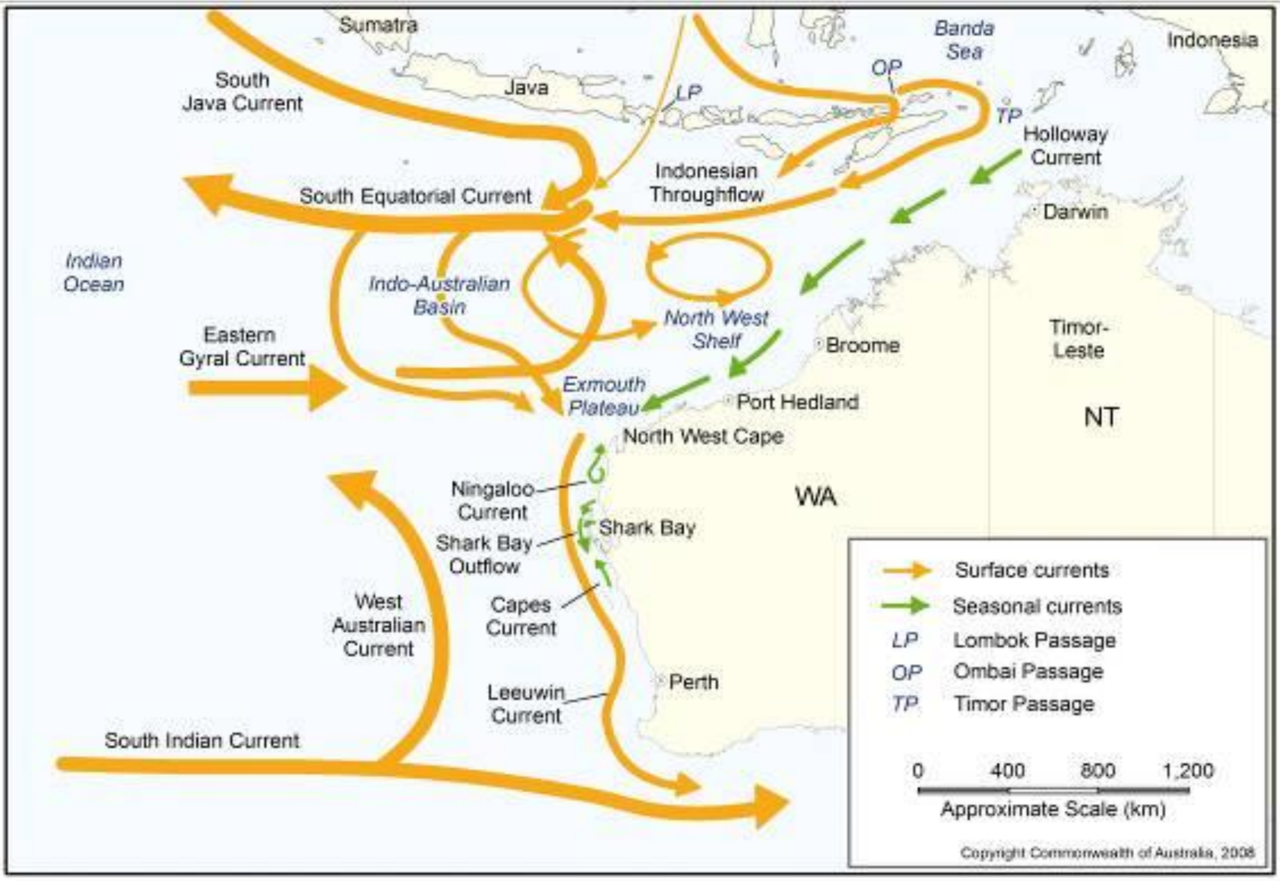
Currents in the Kimberley region are also generated by several more localised factors, including tidal forcing, local wind forcing, inertial oscillations, shelf waves, seiche and trapped waves. Studies undertaken in the vicinity of Scott Reef and Seringapatam Reef suggest that the ITF does not directly influence these systems, but it is the eddies that peel off the main 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 the RISK 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 RISK 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 3-2: Key ocean currents influencing Western Australia

3.3.3 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.

3.3.4 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 Field 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 Field are typically low (<0.2 NTU; Jacobs 2017).

3.3.5 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 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.

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.

3.3.6 Sediment Quality

Sediment quality sampling undertaken near the Montara Field 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).

3.3.7 Sediment Particle Size Distribution

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

3.4 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 3-3. The full EPBC Act Protected Matters report is provided in Appendix D.

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

MNES and Other Matter Protected under EPBC Act	Operational Area
Commonwealth Marine Area	✓(1)
Listed Threatened Species	✓ (19)
Listed Migratory Species	✓ (33)
Listed Marine Species	✓ (59)
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	✖

3.4.1 Matters of National Environmental Significance (MNES)

Commonwealth Marine Areas

The Operational Area is within the Exclusive Economic Zone (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.

3.4.2 Listed Threatened and Migratory Species

The protected matters search tool (PMST) search (Appendix D) identified 19 Listed Threatened Species (LTS) and 33 Listed Migratory Species (LMS) as having the potential to occur within the Operational Area. The LTS included:

- Four species of marine mammals;
- Six species of marine reptiles;
- Five shark species; and

- Four 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 3-4 to Table 3-7 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 3-3 to Figure 3-6). The relevant sections also outline the management such as:

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

The requirements of the species recovery plans and conservation advices are considered to identify any requirements that may be applicable to the risk assessment.

3.4.3 Others matters protected by the EPBC Act

Listed marine species

A total of 59 Listed Marine Species are either likely to, or may, occur within the Operational Area, including 11 bird species and 18 reptile species). 10 of these species are also Listed Threatened Species.

Whales and other cetaceans

The Protected Matters search determined that 13 cetacean species or their habitat may occur within the Operational Area. These species are discussed in Table 3-6. Whales and cetaceans occurring in the RISK EMBAs are discussed in Appendix B.

3.4.4 Marine Parks

No State Marine Parks (MP) or Australian Marine Park's (AMP) intersect with the Operational Area.

3.4.5 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.

3.4.6 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.

3.5 Biological Environment – Species and Communities' Descriptions

3.5.1 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).

3.5.2 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.

3.5.3 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 3-4.

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 3-3).

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 3-4: Fish, Sharks and Rays EPBC listed species

Common Name (Scientific Name)	EPBC Act Status	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	No
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*) (DSEWPaC 2013a)	No
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, 2014)	✓ Sawfish and river shark multispecies recovery plan (Commonwealth of Australia, 2015b)	No
Green Sawfish *(Pristis zijsron)*	V, M	Species or species habitat known to occur within area	No	✓ Approved conservation advice for *Pristis zijsron* green sawfish (Threatened SpeCommittee, 2008b)	✓ Sawfish and river shark multispecies recovery plan (Commonwealth of Australia, 2015b)	No
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	No

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
					plan (Commonwealth of Australia, 2015b)	
Narrow/Knifetooth Sawfish *(Anoxypristis caspidata)*	M	Species or species habitat may occur within area	No	No	No	No
Oceanic Whitetip Shark *(Carcharhinus longimanus)*	M	Species or species habitat may occur within area	No	No	No	No
Shortfin Mako *(Isurus oxyrinchus)*	M	Species or species habitat likely to occur within area	No	No	No	No
Longfin Mako *(Isurus paucus)*	M	Species or species habitat likely to occur within area	No	No	No	No
Giant Manta Ray (*Manta birostris*)	M	Species or species habitat may occur within area	No	No	No	No
Reef Manta Ray *(Manta alfredi)*	M	Species or species habitat may occur within area	No	No	No	No

CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory

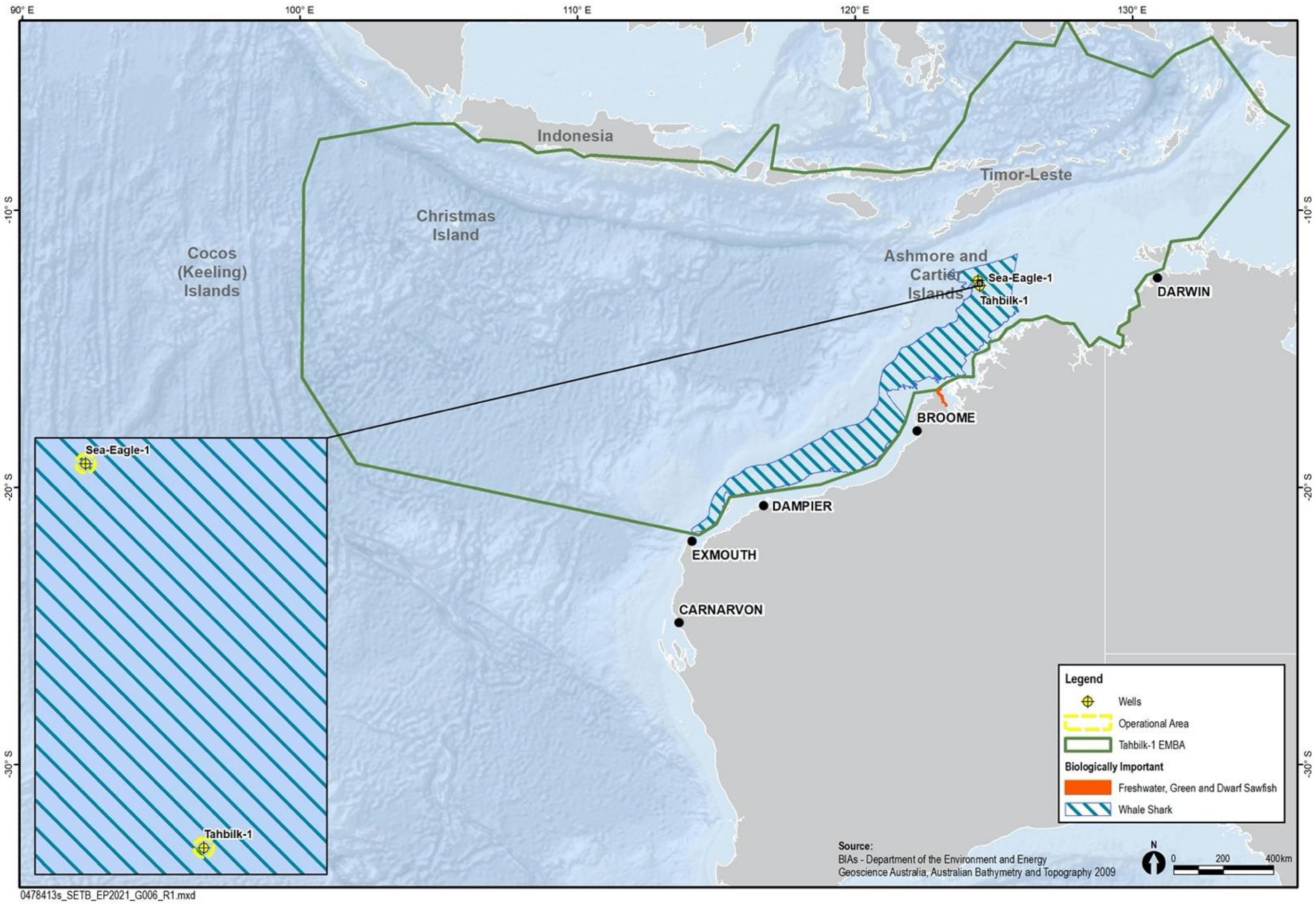


Figure 3-3: Biologically important areas for fish, sharks and rays

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). Of these locations, only the Ningaloo Reef is partly within the RISK 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 3-3). 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 RISK EMBA. No great white shark BIAs are intersected by either the Operational Area or RISK EMBA.

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 RISK 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 Western Australia, Northern Territory, Queensland and New South Wales at depths ranging from shallow coastal waters to at least 500 m (DoEE 2017b).

No BIAs for either of these species are intersected by the Operational Area. However, these species may migrate through the Operational Area and may be found within the RISK EMBA.

Oceanic Whitetip Shark (Migratory)

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

1961, Last and Stevens 1994). Based on this offshore habitat preference, it is possible that the species may be encountered within the Operational Area and the RISK EMBA.

No oceanic whitetip shark BIAs are intersected by the Operational Area.

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).

No BIAs for the reef manta ray are intersected by the Operational Area and based on the species' habitat preferences it is unlikely that the reef manta ray will be encountered in the Operational Area. Given the RISK EMBA overlaps with a number of coral and rocky reefs in the region, it is possible the species may be encountered within the RISK 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).

No BIAs for the giant manta ray are intersected by the Operational Area and based on the species' habitat preferences it is unlikely that the giant manta ray will be encountered in the Operational Area. Given the RISK EMBA overlaps with a number of coral and rocky reefs in the region, it is possible that the species may be encountered within the RISK 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).

No BIAs for the freshwater sawfish are intersected by the Operational Area and 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 RISK 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).

No BIAs for the green sawfish are intersected by the Operational Area and 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 RISK 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). No BIAs for the narrow sawfish are intersected by the Operational Area and based on the species' habitat preference it is highly unlikely to be found within the Operational Area, although may be encountered within the RISK EMBA.

3.5.4 Marine Reptiles

The Operational Area PMST report (Appendix D) identified:

- Six threatened/ migratory

A description of marine reptiles is provided in Table 3-5.

Table 3-5 Marine Reptiles EPBC listed species

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
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 Species Scientific Committee, 2008a)	✓ Recovery plan for marine turtles in Australia (DoEE 2017)	✓ Marine debris
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

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
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

CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory

Marine Turtles

Six threatened/migratory marine turtles may be 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 3-4). The Operational Area is approximately 106 km 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 Marine Park (MP) and Cartier Island MP, approximately 149 and 106 km to the northwest of the Operational Area, respectively (Figure 3-4).

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. The closest interesting site to the Operational Area is Ashmore Reef approximately 149 km to the north-west, and the closest nesting site is Scott Reef, approximately 321 km to the south-west.

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 the Dampier Archipelago (Baldwin et al. 2003), approximately 1,500 km south-west of the Operational Area. Loggerhead turtles have been recorded in the reserves of Ashmore Reef MP (149 km) and Cartier Island MP (106 km), west- northwest of the Operational Area (Guinea 1995) and have a large BIA for foraging within the Western Joseph Bonaparte Depression. 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.

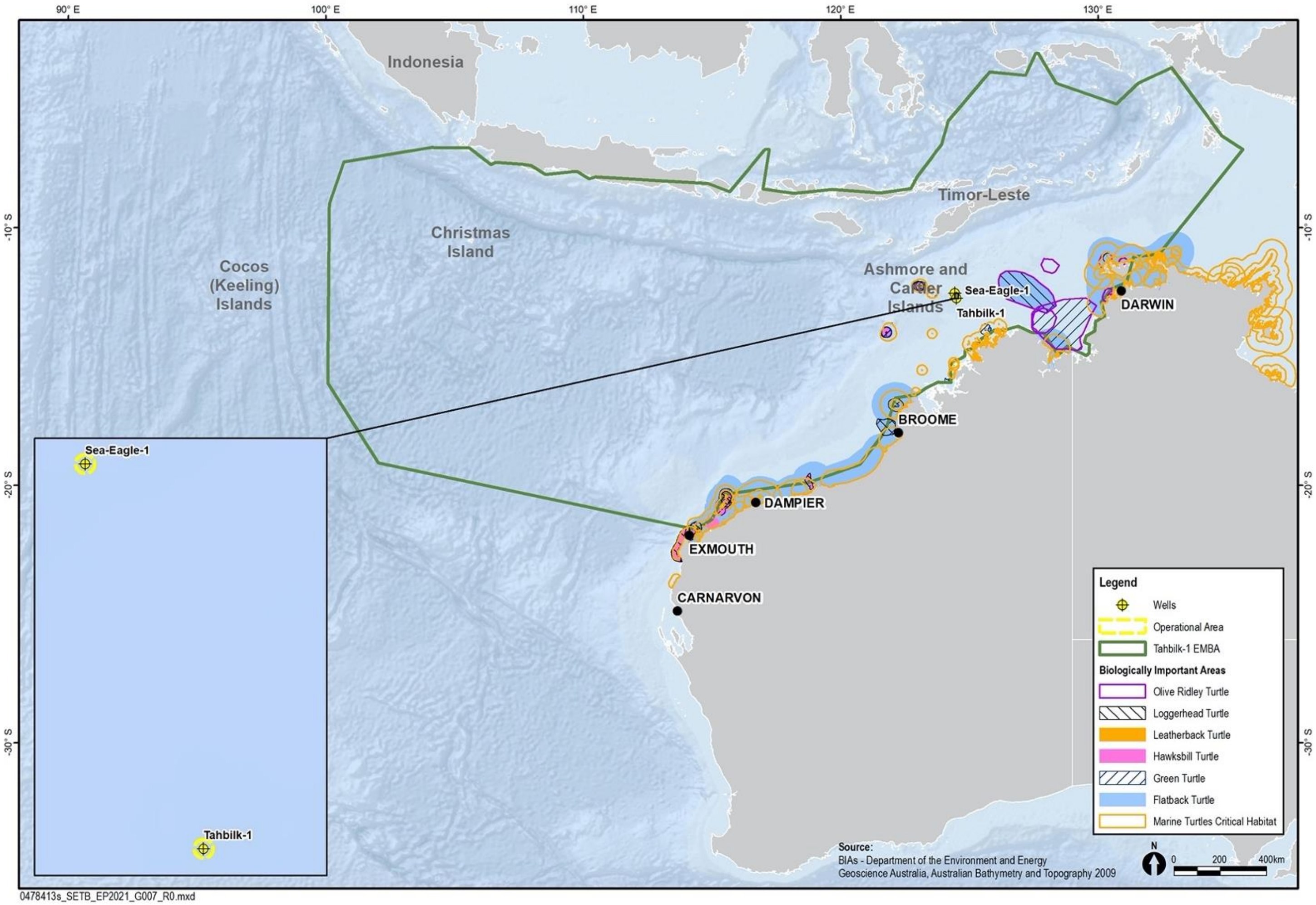


Figure 3-4: Biologically important areas for marine reptiles

3.5.5 Marine Mammals

The Operational Area PMST report (Appendix D) identified:

- Four threatened/ migratory; and
- Three migratory

A description of marine mammals is provided in Table **3-6**.

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.

The Operational Area does not intersect with any BIAs for listed marine mammal species (Figure **3-5**).

Table 3-6 Marine Mammal EPBC listed species

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Humpback Whale (*Megaptera novaeangliae*)	V,M	Species or species habitat likely to occur within area	No	✓ Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (Threatened Species Scientific Committee, 2015a)	Ceased 2015	✓ Marine debris
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 may 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 may occur within area	No	✓ Conservation advice *Balaenoptera physalus* fin whale (Threatened Species Scientific Committee, 2015c)	Ceased 2015	✓ Marine debris

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Bryde's Whale *(Balaenoptera edeni)*	M	Species or species habitat may occur within area	No	No	No	✓ Marine debris
Orca, Killer Whale *(Orcinus orca)*	M	Species or species habitat may occur within area	No	No	No	✓ Marine debris
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) (*Tursiops aduncus*)	M	Species or species habitat may occur within area	No	No	No	No

CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory

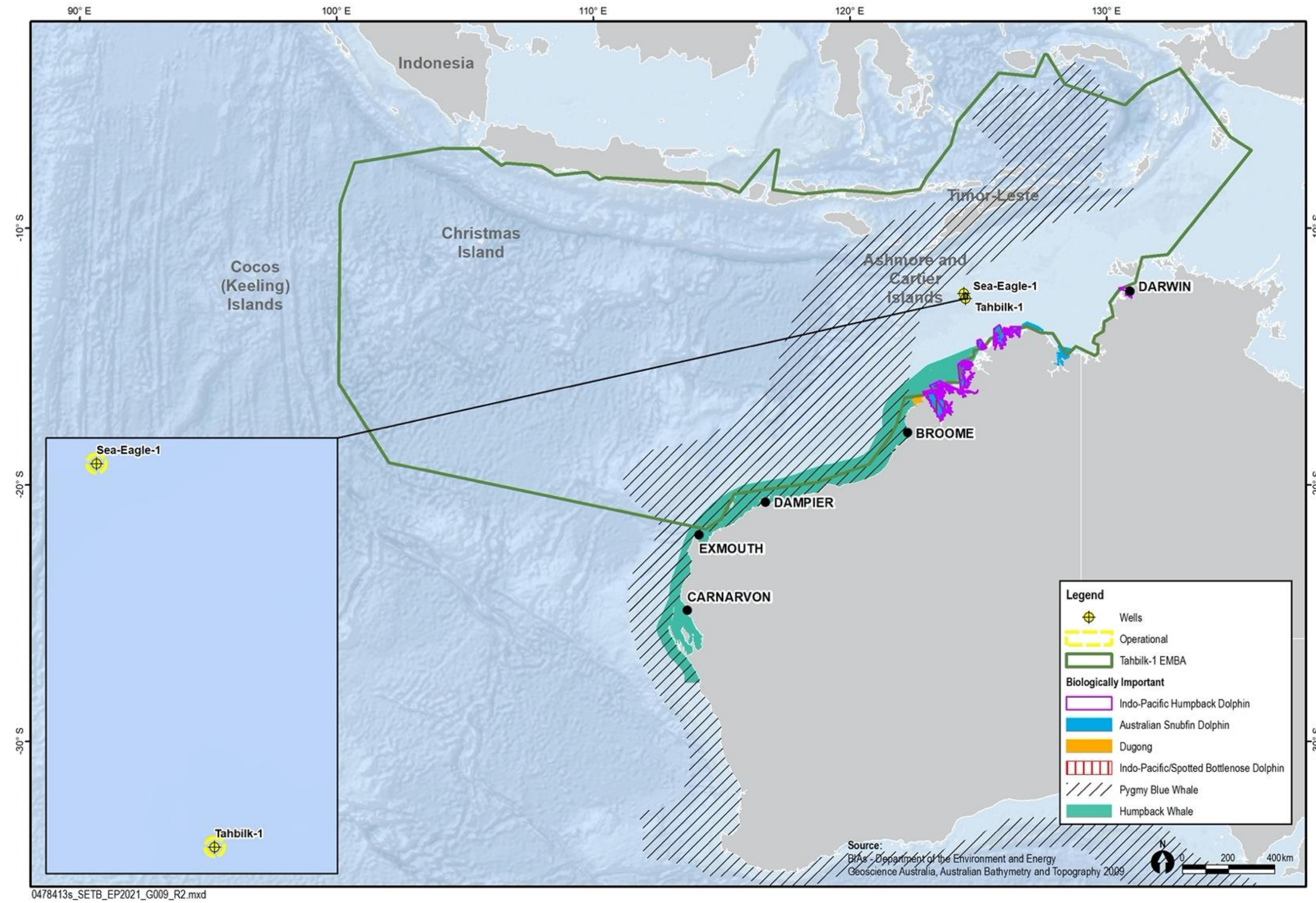


Figure 3-5: Biologically important areas for marine mammals

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.

Humpback Whale (Vulnerable/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 RISK EMBA overlaps with the humpback whale BIA identified for breeding and calving at Camden Sound MP, adjacent to the Kimberley coast (Figure 3-5).

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 RISK EMBA.

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 RISK 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 and may be found within the RISK EMBA, however, no BIAs for Bryde's whales are intersected by the Operational Area.

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 or the RISK EMBA in significant numbers.

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 3-5.

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 and the RISK EMBA.

3.5.6 Avifauna

The Operational Area PMST report (Appendix D) identified:

- Four threatened/migratory; and
- Seven migratory

A description of avifauna species is provided in Table 3-7.

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 avifauna migration, resting, foraging or breeding BIAs are present within the Operational Area (Figure 3-6). The nearest breeding/roosting site to the Operational Area is Cartier Island approximately 106 km away.

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 RISK 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 RISK 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 RISK 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 RISK EMBA.

Common Noddy (Migratory)

In Australia, the common 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 RISK 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 RISK 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 3-6). 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 RISK 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 3-6). 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 RISK 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 RISK 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 RISK EMBA.

Table 3-7 Avifauna Listed EPBC species

Common Name (Scientific Name)	EPBC Act Status	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	Species or species habitat may occur within area	No	✓ Conservation advice *Anous tenuirostris melanops* Australian lesser noddy (Threatened Species Scientific Committee, 2015e)	No	No
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
Common Noddy (*Anous stolidus*)	M	Species or species habitat may occur within area	No	No	No	Threat abatement plan for predation by feral cats. (DoE, 2015)
Streaked Shearwater (*Calonectris leucomelas*)	M	Species or species habitat may occur within area	No	No	No	Threat abatement plan for predation by feral cats. (DoE, 2015)

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Lesser Frigatebird (*Fregata ariel*)	M	Species or species habitat may occur within area	No	No	No	No
Great Frigatebird (*Fregata minor*)	M	Species or species habitat may occur within area	No	No	No	No
Common Sandpiper (*Actitis hypoleucos*)	M	Species or species habitat may occur within area	No	Wildlife conservation plan for migratory shorebirds (Commonwealth of Australia, 2015c)	No	No
Sharp-tailed Sandpiper (*Calidris acuminata*)	M	Species or species habitat may occur within area	No	Wildlife conservation plan for migratory shorebirds (Commonwealth of Australia, 2015c)	No	No
Pectoral Sandpiper (*Calidris melanotos*)	M	Species or species habitat may occur within area	No	No	No	No

CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory

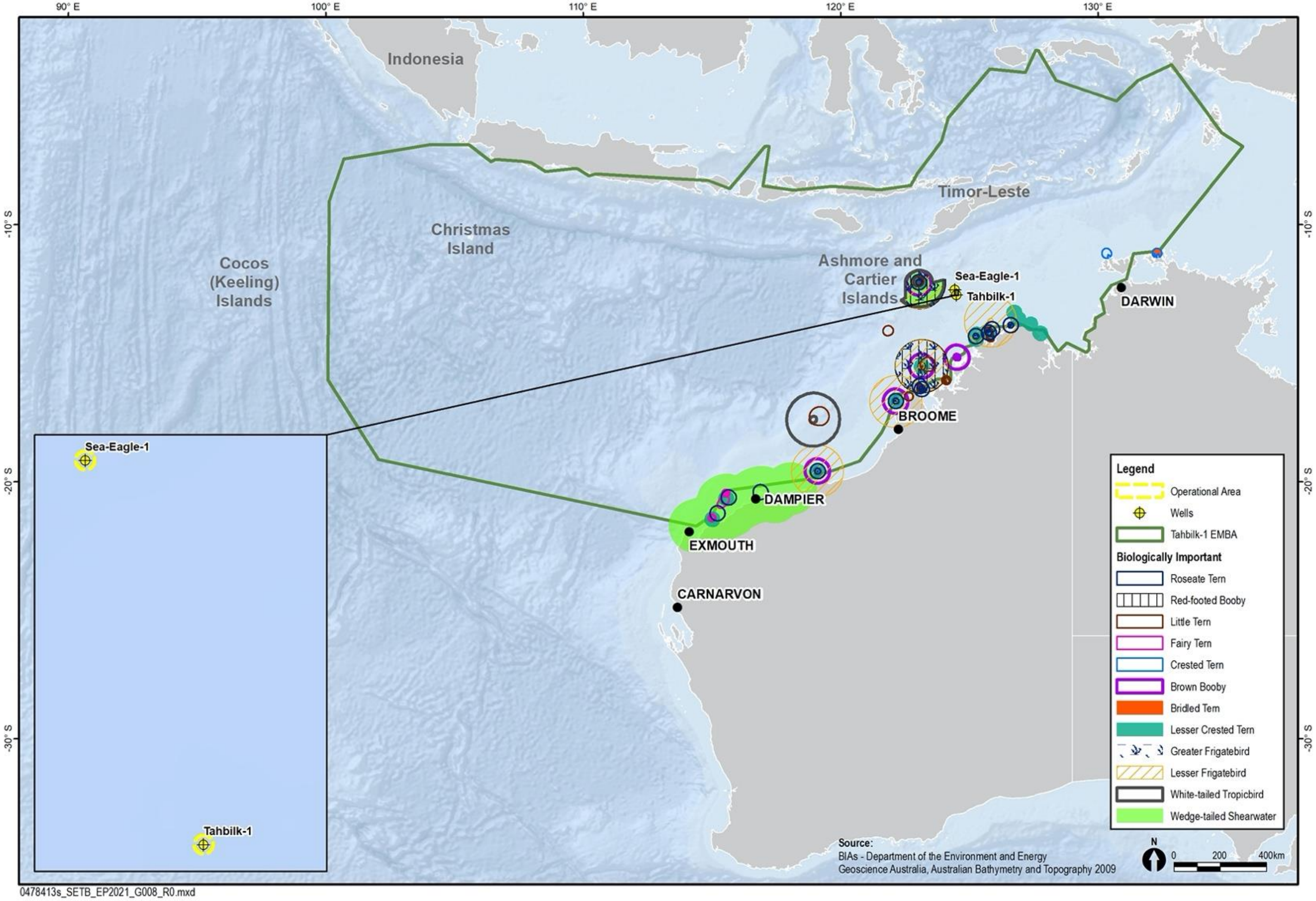


Figure 3-6: Biologically important areas for avifauna

3.6 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 (MNES) protected under the EPBC Act, are summarised in Table 3-8.

Table 3-8 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 Field floating production storage and offtake (facility) (FPSO). Support vessels servicing the nearby infrastructure do pass through the Operational Area (AMSA, 2014) (refer Figure 3-7).	✓
Commercial Fishing	Based on the assessment of fisheries (Appendix C, Table 4) the following Commonwealth and State fisheries are permitted to, and it is feasible that they may, operate in the Operational Area (based on last 5 years of catch data): ● Western Tuna and Billfish Fishery ● Northern demersal scalefish managed fishery The spawning grounds for the Southern Bluefin tuna fishery occur off the northwest of WA.	Minimal effort
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.	–

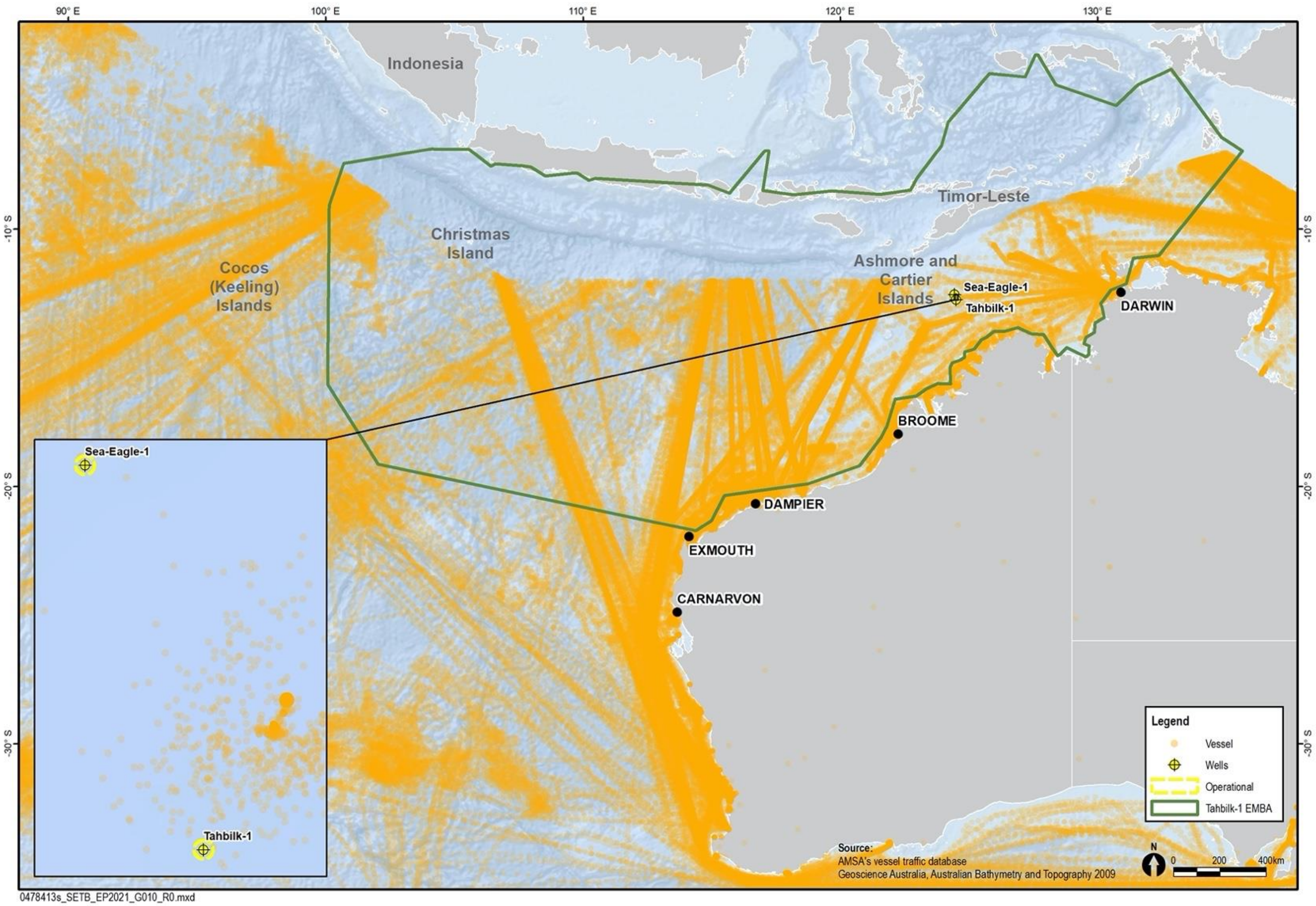


Figure 3-7 Shipping activity within the region

4. CONSULTATION OF RELEVANT PERSONS

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

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

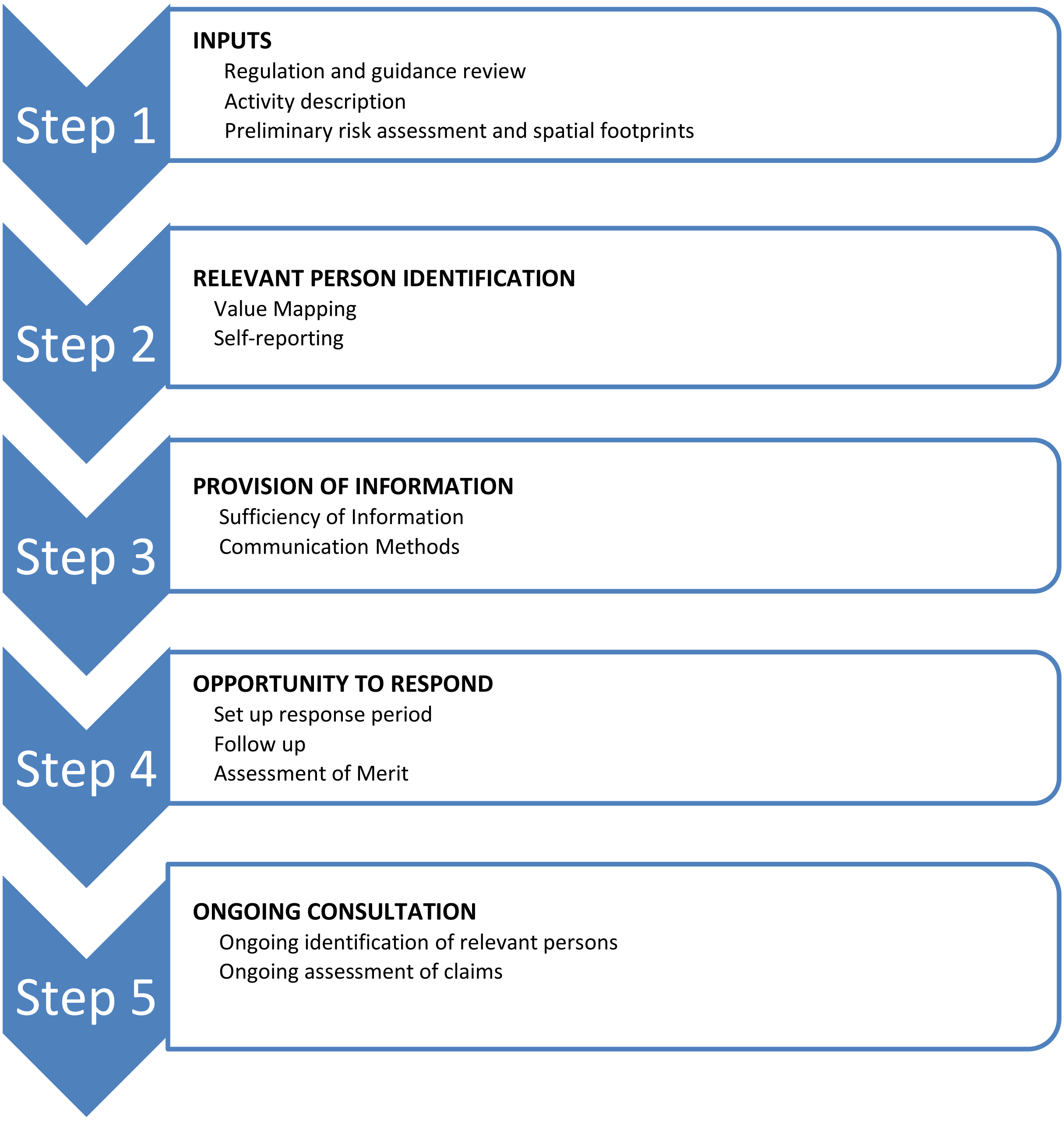


Figure 4-1: Summary of the Jadestone Relevant Person Engagement process

4.1 Fulfilment of Regulatory Requirements

The *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* stipulate a number of requirements in relation to consultation associated with an EP (Table 4-1).

Table 4-1: Regulatory Requirements

Regulation	Description	Fulfilment
11A(1)	In the course of preparing an environment plan, or a revision of an environment plan, a titleholder must consult each of the following (a relevant person): (a) each Department or agency of the 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.	Section 4.2 of the EP outlines the process (as per Jadestone Stakeholder Engagement Process for Regulatory Approvals) that was used to identify relevant persons in each of the five groups required under the regulations. A list of the relevant persons can be found in Table 4-3 of this EP. A log of engagement with each of the relevant persons identified is provided in the Sensitive Information Report (not published for privacy reasons).
11A(2)	For the purpose of the consultation, the titleholder must give each relevant person sufficient information to allow the relevant person to make an informed assessment of the possible consequences of the activity on the functions, interests or activities of the relevant person.	For key stakeholders (particularly government agencies) email and phone discussions between staff were undertaken on specific issues. In addition to this all stakeholders were provided with targeted information fact sheets (Appendix C).
11A(3)	The titleholder must allow a relevant person a reasonable period for consultation.	To every extent possible, Jadestone has allowed 30 days for relevant persons to review and respond to new information regarding the proposed activity.
14(9)	The implementation strategy of the environment plan must provide for appropriate consultation with: (a) Relevant authorities of the Commonwealth, a State or Territory; and (b) Other relevant interested persons or organisations.	The implementation section (Section 8.1.4) includes notification and ongoing consultation triggers.
16(b)	A report on all consultations between the titleholder and any relevant person, for regulation 11A, that contains: (a) A summary of each response made by a relevant person;	a) A log of all engagement undertaken with relevant persons is provided in the NOPSEMA sensitive information report (not published for privacy reasons).

Regulation	Description	Fulfilment
	(b) An assessment of the merits of any objections or claim about the adverse impact of each activity to which the environment plan relates; (c) A statement of the titleholder's response, or proposed response, if any, to each objection or claim; and (d) A copy of the full text of any response by a relevant person.	b) An assessment of merits including Jadestone's response to all claims is provided in Table 4-5 of this EP. c) Full text of correspondence can be found in the NOPSEMA sensitive information report (not published for privacy reasons).
27	Storage of records: • Records must be stored in a way that makes retrieval reasonably practicable; • Records must be kept for five years; and • Records generated through preparation of the environment plan, demonstrating environmental performance, incidents, emissions and discharges, calibration and maintenance, and in relation to the implementation strategy arrangements must be kept.	The Jadestone Stakeholder Engagement Process stipulates internal requirements for the storage of records.

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

Table 4-2: Consultation Guidance

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

Agency	Guidance	Requirements	Fulfilment
		sufficient information, and expectations of ongoing consultation.	

4.2 Relevant Person Identification

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

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

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

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

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

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

Table 4-3: Assessment of Relevance of Identified Stakeholders

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

Stakeholder	Relevant to Activity	Relevance/ Reason for Engagement
Australian Maritime Safety Authority (AMSA)	Considered relevant persons under Regulation 11A(1) (a)	AMSA is the statutory and control authority for maritime safety and vessel emergencies in Commonwealth Waters. The Operational Area is in commonwealth waters.
Department of Defense (DoD)	Considered relevant persons under Regulation 11A(1) (a)	ADF activities may occur within the region.
Department of Agriculture, Water and the Environment – Biosecurity and Compliance	Considered relevant persons under Regulation 11A(1) (a)	DAWE (marine pests) has primary policy and regulatory responsibility for managing biosecurity for incoming goods and vessels, including biosecurity for marine pests. The Department is a relevant agency when an offshore activity has the potential to transfer marine pests. The Operational Area is in Commonwealth waters.
Department of Agriculture, Water and the Environment – Fisheries, Forestry and Engagement (Fisheries)	Considered relevant persons under Regulation 11A(1) (a)	The activity has the potential to impact fishing operations and/or fishing habitats in Commonwealth waters.
Director of National Parks (DNP)	Considered relevant persons under Regulation 11A(1) (a)	The DNP is the statutory authority responsible for administering, managing and controlling Commonwealth marine reserves (CMRs). The Operation Area does not intersect any Australian Marine Parks. Notified as a RP due to potential spill impacts.
State Government Agencies – WA		
Western Australian Department of Mines, Industry Regulation and Safety	Considered relevant persons under Regulation 11A(1) (b)	Relevant state government authority for state industry safety and regulation. Notified as a RP due to potential spill impacts.
Department of Biodiversity, Conservation and Attractions	Considered relevant persons under Regulation 11A(1) (b)	Relevant state government authority for State Marine Parks. Notified as a RP due to potential spill impacts.
Department of Water and Environmental Regulation	Considered relevant persons under Regulation 11A(1) (b)	Relevant government authority for land based environmental management. Notified as a RP due to potential spill impacts.
Department of Jobs, Tourism, Science and Innovation	Considered relevant persons under Regulation 11A(1) (b)	Relevant government authority due to tourism scope. Notified as a RP due to potential spill impacts.
Department of Transport	Considered relevant persons under Regulation 11A(1) (b)	Relevant state government authority for maritime transport.

Stakeholder	Relevant to Activity	Relevance/ Reason for Engagement
Western Australian Museum	Considered relevant persons under Regulation 11A(1) (c)	Relevant organization for samples and marine biology
Department of Primary Industries and Regional Development (Fisheries)	Considered relevant persons under Regulation 11A(1) (b)	Relevant state government authority for fisheries management including biosecurity
State Government Agencies – Northern Territory		
Department of Environment and Natural Resources (NT)	Considered relevant persons under Regulation 11A(1) (b)	Relevant state government authority for state industry safety and regulation. Notified as a RP due to potential spill impacts.
Department of the Chief Minister (NT)	Considered relevant persons under Regulation 11A(1) (b)	Relevant state government authority. Notified as a RP due to potential spill impacts.
Department of Infrastructure, Planning and Logistics (NT)	Considered relevant persons under Regulation 11A(1) (b)	Relevant state government authority for maritime transport. Notified as a RP due to potential spill impacts.
Department of Primary Industry and Resources - Mines and Energy and Fisheries	Considered relevant persons under Regulation 11A(1) (b)	Relevant state government authority for fisheries management including biosecurity. Notified as a RP due to potential spill impacts.
Department of Tourism and Culture (Parks and Wildlife Commission of the NT, Tourism NT)	Considered relevant persons under Regulation 11A(1) (b)	Relevant state government authority for state marine parks. Notified as a RP due to potential spill impacts.
Northern Territory Environment Protection Authority	Considered relevant persons under Regulation 11A(1) (b)	Relevant government authority for environmental protection. Notified as a RP due to potential spill impacts.
Commonwealth fisheries		
Commonwealth Fisheries Association (CFA)	Considered relevant persons under Regulation 11A(1) (d)	Peak representative group for Commonwealth fisheries. The Operational Area is in commonwealth waters. CFA advice was to engage through state representative bodies but will still keep them informed.
Australian Southern Bluefin Tuna Industry Alliance (ASBTIA)	Considered relevant persons under Regulation 11A(1) (d)	Representative body for Commonwealth Bluefin Tuna fishery (upwelling of interest to the fishery in vicinity of operations area).
Individual license holders	Considered relevant persons under Regulation 11A(1) (d)	Consulted through CFA, Northern Prawn Fishery Industry Pty Ltd, Australian Council of Prawn Fisheries, ASBTIA, Western

Stakeholder	Relevant to Activity	Relevance/ Reason for Engagement
• Western Tuna and Billfish, Southern Bluefin Tuna, Western Skipjack • North West Slope Trawl Fishery		Tuna and Billfish Fisheries, Australian Fisheries Trade Association and Commonwealth Fisheries Association (CFA)
State fisheries (WA and NT)		
NT Seafood Council	Considered relevant persons under Regulation 11A(1) (d)	Primary representative body for NT fisheries.
WAFIC	Considered relevant persons under Regulation 11A(1) (d)	Primary representative body for WA fisheries.
Joint Authority Northern Shark Fishery (WA)	Considered relevant persons under Regulation 11A(1) (d)	No catch history in blocks in last 5 years - not considered RP and engaged through WAFIC
Northern Demersal Scalefish Fishery (WA)	Considered relevant persons under Regulation 11A(1) (d)	Individual license holders consulted directly as catch history in last 5 years in grids of activity
Mackerel Managed Fishery (Area 1) (WA)	Considered relevant persons under Regulation 11A(1) (d)	No catch history in blocks in last 5 years - not considered RP and engaged through WAFIC
Spanish Mackerel Managed Fishery (NT)	Considered relevant persons under Regulation 11A(1) (d)	Advised by NT fisheries to consult through NT Seafood Council rather than directly with license holders
Demersal Fishing License holders (NT)	Considered relevant persons under Regulation 11A(1) (d)	Advised by NT fisheries to consult through NT Seafood Council rather than directly with license holders
Pearl Producers Association	Considered relevant persons under Regulation 11A(1) (d)	Representative body for pearl license holders
Oil and Gas		
Australian Petroleum Production and Exploration Association (APPEA)	Considered relevant persons under Regulation 11A(1) (d)	Oil and gas industry representative body
Santos	Considered relevant persons under Regulation 11A(1) (d)	Titleholder of several exploration permits, production licences and retention leases in adjacent areas.

Stakeholder	Relevant to Activity	Relevance/ Reason for Engagement
Shell	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)	Titleholder of several exploration permits, production licences and retention leases in adjacent areas.
Conservation and Research		
Australian Institute of Marine Science	Considered relevant persons under Regulation 11A(1) (d)	Organisation concerned with conservation and research outcomes in the area.
CSIRO	Considered relevant persons under Regulation 11A(1) (d)	Organisation undertaking marine conservation research in the area
Western Australian Marine Science Institute	Considered relevant persons under Regulation 11A(1) (d)	Organisation undertaking marine conservation research in the area
Recreation		
Recfishwest	Considered relevant persons under Regulation 11A(1) (d)	Representative body for recreational fishing in WA
NT Guided Fishing Association	Considered relevant persons under Regulation 11A(1) (d)	Representative body for fishing tours in NT
Amateur Fisherman's Association of the NT	Considered relevant persons under Regulation 11A(1) (d)	Representative body for recreational fishing in NT
Others		
Hon Sussan Ley MP - Minister for Environment	Considered relevant persons under Regulation 11A(1) (d)	Relevant government portfolio holder
Hon Jonathon Duniam - Assistant Minister for Forestry and Fisheries	Considered relevant persons under Regulation 11A(1) (d)	Relevant government portfolio holder
Hon Greg Hunt - Minister for Industry, Innovation & Science	Considered relevant persons under Regulation 11A(1) (d)	Relevant government portfolio holder

Stakeholder	Relevant to Activity	Relevance/ Reason for Engagement
Darwin Port Authority	Considered relevant persons under Regulation 11A(1) (d)	Port operator potentially used for vessels.
Kimberley Port Authority (Port of Broome)	Considered relevant persons under Regulation 11A(1) (d)	Port operator potentially used for vessels.

4.3 Engagement Process

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

Engagement was undertaken concurrently for this EP and Montara 1,2,3 Well Abandonment Environment Plan (a separate EP). The information provided to relevant persons clearly delineated the scope and risks associated with each activity. It was decided to undertake concurrently to reduce stakeholder fatigue and avoid confusion of two engagement processes in such a close timeframe.

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

4.3.1 Sufficiency of Information

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

Table 4-4: Information provided to relevant persons

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

4.3.2 Reasonable period

Jadestone commenced consultation with relevant persons on 18 August 2021 with a general notification to all relevant persons.

Relevant persons were encouraged to provide comment within a 30-day period from receipt of any update or information (by 20 September 2021). Comments provided outside of this time were still considered and incorporated into the approvals process. The criteria used to determine if engagement was sufficient and no more follow up was required included:

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

This was subsequently assessed as:

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

4.4 Assessment of Relevant Persons Objections and Claims

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

For all responses received by Jadestone during the engagement, the merit of each of these responses was assessed. If responses weren't relevant for the Sea Eagle and Tahbilk-1 EP they weren't included in the Assessment of Merit (Table 4-5). Additional responses were received from WAFIC in relation to the Montara 1,2,3 EP and the merit of these responses were deemed not relevant for this EP, however for completion these have been included in the Sensitive Information Report. For minor/administrative changes these are noted in the Sensitive Information Report. Assessment of merit for all other responses is found in Table 4-5.

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

Table 4-5: Assessment of Merit

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
Australian Maritime Safety Authority	**Stakeholder Engagement** • To notify AMSA's Joint Rescue Coordination Centre (JRCC) (rccaus@amsa.gov.au, Ph 1800 641 792) 24-48 hrs prior to operations commencing and at cessation of operations • Australian Hydrographic Office (datacentre@hydro.gov.au) to be contacted no less than 4 working weeks prior to operations commencing for the promulgation of related notices to mariners. • To plan to provide updates to both the Australian Hydrographic Office and the JRCC on progress and, importantly, any changes to the intended operations	Jadestone considers this comment has merit and has been actioned through changes to the EP.	• Item included in implementation section of EP (Section 8.1.4) to ensure notification 48 hrs prior to operations commencing and at cessation. • Item included in implementation section of EP (Section 8.1.4) to ensure notification 4 working weeks prior to commencement. • Item included in implementation section of EP (Section 8.1.4) to ensure notification to AHO and JRCC.
	• Reminder on obligations to comply with COLREGs esp in regard to appropriate lights and shapes and ensuring their navigation status is set correctly in the ship's AIS unit	Comment has merit and has been actioned.	• Reference to COLREGs include under CM 006 and 056, showing commitment to ensure these obligations are met.
Australian Hydrographic Office (AHO)	• Acknowledged and noted will be included in charting information.	Noted	• No further action required.
Australian Fisheries Management Authority (AFMA)	• Unable to comment on individual proposals but noting resources for consultation with representative bodies or licence holders	Comment has merit and has been actioned.	• In accordance with this guidance, as part of Jadestone's standard approach to consultation the representative bodies for Commonwealth fisheries have been engaged with during the development of the EP.
Australian Institute of Marine Science (AIMS)	• Providing details of previous research undertaken of infrastructure in the area in conjunction with industry • Noting AIMS previous experience in modelling of fish production on the north-west shelf and contaminant monitoring	Services available relevant to activity and reviewed	• Jadestone reviewed the information provided but has chosen to undertake the monitoring activities under other contractual arrangements. Response provided to AIMS.
Department of Biodiversity,	• No comments on the activity	Noted	• No action required

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
Conservation and Attractions (DBCA)			
Western Australian Fishing Industry Council (WAFIC)	• Advised contacted all licence holders in Northern Demersal Scalefish fishery regarding proposal. Only one response which related to the concurrent EP process for abandonment of Montara field wellheads.	Noted	• No action required
Department of Mines, Industry Regulation and Safety (DMIRS)	• To provide DMIRS (petroleum.environment@dmirs.wa.gov.au) with pre-start notification confirming the start date of the proposed activity and a cessation notification to inform DMIRS upon completion of the activity • Ensure the EP includes information about the reporting of environmental incidents that could potentially impact on any land or water in State jurisdiction, including that any notifications or reports are to be sent to petroleum.environment@dmirs.wa.gov.au	Comment has merit and addressed in the EP	• Item included in implementation section of EP (Table 8-1, ID059) to ensure notification to DMIRS on commencement and cessation of activity. • Item included in Table 9-1 'Routine and incident reporting requirements'
Director of National Parks (DNP)	• Confirmed no authorisation required as outside AMP	Comment has merit and addressed in the EP	• EP has been drafted to include information on the AMPs in Section 3.4.4. With no AMP in the operational area there is not expected to be any impact from planned activities on the AMP.
	• 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	Comment has merit and addressed in the EP	• Triggered consultation item included to notify AMP DG if any change to planned activity that results in change in risk to AMP (**Table 8-2**).
	• Confirmed DNP do not need any further notification on progress unless change of activity results in overlap with or new impact to a marine park or for emergency responses	Comment has merit and has been included in the EP	• Notification of DNP in the event of a oil or gas pollution incident has been included in Table **8-2** of the EP.
	• DNP should be made aware of oil/gas pollution incidences which occur with a marine park or are likely to impact on a marine park as soon as possible. Notification should be provided to the 24 hour Marine Compliance Duty Officer on 0419293465. Notification should include: o Titleholder details	Comment has merit and addressed in the EP	• EP has been drafted to include information on the AMPs in Section 3.4.4. With no AMP in the operational area there is not expected to be any impact from planned activities on the AMP.

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
	○ Time and location of the incident (including name of marine park likely to be effect) ○ Proposed response arrangement as per the Oil Pollution Emergency Plan ○ Confirmation of providing access to relevant monitoring and evaluation reports when available and ○ Contact details for the response coordinator		
Department of Transport	• There are references in the OPEP to the HMA being the Department of Transport (DoT) Marine Safety General Manager or proxy. This is no longer the case and the updated State Hazard Plan – Maritime Environmental Emergencies outlines the new arrangements. Please ensure the OPEP accurately reflects the correct arrangements.	Comment has merit and addressed in Appendix A7 of the OPEP.	• Appendix A7, Section 4.3 (now Section 5.3) has been amended to read "If a Level 2/3 spill arises within, or has potential to enter Western Australian State waters, the HMA (DoT Chief Executive Officer or delegate) will take on the role as the State Maritime Pollution Coordinator (SMPC) and DoT will take on the role as a Controlling Agency."
	• How are the different incident level classifications defined and what process is in place for determining escalation and de-escalation?	Comment has merit and addressed in Appendix A7 of the OPEP.	• A section was missing in Appendix A7 from the Jadestone Incident Management Team Response Plan (JS-70-PLN-F-00008) which describes the response levels, escalation and de-escalation processes. This has now been included in Appendix A7 as Section 4.
	• Section 5 states that 'Shoreline locations that were identified as priority protection areas based on modelling thresholds described in the EP are shown in Figure 5-1', however, this figure doesn't appear to show anything – please clarify.	Comment has merit and addressed in OPEP.	• The locations of the PPA's are identified in Figure 5-1, but may not have been very clear. A corresponding list has been added to Section 5 (and also appears in the Quick Reference Information Section as the beginning) to confirm this list.
	• Which waste contractor will be utilised and have shoreline clean-up waste volumes been considered? If so, what are they?	Comment has merit and	• Jadestone have a contract in place with North West Alliance in Karratha and Cleanaway in Darwin. Shoreline clean-up volumes have been provided in Table 13-2 (Resource Rationale for

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
		addressed in the OPEP.	Shoreline Clean-up Personnel Per Priority Receptor). Please note, as mentioned in Section 13.3, these volumes are based on stochastic modelling results and should a spill occur, not all receptors would be contacted. These volumes are therefore very conservative.
	• Does Jadestone have a system in place to access all the relevant emergency management documents and templates that may be required in a response? If so, please provide some details.	Comment has merit and addressed in the Appendix A7 of the OPEP.	Yes, the following sentence has been added to Section 7 of Appendix A7 of the OPEP for clarity. • "Jadestone utilises an electronic platform to provide all IMT personnel with universal access to key emergency management documents that may be required in the event of a spill (e.g. IMTRP, OPEPs, ICS forms). This system is also directly linked to Jadestone's Electronic Document Management System (EDMS)."
	• There does not appear to be any reference to the DoT Duty Officer number (08 9480 9924). Please confirm where this is referenced.	Comment has merit and addressed in the OPEP.	The DoT Duty Officer number, and all emergency contact numbers are held within the Incident Management Contact List which is maintained and available on the Jadestone intranet page. This is referred to in the Jadestone Incident Management Team Response Plan (JS-70-PLN-F-00008) which is used in the event of an emergency incident, but JSE have added the following sentence to Section 9.3 (Notifications) to make this clear in the OPEP. • "Jadestone store and maintain an Incident Management Contact List on the Jadestone intranet page which contains the contact numbers for external organisations and facilities required to be contacted in the event of an

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
			emergency. This includes the organisations to be contacted in Appendix A6: Regulatory Notifications.”
	• Are there any training requirements for field responders? And if so, what are these?	Comment has merit and addressed in the OPEP.	• Jadestone have contracts in place with AMOSC and OSRL to obtain access to suitably trained field response personnel to assist with implementing the response strategies for this OPEP.
	• Section 11.2.1 outlines the activation of the State Response Team (SRT) through AMSA. Please note that SRT resources are managed by DoT.	Comment has merit and addressed in the OPEP.	• That sentence has been amended to read as follows “If conditions and equipment are proving successful, then further activity will be implemented with vessels on contract to Jadestone Energy using booms and pumping equipment from AMOSC, (AMSA) National Plan equipment, OSRL equipment, and personnel from the AMOSC core group, OSRL and National Response Team personnel through AMSA and State Response Team personnel through WA DoT.”
	• Appendix A7 contains references to old ‘WestPlans/State Hazard Plans’ that are no longer current. Please ensure that references to external documents is accurate and up to date.	Comment has merit and addressed in the OPEP.	• Section 5.3 (was Section 4.3), has been amended to remove all instances of the old State Hazard Plans and West Plan (MOP).
	• Appendix A7, Section 8 outlines the 11 personnel required to be provided to DoT in the event of a cross-jurisdictional incident. However, the positions do not reflect the positions as outlined in the DoT Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (July 2020). Please amend.	Comment has merit and addressed in the OPEP.	• The titles of these positions have been reflected to match those listed in the DoT Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (July 2020).
	• There are references to old terminology, for example ‘tiers’, which is no longer used. Please ensure the arrangements are aligned to current State arrangements.	Comment has merit and	• All relevant references to ‘tiers’ have been changed to ‘levels’.

Stakeholder	Stakeholder Concern, Objection or Claim	Jadestone Assessment of merit	Jadestone Response
		addressed in the OPEP.	

5. EVALUATION OF ENVIRONMENTAL IMPACTS AND RISKS

As required by Regulation 13(5) of the OPGGS(E) Regulations, this section of this EP provides an outline of Jadestone Energy's approach to the evaluation of impacts and risks due to the VBA (Section 5.1), and the outcomes of the impact and risk assessment undertaken (Section 5.6).

5.1 Assessment Method

The environmental impacts and risks associated with the proposed VBA in production licence AC/L7 and AC/L8 have been assessed using the Jadestone Impact and Risk Management Framework (JS-70-PR-F-00009) and methods consistent with HB 203:2012 and AS/NZS ISO 31000:2009.

'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 a planned event associated with the activity.

'Risk' is evaluated in terms of likelihood and consequence. Likelihood is defined as the probability or frequency of the unplanned event occurring, and 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 the event associated with the activity.

The assessment methodology provides a framework to demonstrate:

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

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

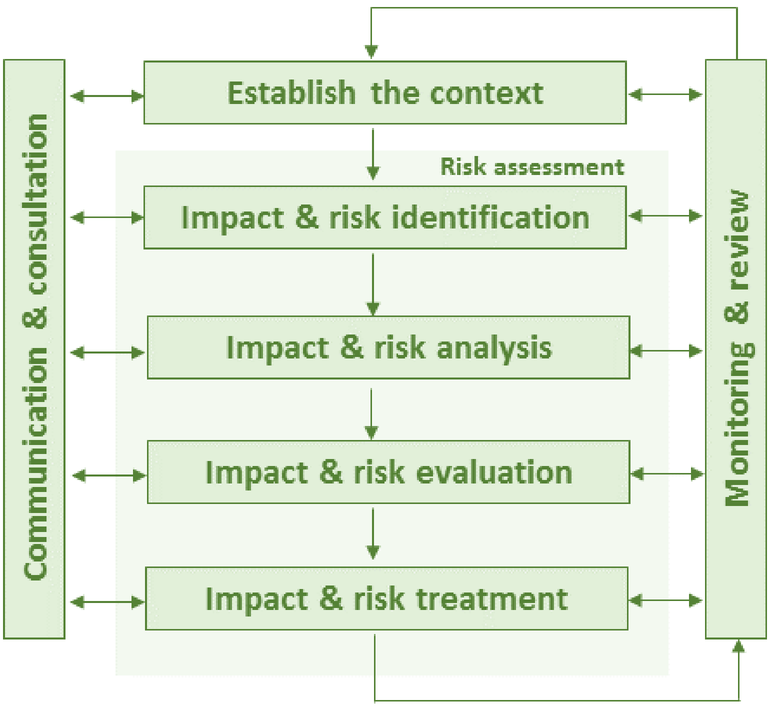


Figure 5-1: Impact and risk evaluation process

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

5.2 Risk Assessment

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

- The Risk Workshop was 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 and performance reports;
- Consultation with 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 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; and
- Determination of the residual impact/risk ratings (Section 5.5).

5.2.1 Identification of control measures

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

- **Legislation, Codes and Standards** – identifies the requirements of legislation, codes and standards which are to be complied with for the activity;
- **Good Industry Practice** – identifies further engineering control standards and guidelines which may be applied over and above that required to meet the legislation, codes and standards;
- **Professional Judgement** – uses relevant personnel with the knowledge and experience to identify alternative controls. When formulating control measures for each environmental impact or risk, the 'Hierarchy of Controls' philosophy (see below) is applied. This Hierarchy is used in the industry to minimise or eliminate exposure to impacts and risks;
- **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 Energy's HSE Policy; and
- **Societal Values** – identifies the views, concerns and perceptions of relevant persons and addresses their concerns as gathered through the ongoing consultation process.
- The Hierarchy of Control philosophy is used by Jadestone Energy to help evaluate potential management controls to ensure alternative reasonable and practicable solutions have not been overlooked:
- **Elimination –** it is preferable to remove the impact or risk altogether;
- **Substitution –** substitute the impact or risk for a lower one;
- **Engineering control measures** – use engineering solutions to prevent or detect the hazard or control the severity of consequences/ impacts;
- **Administrative control measures** – use of procedures, JHA etc. to assess and minimise the environmental impacts or risks of an activity; and

- **Protective** – use of protective equipment (e.g. the use of appropriate containers).

5.2.2 Risk ranking process for unplanned events

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

Table 5-1: Jadestone Qualitative Risk Matrix

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

Consequence levels for unplanned 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 **5-2**).

Table 5-2: Definition of consequence level

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

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

Table 5-3: Definition of likelihood levels

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

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

5.3 Impact Assessment

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

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

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

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

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

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

5.4 Demonstration of Acceptability

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

Table 5-4: Jadestone Energy's acceptability matrix

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

5.5 Demonstration of as Low as Reasonably Practicable (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 impact 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 adoption/rejection provided.

Where the residual rank is **HIGH** or **EXTREME,** the risk is not considered to be acceptable and the activity cannot continue as described. Further control measures must be applied such that an acceptable risk is demonstrated; and the residual risk is reduced to 'Medium' or lower as described above. The activity should not be carried out if the residual risk remains 'High or Extreme'.

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

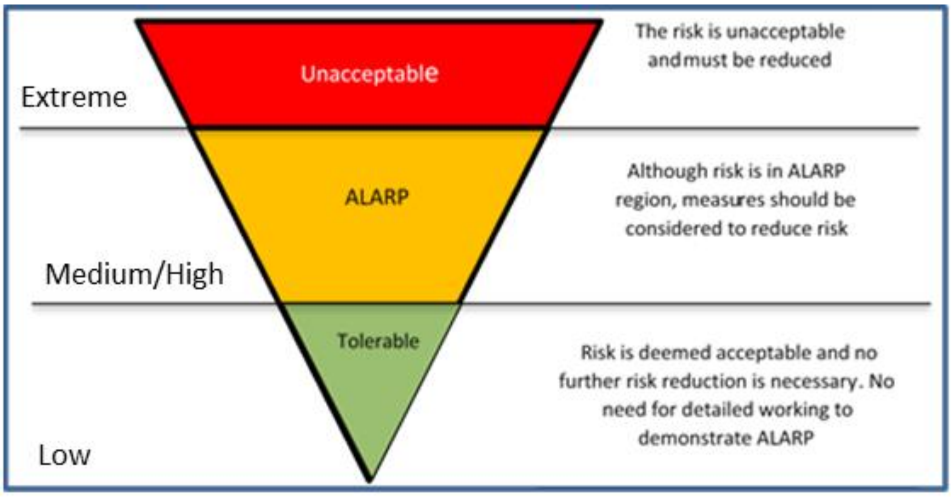


Figure 5-2: ALARP triangle

5.6 Evaluation Summary

An impact and risk assessment was conducted by Jadestone Energy in August and September 2021 to reflect the Jadestone Energy 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, emergency response and environmental personnel.

The assessment process undertaken by Jadestone Energy for the VBA identified six planned aspects and six unplanned hazards and their associated environmental impacts and risks that will or may occur during the activities.

The output of the assessment process is documented in this EP and summarised in Table **5-5** .

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

Aspect/Hazard	Residual Assessment
Planned activities	
1. Physical presence – other users, marine fauna, seabed disturbance	Acceptable
2. Light emissions	Acceptable
3. Noise emissions	Acceptable
4. Atmospheric emissions	Acceptable
5. Operational discharges	Acceptable
6. Spill response activities	Acceptable or Low
Unplanned events	
1. Marine pest introduction	Medium
2. Interaction with fauna	Low
3. Unplanned release of solids	Medium
4. Unplanned release of (non-hydrocarbon) liquids	Low
5. Worst case crude oil spill	Medium
6. Worst case spill diesel	Low

5.7 Risk Assessment Approach for Worst-case Hydrocarbon Spill Response

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

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

5. Determine priority receptors; and
6. ALARP and acceptability evaluation for spill response activities.

5.7.1 Determine Oil Spill Modelling Thresholds

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

5.7.2 Determine the RISK EMBAs

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

5.7.3 Determine the impact threshold

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

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

5.7.4 Sensitive Receptor Identification

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

Sensitive receptor assessment considers:

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

- Listed species status and predominant habitats (surface versus subsurface): critically endangered/ endangered species, listed species, surface species (e.g. reptiles and birds) and subsurface species (e.g. mammals, sharks and fish); and
- Recovery Plans, Conservation Advice for threatened species.

Once the sensitive receptors within the RISK EMBA have been identified, the potential oil pollution risks are described and evaluated (refer Sections 7.6 and 7.7). In addition, the environmental risks from implementing spill response activities are described and evaluated.

Sensitive receptors are further evaluated by considering what values are contained within them when determining appropriate spill response strategies (refer Table 7-8). 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 RISK EMBA that are considered the highest risk from the worst-case credible oil spill scenario and are common across ALL modelled scenarios and seasons, that is, the priority receptors.

5.7.5 Priority Receptors

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

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

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

- Sensitive receptor within RISK EMBA; AND
- >5% probability of shoreline contact based on modelling results; OR
- Has the largest volume of floating oil shoreline contact; OR
- Has the shortest timeframe to floating oil shoreline contact; OR
- Vulnerability to impact from hydrocarbons – e.g. mangroves are more vulnerable than intertidal rock pavement; known turtle nesting beaches are vulnerable during nesting periods[1]*;* AND
- Any other area of interest within the RISK EMBA including areas that have a high social value or are a concern raised through stakeholder consultation (refer Section 4).

It is logical and best practice to focus spill response planning and strategies on those locations most likely to be contacted in the credible worst-case oil spill scenario; that is, the scenario that represents the highest risk across all modelled scenarios covering any season, rather than attempt to cover the full spatial extent of the

[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.

RISK EMBA. This allows for flexibility in response planning as plans are developed for environmental resources at greatest risk of being contacted by an oil spill and can be adapted for any scenario that occurs.

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

5.7.6 ALARP and Acceptability Evaluation for Spill Response

Jadestone Energy 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 that effective control measures exist to mitigate environmental risks and impacts to a level that is ALARP and acceptable. This process is depicted in Figure **5-3**.

The process promotes a clear link between the nature and scale of the maximum credible worst-case spill scenario and the identified 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 **5-4**).

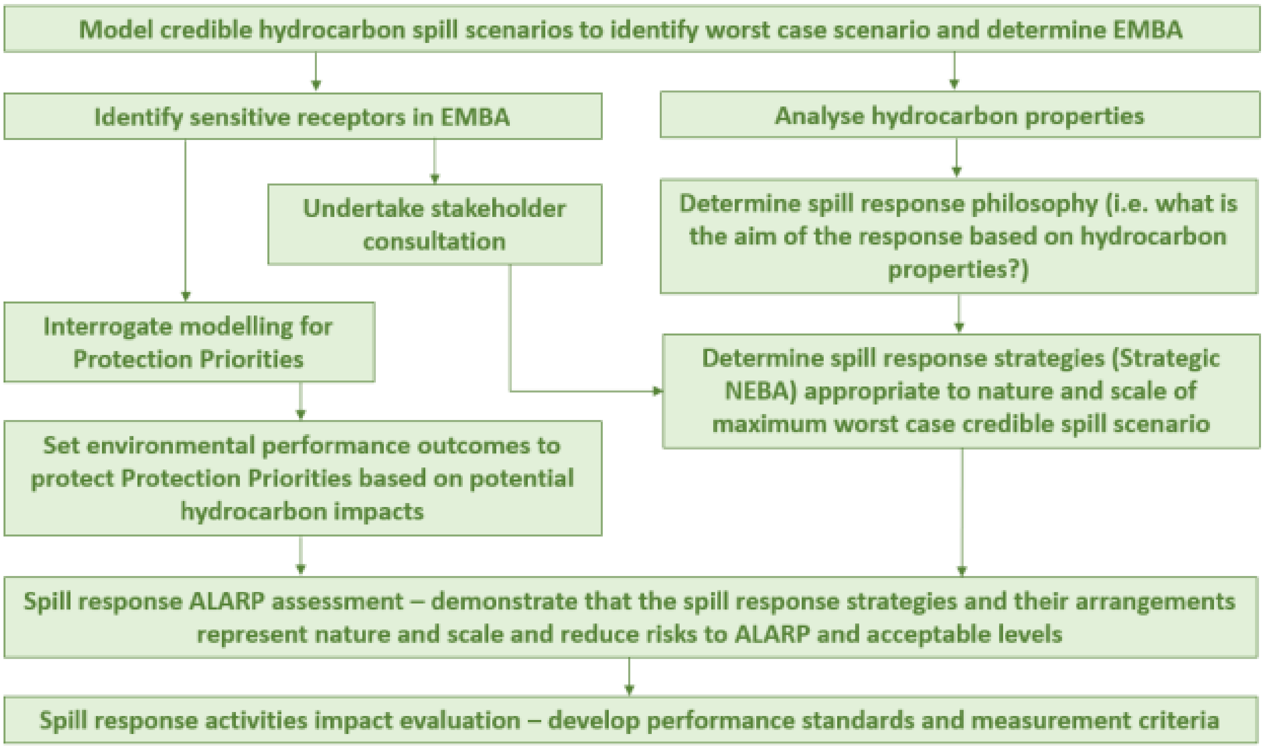


Figure 5-3: Spill scenario evaluation and ALARP determination process

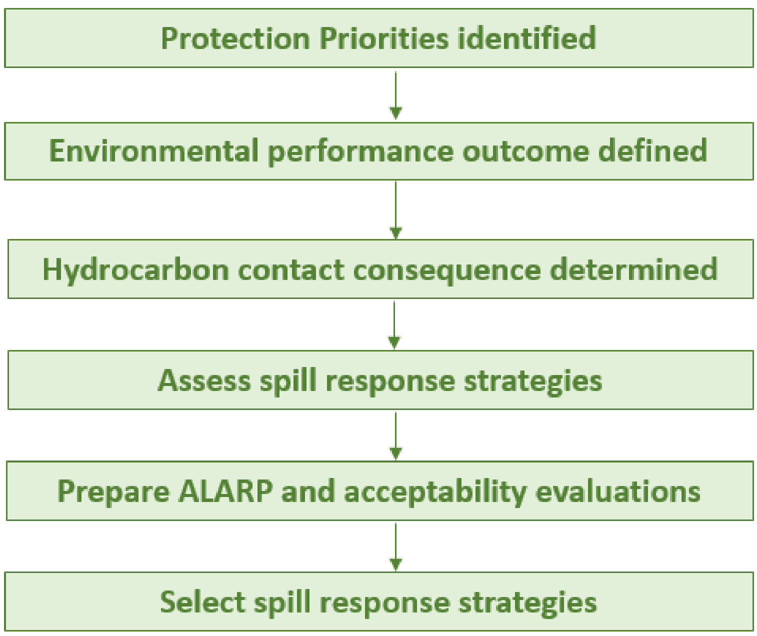


Figure 5-4: Spill control analysis and ALARP determination process

6. ASSESSMENT – PLANNED ACTIVITIES

6.1 Physical Presence

6.1.1 Description of aspect

Physical presence	The wellheads remain in situ for the duration of the EP with activities occurring at the surface and seabed. No additional seabed disturbance will occur from their presence, and they are marked on nautical charts. The remote monitoring system will not require any equipment installed on the seabed The presence of vessels will be intermittent over the life of the EP with the vessel on location for a maximum of 2 days in 2022 (at the earliest) for the installation activity, and for <0.5 days within every 12-week period for visual observations until the system is installed. Thereafter, annual vessel visits of <24 hours at each well location are planned. A 500 m Petroleum Safety Zone (PSZ) is present around the vessel when undertaking VBA at the wellhead locations (other than the regular vessel-based inspections undertaken for <0.5 days each time) to ensure restricted and controlled vessel access within close proximity of the facilities. The physical presence of the vessel and temporary 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 wellhead presence will also prevent trawling activities over the infrastructure for the duration of the EP due to the snagging hazard. The physical presence of infrastructure may alter marine fauna behaviour such as avoidance or attraction. The installation of monitoring equipment and ROV activities will result in a temporary increase in turbidity close to the seabed but no equipment is planned to be installed on the seabed. Marine growth removal during annual ROV surveys would be minimal and would result in removal of small parts of the surface community from the wellheads and monitoring system, and some subsequent seabed disturbance as the marine growth settles. The area alongside the wellheads has previously been disturbed (i.e. during previous drilling activities) No vessels anchor within the Operational Area unless in emergency. Helicopters operating at low altitude during ascent from and descent to the helidecks or conducting in-field observations also have the potential to disrupt the behaviour of marine fauna due to the effects of noise. Avoidance behaviours in response to vessel and helicopter noise are assessed separately in Section 6.3.

6.1.2 Impacts

Sensitive Receptor	Impact description
Social receptors	
Fishing Shipping	Interaction between the 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 wellheads have been present since 1990 (Tahbilk) and 2008 (Sea Eagle) and marked on nautical charts. In the immediate vicinity, the greater 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 Operational Area or its immediate vicinity. The wellheads and PSZ (when established for VBA occurring on location) represents 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 vessels. The temporary presence of the 500 m PSZ exclusion area around the wellheads during VBA, and the movement of vessels, present obstacles for shipping traffic in the region and are potential navigational hazards and a collision. The Operational Area is located northwest of the nearest designated shipping route with heavy vessels utilising the Osborne Passage in the northern part of

Sensitive Receptor	Impact description
	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 3.6 and Figure 3-7 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, cetaceans	Fauna most susceptible to impacts from the temporary physical presence of vessels and helicopters include birds, and cetaceans. Migratory species such as seabirds may experience localised and short-term effects through behavioural changes; such as resting or roosting on the vessel on location during monitoring system installation 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, causing injury/mortality, may cause a minor disruption to a small proportion of the population. The only known biologically important areas (BIAs) that overlap the Operational Area are the most northern part of the whale shark foraging BIA as described in Section 3. However, only occasional individuals are expected to traverse the area 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 and foraging marine fauna including whale sharks and pygmy blue whales, to avoid the vessels may be required, however this impact is considered negligible given the large navigable area available and the relatively small Operational Area. Impacts to marine fauna are considered ***negligible***.

<table>
<tr><th>Sensitive Receptor</th><th colspan="2">Impact description</th></tr>
<tr><td>Benthic communities</td><td colspan="2">The installation of monitoring equipment may impact a highly localised area through turbidity during ROV activities at installation and annual surveys. The Operational Area is distant from key habitats of ecological importance such as coral reefs or shoals (detailed in Section 3), the nearest being Goeree and Vulcan Shoals located approximately 28 km to the southwest. Such habitats will therefore not be disturbed by VBA.

There are no sensitive or unique marine habitats in the area and the diversity and coverage of epibenthos is low (ERM 2011).

Given the widespread distribution and abundance of benthic communities within the surveyed areas and the NW Marine Bioregion, the consequence to benthic communities will be highly localised, negligible, and reversible change to a very small proportion of the of the overall benthos.

The presence of subsea infrastructure (wellheads) 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. As shown in Figure 2-1 and Figure 2-2, the wellheads have some marine growth on them which also attracts fish, but the coverage that is present has accumulated over time (20-30 years) and is minimal, probably due to the water depths and distance from other areas of high benthic coverage. Installation of additional monitoring equipment will result in colonisation with species likely sourced from the existing colonies on the wellheads. Marine growth may be removed during ROV surveys through water blasting resulting in some removal of the communities from the wellheads, and slight disturbance to the seabed as the marine growth debris settles on the seabed.

Impacts to benthic communities are considered negligible.</td></tr>
<tr><th colspan="2">Consequence</th><th>Ranking</th></tr>
<tr><td colspan="2">Negligible</td><td>Acceptable</td></tr>
</table>

6.1.3 Environmental performance

Aspect		Physical presence		
Performance outcome		**Recreational and commercial fishers, and shipping traffic, are aware of exclusion and cautionary areas and are not significantly disrupted. Seabed disturbance limited to planned activities and defined locations**		
ID	**Management control**	**Performance standard**	**Measurement criteria**	**Responsible**
001	Vessel navigational and communication equipment installed, maintained and operated in alignment with AMSA requirements	The vessel when alongside the wellheads will be alongside facilities already charted on Australian Hydrographic Office (AHO) nautical charts. A new PSZ will be temporarily gazetted around the wellhead when undertaking activities, other than during in-field observations (described in Section 2.5.1).	Australian Hydrographic Service (AHS) Chart Communications with AHO	Marine Superintendent
002		Navigation and communication equipment on the vessel comply with Safety of Life at Sea (SOLAS) requirements	PMS records show evidence of fully functional navigation and communication equipment maintenance	Marine Superintendent
003		ARPA with integrated AIS system are located on the vessel	CCR panel.	Marine Superintendent
004	Jadestone Energy Stakeholder Consultation procedure (JS-70-PR-I-00034) details consultation requirements to ensure other marine users are aware of the activity	Consultation undertaken with relevant stakeholders as described in Section 4. Other users who may be present in the area will be advised of VBA through: • Notice to Mariners issued by the AHS prior to mobilisation and following demobilisation; and • Cautionary areas delineation on Admiralty Chart.	Stakeholder communication records • Records confirm that AHS have received notification of activity commencement prior to mobilisation and following demobilisation of the vessel. • Records confirm that Cautionary area is delineated on Admiralty Chart	HSE Manager
005		Rights of commercial fishers to operate in the Cautionary Area (as delineated on Admiralty charts) will be communicated to relevant vessel personnel.	Vessel induction records include awareness of rights for commercial fishers.	Country Manager

6.1.4 ALARP assessment

Based on 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 VBA to activities undertaken by relevant persons, as well as impacts to seabed. Additional controls considered but rejected are detailed below. The potential impacts are considered Acceptable (negligible to minor impacts). No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
Reduce number or remove vessel and helicopter use or reduce 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 to ensure ongoing monitoring of the wellheads at regular intervals. The Operational Area is located outside of intensive shipping fairways and is not positioned in highly prized fishing habitat.
Installation of an active well monitoring system instead of the passive	Substitution	Yes	No	This system would require a longer period on location for installation and regular vessel visits to site for approximately 2 days every two weeks. This would therefore increase the potential for vessel interaction with third parties.
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 vessel are undertaken. Additional procedures would provide no further benefit.
Additional vessels on location to inform third party vessels in the vicinity of the facility	Engineering	No	No	The additional cost of 24/7 vessel presence in field during each of the VBA is considered grossly disproportionate to the benefit gained given the activity occurring at the nearby Montara facility, and the ongoing presence of the wellheads is marked on charts. The radio room on the vessel is manned 24/7 allowing contact to be made with 3rd party vessels in the vicinity as required. If radio from the vessel cannot raise the vessel, calls are made to the Home Affairs Office for their control.

6.1.5 Acceptability assessment

The potential impacts of physical presence from the vessels during VBA are considered 'Acceptable' in accordance with Section 5, 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 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Social acceptability	Stakeholder consultation has been undertaken (Section 4), and no stakeholder concerns have been raised with regards to physical presence as denoted by the PSZ and preclusions within it. Impacts beyond temporary exclusion of areas local to the activity are not predicted.
Environmental context	While the presence of vessels during VBA 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. There have been no concerns raised regarding the presence of the wellheads over the previous 20-30 years which are marked on charts. The sites around the wellheads are already disturbed. The area of seabed impacted by the increased turbidity and marine growth removal, is negligible in size, with recovery predicted through local recruitment from adjacent unimpacted areas. Previous surveys in the area show soft sandy sediments with sparse benthic communities typical of the greater NW Bioregion. Impacts to protected species are negligible with no permanent or population effects, given the large navigable area available and the relatively small Operational Area. The disturbed seabed is negligible in comparison to the vast size of soft substrata habitats spanning the North-West Marine Bioregion. The potential impact is considered acceptable after consideration of: • Potential impact pathways: the pathways and consequences from the temporary localized presence vessels and monitoring equipment are assessed in Section 6.1.1; • Preservation of critical habitats: localised disturbance is remote from Protected Areas; • Assessment of key threats as described in species and Area Management/ Recovery plans: see below under 'Conservation and Management Advice'; • Consideration of North-West Bioregional Plan: no impacts beyond 'negligible' (localized disturbance) predicted from the physical presence of the vessel to KEFs, shipwrecks/ other heritage places or protected species that are listed as values within the NW Bioregional Plan; and • Principles of ecologically sustainable development: impacts are fully recoverable, biological diversity and ecological integrity are not impacted.
Conservation and management advice	No management plans identified physical presence as described above as being a threat to marine fauna or habitats. Jadestone Energy has had regard to the representative values of the protected areas within the EMBAs, and the respective management plans and other published information. Impacts from physical presence will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state marine parks. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable.

6.2 Light emissions

6.2.1 Description of aspect

Artificial light	Navigational and safety lighting on the vessel will generate light emissions that may potentially affect marine fauna behaviour. Lighting typically consists of bright white (metal halide, halogen, fluorescent) lights attenuating with distance. The ROV will be used during the monitoring and installation activities and it will require the use of spot lighting while it is underwater working. Lighting will typically consist of bright white (i.e., metal halide, halogen, fluorescent) lights.

	Direct light spill on surface waters will be limited to the area directly adjacent to the vessel as it operates within the Operational Area with the longest duration being ~2 days during monitoring system installation and then during annual ROV monitoring.

6.2.2 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 drilling program 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. 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 VBA will affect a small portion of the vast biologically important foraging area for whale sharks. However, impacts at a population level are not expected due to the limited duration of the activities (2 days maximum at each wellhead, and short periods of time (24hrs) intermittently during the EP duration). Light impacts to plankton, fish, sharks (including whale sharks) are considered ***negligible.***
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

Sensitive Receptor	Impact description	
	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). National Light Pollution Guidelines for Wildlife have also been published (Commonwealth of Australia 2019). According to the National Light Pollution Guidelines for Wildlife, a 20 km threshold provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings demonstrated to occur at 15-18 km and fledgling seabirds grounded in response to artificial light 15 km away. The effect of light glow may occur at distances greater than 20 km for some species and under certain environmental conditions (Commonwealth of Australia 2019). The closest turtle nesting habitat to the Operational Area is significantly beyond this distance as Cartier Island is approximately 106 km north-west of the Montara field. The nearest BIA boundary for marine reptiles (green turtle) is 92 km west of the Operational Area. As a result, impacts to adults and hatchlings are expected to be ***negligible***. 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 vessel. 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 nearby Montara facility may therefore attract seabirds which in turn would potentially be attracted to the vessels undertaking VBA at the wellheads. This additional lighting 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 106 km north-west of the locations 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 vessel is not considered to have an impact on marine mammal behaviour.	
Consequence		**Ranking**
Negligible		Acceptable

6.2.3 Environmental performance

Aspect		Light emissions		
Performance outcome		**Activity lighting managed in accordance with OHS requirements**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
006	Vessel navigation aids and equipment meet regulatory and safety requirements by aligning with Navigation Act 2012	Vessels will comply with maritime safety and navigation requirements including: • International Regulations for Preventing Collisions at Sea 1972 (COLREGS); • Chapter V of Safety of Life at Sea (SOLAS); • Marine Order 21 (Safety of navigational and emergency procedures) (as appropriate to vessel class); • Marine Order 30 (Prevention of collisions) (as appropriate to vessel class)	PMS confirms navigational equipment is maintained to regulatory and safety standards	Vessel Master

6.2.4 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 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. VBA cannot be shut down on a daily basis due to the process required to install monitoring equipment, and there would be a >100% increase in time taken to complete the activities resulting in a doubling of costs and the requirement to anchor or standby on location overnight with navigational and safety lighting on anyway to ensure vessel is visible to other users. Light from the vessel 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.
Installation of an active well monitoring system instead of the passive	Substitution	Yes	No	This system would require a longer period on location for installation and regular vessel visits to site for approximately 2 days every two weeks. This would therefore increase the light emissions from the activity significantly over the course of each year.
Add filters to lights or re-design placement/ positioning	Engineering	No	No	Lighting has been positioned such that maximum illumination of work surfaces within asset structures is achieved. Costly and considered grossly disproportionate to any gain when considering the distances that the Operational Area is from turtle or seabird nesting areas.
Reduce usage of lighting in peak sensitive receptor windows	Isolation	No	N/a	To ensure lighting meets health and safety requirements, lighting is required throughout the day/ night for the duration of the activities. To isolate usage such that lights were not used during sensitive receptor windows would create a non-conformance with health and safety requirements.
None identified	Administrative	N/a	Na/a	N/a

6.2.5 Acceptability assessment

The potential impacts due to light emissions are considered acceptable in accordance with Section 5, 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 8 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 4), 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 vessel, 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 and the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia 2019). Jadestone has had regard to the representative values of the protected areas within the RISK EMBAs, and the respective management plans and other published information. Impacts from 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 B) and considered acceptable.

6.3 Noise Emissions

6.3.1 Description of aspect

Noise emissions	Throughout the VBA, low intensity underwater noise of a continuous nature will be emitted from the vessel intermittently for the duration of each VBA. Noise will be generated from a vessel engine rotation of propellers and by machinery operated on the decks and working areas of the vessel as well as from ROVs. Marine operations conducted on the decks and working areas of the vessel introduce strong sounds of varying characteristics into the water column, largely at low frequencies. There are no noise emissions associated with the remote monitoring system itself. Vessel noise varies with the size, speed, and engine type and the activity being undertaken. The loudest noise level from vessels are where thrusters are used to maintain position which will be required during the VBA. Noise levels for a range of vessels have been measured at 164-182 dB re µPa at 1 m (Wyatt 2008). Vessel noise is expected to decrease rapidly from the source. The extent of helicopter noise impacts is limited to take off and landing at the vessel as they do not fly close to the ocean surface (typical cruising height of between approximately 1,000 to 1,400 m). 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 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). As underwater sound levels are dependent on the primary (noisiest) sound source rather than being strictly additive, and since ROV operations will be undertaken from a vessel they will make little contribution to the overall noise emissions associated with vessel activities, as described above and are not risk assessed further. A summary of anthropogenic noise sources associated with the VBA, and natural underwater noise sources, are provided in Table **6-1** below.

Table 6-1: 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 VBA		
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).
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).

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

Sensitive Receptor	Impact description
	Although there are likely to be transient whales passing through the Operational Area (refer Section 3), 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 63 km at its closest point from the Operational Area and is therefore not expected to be impacted by noise from vessels and helicopters. Impacts to cetaceans from underwater noise generated by VBA 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). The Recovery Plan for Marine Turtles in Australia (2017) identifies noise interference as a threat to marine turtles and suggest the impact of noise on turtle stocks may vary depending on whether exposure is acute or chronic. This activity will result in chronic noise rather than acute, from the vessel movements. 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. The Operational Area does not intersect any known inter-nesting areas and is 106 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***). 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 Operational Area.
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 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. The whale shark foraging BIA intersects the Operational Area. Approved Conservation Advice for

Sensitive Receptor	Impact description
	Rhincodon typus (whale shark) (2015) does not identify noise interference as a threat to the species. Elasmobranchs (rays, skates, sharks) rely on low frequency sound to locate prey (Myrberg 1978). The large hearing structure of the whale shark will be most responsive to long-wave, low-frequency sound (Myberg 2001) in the range of 20 and 800 Hz. Elasmobranchs do not have swim bladders and are not typical hearing specialists (Baldridge 1970). 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 the VBA 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

6.3.3 Environmental performance

Aspect		Noise emissions		
Performance outcome		**Controls implemented to minimise potential harmful impacts to marine fauna from noise**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
007	Vessels will comply with EPBC Regulations 8.05 and 8.06	Support Vessel Masters will comply with relevant parts of EPBC Regulation (2000): Reg. 8.05 & 8.06 respectively, where safe to do so: Within the caution zone for a cetacean (including a calf) (within 300 m of a cetacean), the Vessel Master must operate the vessel at a constant speed of less than 6 knots and minimise noise; and If a calf appears within an area that means the vessel is then within the caution zone of the calf, the Vessel Master must immediately stop the vessel and turn off the vessel's engines or disengage the gears or withdraw the vessel from the caution zone at a constant speed of less than 6 knots. The above requirements will also apply to whale sharks if they are sighted within 300m of the vessel.	Vessel Masters provided and required to operate in accordance with the 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) Induction includes whale shark avoidance requirements	Vessel Master
008	Helicopters will comply with EPBC Regulations 8.07 as per Jadestone's Aviation Standard (JS-83-PR-G-00010)	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 Contractors provided Jadestone's Aviation Standard (JS-83-PR-G-00010) Incident reports record non-compliances with EPBC Regulations 2000 – Part 8 Division 8.1 (interacting with cetaceans)	Helicopter pilot
009	Vessel machinery is certified and maintained in	Vessel machinery is maintained in accordance with vessel class requirements.	PMS provides status of maintenance	Vessel Master

Aspect		Noise emissions		
Performance outcome		**Controls implemented to minimise potential harmful impacts to marine fauna from noise**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
	accordance with Flag State regulations and vessel class			

6.3.4 ALARP assessment

Based on 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 Acceptable 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 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.
Installation of an active well monitoring system instead of the passive	Substitution	Yes	No	This system would require a longer period on location for installation and regular vessel visits to site for approximately 2 days every two weeks. This would therefore increase the noise emissions from the activity significantly over the course of each year.
Provide additional muffling on machinery, or design to reduce noise emissions	Engineering	No	No	Machinery is generally designed with human health hearing requirements taken into consideration, reducing operating noise to as low as efficiently and cost effectively as possible.
Do not operate noisy machinery in areas of sensitivity	Isolation	No	N/a	The 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	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.
Undertake site specific acoustic modelling as per Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (2015))	Administrative	No	No	Additional cost to undertake site specific acoustic modelling to increase the knowledge of potential impacts. However, noise emissions from these activities are already well documented and the operational area is not within critical habitat for humpback whales
Develop a noise management plan as per approved Conservation Advice for	Administrative	No	No	Additional cost to develop a noise management plan for an activity that is low risk to marine fauna due to the

Megaptera novaeangliae (humpback whale) (2015)).				noise emissions and the activity is not within critical habitat for humpback whales.
Undertake activity in alternate season to potentially further reduce exposure to marine fauna from noise emissions e.g. outside of turtle nesting and whale migration periods	Substitution	Yes	No	Activity timing can be any time of the year. As the impacts are localised and no significant impacts predicted to marine fauna/habitats or socio- economic receptors, any restriction on timing results in an unacceptable cost for little environmental benefit. Any restriction on activity timing would not be considered reasonably practicable and would not achieve any significant environmental benefit by being seasonally specific.

6.3.5 Acceptability assessment

The impacts due to machinery, ROV, helicopter and vessel noise are considered acceptable in accordance with Section 5, 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	Key Jadestone management system controls include EPBC Regulations (2000) pertaining to vessel and helicopter operations. Jadestone's HSE Policy objectives are met. Section 8 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 4), 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 indicates that noise will not result in death, injury or significant behavioral effects to marine fauna The potential impact is considered acceptable after consideration of: • Potential impact pathways: the pathways and consequences from the temporary localised ROV and engine sources from the vessel are assessed in Section 6.3.2; • Preservation of critical habitats: remote from Protected Areas or aggregations of noise sensitive receptors; • Assessment of key threats as described in species and Area Management/Recovery plans: See 'Conservation and management advice' below; • Consideration of North-West Bioregional Plan: vessel and offshore mining noise is regarded 'of potential concern' to multiple conservation values (see Section 6.3.2). As such, minimisation through maintenance and avoidance through application of EPBC Act Reg 8.05 and 8.06 are aligned with the objectives of the Plan; and • Principles of ecologically sustainable development (ESD): no impacts from noise sources beyond' negligible' to biological diversity or ecological integrity, no irreversible damage.
Conservation and management advice	Noise interference is identified as a threat in: • The Recovery Plan for Marine Turtles in Australia (2003) • Approved Conservation Advice for M. novaeangliae (Humpback Whale) (2015) • The Conservation Management Plan (Recovery Plan) for the Blue Whale (B. musculus) (DoE 2015)

	Which suggest noise may lead to the avoidance of important habitat in marine turtles and mask cetacean vocalisations. The Operational Area does not overlap with any turtle or whale BIAs or migratory pathways. Given the distance from the Operational Area to the closest turtle nesting site at Cartier Island (106 km) and the large navigable area available in the open ocean, it is expected that the impact of noise interference on individual transient turtles or cetaceans travelling through the Operational Area is expected to result in temporary avoidance reactions. Avoidance of migratory or nesting seasons is not considered to be ALARP given the low levels of noise from the planned activities, short term activities and the location of the activity outside of BIAs and migratory pathways. The risk matrix presented within the Recovery Plan for Marine Turtles in Australia provides a risk rating of low to moderate associated with industrial and shipping noise on turtles. No further controls are considered appropriate given the distance from turtle BIAs and the low levels of noise from the proposed activity. The Approved Conservation Advice for *M. novaeangliae* (Humpback Whale) (2015) suggests that should acoustic impacts on humpback calving, resting, foraging areas, or confined migratory pathways be identified a noise management plan should be developed. Given the level of noise generated during this activity and the Operational Area does not overlap a humpback whale BIA or key area for this species, a management plan is not considered applicable. The risk matrix presented within the Conservation Management Plan for Blue Whales (DoE (2015)) provides a risk rating of low to moderate associated with industrial and shipping noise on blue whales. The proposed controls including reduction of vessel speed in the vicinity of a whale align with the priority for action recommended in this management plan. Jadestone has had regard to the representative values of the protected areas within the RISK EMBA, and the respective management plans and other published information. Impacts from noise will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state MPs. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable. EPBC Regulation 8 and the Australian National Guidelines for Whale and Dolphin Watching 2005 (DEH 2006) set the requirements for vessels interacting with cetaceans. Commercial vessel noise is identified as a risk in the 'Whale shark management with particular reference to Ningaloo MP' (2013). The Operational Area overlaps a small portion of the Whale shark foraging BIA where aggregations are not as dense or sustained as the Ningaloo MP and the open ocean location does not restrain migratory routes.

6.4 Atmospheric Emissions

6.4.1 Description of aspect

Emissions	The main sources of atmospheric emissions during operational activities are: • Power generation for machinery and vessel operations; and • Emergency conditions. The use of fuel (specifically marine-grade diesel) to power vessel engines, generators and mobile and fixed plant and equipment will result in emissions of greenhouse gases (GHG) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), and non-GHG such as sulphur oxides (SO_x) and nitrous oxides (NO_x). Trapped gases will be released to atmosphere during the well activities (Section 2.8).

6.4.2 Impacts

Sensitive Receptor	Impact description
Air quality	Emissions can reduce air quality in the immediate vicinity of the vessel present in the Operational Area. The emissions will under normal circumstances quickly dissipate into the surrounding atmosphere. 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. No avifauna BIAs overlap the Operational Area (Section 3.5.6), however, eleven threatened and/or migratory seabirds were identified as potentially transiting, occurring within, or having habitat potentially occurring within the greater region. These species may be impacted by deterioration in air quality if they are transiting the immediate area of the vessel 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 approximately 106 km north-west of the Operational Area, 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 the Operational Area sits in offshore waters, the combustion of fuels in such remote locations will not impact on air quality in coastal towns or other sensitive locations. The Sea-Eagle-1 wellhead is approximately 4 km from the WHP and FPSO within the Montara field and therefore emissions are expected to have dissipated in the vicinity of the wellhead with no potential impacts to personnel on the FPSO. No impacts are therefore expected, and the consequence is considered to be ***negligible***.

Consequence	Ranking
Negligible	Acceptable

6.4.3 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**
010	Vessel machinery is certified and maintained in accordance with Flag State regulations and vessel class	Vessel machinery is maintained in accordance with vessel class requirements.	PMS provides status of maintenance	Vessel Master

6.4.4 ALARP assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage atmospheric emissions from VBA 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 equipment producing emissions is removed	Eliminate, Engineering	No	N/a	Atmospheric emissions from operating equipment including vessels and helicopters is required to undertake the Activity. Equipment cannot be removed completely. Risk and impact reduction are achieved through planned maintenance ensuring clean and efficient running of engines.
Installation of an active well monitoring system instead of the passive	Substitution	Yes	No	This system would require a longer period on location for installation and regular vessel visits to site for approximately 2 days every two weeks. This would therefore increase the air emissions from the activity significantly over the course of each year.
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.
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

6.4.5 Acceptability assessment

The potential impacts of atmospheric emissions are considered acceptable in accordance with Section 5, 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 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for the activities.
Laws, standards and Industry best practice	Compliance with relevant and appropriate MARPOL requirements. The APPEA Code of Environmental Practice (CoEP) (2008) principles are met with regards to meeting the requirements of all laws and regulations, and meeting industry's objective to maintain a social license to operate. In accordance with APPEA objectives, appropriate systems are in place to minimise impacts, manage complaints, document consultation and communicate with stakeholders.
Stakeholders & reputation	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regards to impacts from atmospheric emissions on sensitive receptors.

	The Activity is located at distance from aggregations of sensitive receptors and the coastal communities.
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: Section 6.4.2 assesses the pathways and consequences of the localised degradation of air quality potentially impacting transiting migratory shorebirds and protected seabirds; • Preservation of critical habitats: remote from Protected Areas and aggregations of sensitive receptors; • Assessment of key threats as described in species and Area Management/ Recovery plans: see Conservation and Management Plans' below; • Consideration of North-West Bioregional Plan: no specific actions noted regarding offshore air emissions but contributions to the global GHG inventory resulting in ocean acidification are noted. As such, minimisation of inefficient engine exhaust gases though timely PMS is aligned with the NW Bioregional objectives; and • Principles of ecologically sustainable development (ESD): no impacts from air emissions beyond 'negligible' to biological diversity or ecological integrity.
Conservation and management Plans	No Management Plans identified air emissions such as those described above as being a threat to marine fauna or habitats. Jadestone has had regard to the representative values of the protected areas within the RISK EMBAs, and the respective management plans and other published information. Impacts from atmospheric emissions will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state MPs. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable.

6.5 Operational Discharges

6.5.1 Description of aspect

Liquid discharges	Liquid discharges generated from the vessel and routinely discharged to the marine environment include: • Slops water (deck drainage, bilge water, tank washing); • Cooling water; • Desalination brine; and • Sewage, greywater and putrescible waste. A summary of each waste type is provided below. <u>Deck drainage and bilge water</u> Deck drainage from the vessel 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. Oily water from bilges will be collected and treated via an oil-water separator in accordance with MARPOL requirements (<15 mg/L (v) oil-in-water). Once separated, the oil and grease will be stored in suitable containers ahead of transfer ashore for recycling and the treated water discharged to ocean. <u>Cooling Water and Desalination Brine</u>

	Seawater will be pumped aboard the vessel, circulated through various process and marine heat exchangers prior to discharge back into the ocean at a temperature higher than ambient seawater. The seawater is typically treated with biocides then directed to sea chests, pump caissons etc to prevent blockage of marine growth inside pipes and exchangers. Freshwater is produced on board the vessel via desalination. The freshwater makers on board the comparative facilities (for example, *Montara Venture* FPSO) result in discharge of maximum 40 tonnes per day of brine of 50.5ºC and a maximum salinity of 38.5 ppm. As a comparative study, the Montara FPSO was assessed by GEMS (2003). 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, the discharge was not greater than 3°C above the ambient water temperature. Sewage, Grey water and Food waste All sewage (including grey water) generated onboard the vessel is discharged through an inline macerator to comminute solids to a diameter of less than 25 mm. With the persons on board (POB) the vessel being typically <35 personnel, the volume of treated sewage and greywater is conservatively estimated to be <21 m^3/d (based on 0.6 m^3/person/d) and putrescible waste of 35 kg/d (based on 1 kg/person/d). These quantities are derived from existing Jadestone Montara Operations estimates and based on the example vessels described in Section 2.9.1. Given the vessel is manned on a continuous basis, discharges of sewage, greywater and putrescible food waste is expected to occur daily throughout the VBA.

6.5.2 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 vessel 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 vessel. If not properly managed, the discharge of oily water has the potential to create an oil sheen on surface waters and a temporary localised decline in water quality. 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 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 localised with full recovery predicted at the end of the Program, hence ranked ***negligible***.

<table>
<tr><th>Sensitive Receptor</th><th>Impact description</th></tr>
<tr><td></td><td>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. The consequence was assessed as localised with full recovery predicted in the short-term following completion of the Program, hence ranked negligible.

<u>Sewage, grey water and putrescible waste</u>

The potential impact associated with the routine discharge of sewage, grey water and putrescible waste on water quality is changes to ambient water quality and BOD levels from nutrient loading within the direct vicinity of the vessel. The discharges of treated sewage and grey water result in localised increases in nutrient concentrations, generate an increase in bacterial activity and associated Biological Oxygen Demand (BOD) in receiving waters and may promote localised elevated levels of phytoplankton due to nutrient inputs. 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 localised with full recovery predicted in the short term once the vessel departs the area, hence ranked negligible.

The consequence of operational discharges to the water quality are considered to be negligible given the low toxicity of the discharges and expected dilution within the open water.</td></tr>
<tr><td>Marine fauna: cetaceans, turtles, fish, sharks, rays, seabirds</td><td>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 vessel;
Potential behavioral 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.
<u>Deck drainage and bilge water</u>

The potential impact associated with the discharge of treated deck drainage and bilge water is chemical toxicity to marine species within the direct vicinity of the vessel.

If not properly managed, the discharge of oily water has the potential to create an oil sheen on surface waters and a temporary localised decline in water quality and toxic effects to marine fauna. Toxicity to marine organisms would be from small amounts of dissolved hydrocarbons in the oily water drainage after treatment. Given that oil and grease residues in oily water drainage will be in low concentrations, the potential for impact is low and would be further reduced due to the strong tidal movements experienced in the region and the naturally turbid environment.

Dispersion and biodegradation of potentially contaminated oily water drainage is expected to be rapid and highly localised resulting in no long-term or adverse effects on marine ecology. The consequence was assessed as negligible.

<u>Cooling water and desalination brine</u>

Discharge of cooling water has the potential to cause changes in marine ecology through elevated temperatures, as well as the presence of anti-fouling biocides with trace chemical concentrations of copper and aluminium ions being discharged. These small amounts of biocides will disperse rapidly on discharge to concentrations below levels of environmental concern to marine biota especially demersal fauna.</td></tr>
</table>

Sensitive Receptor	Impact description	
	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) 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 increase in salinity and deep, open water surrounding the Operational Area, impacts on fauna from increased salinity in the Operational Area is expected to be ***negligible***. Fish and plankton are likely to be at greatest risk from cooling water discharge impacts since they are most likely to be attracted to the discharge location (fish) or entrained within the discharge plume (plankton). Fish and plankton are relatively small organisms that may experience increased body temperature and altered physiological processes (e.g. increased respiration rate and oxygen demand). However, given that the area of raised water temperature will be highly localised and within the range of temperature on the North-West Bioregion, significant impacts on a larger ecosystem or population levels to fish or plankton are not expected to occur. Given the hydro-dynamically active open water environment surrounding the Operational Area, it is expected that the surface 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***. Only receptors in close proximity to the discharge point have the potential to be impacted with full recovery predicted within weeks. <u>Sewage and greywater and putrescible food waste</u> The potential impact associated with the routine discharge of sewage and 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 vessel 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 temporary and is not expected to result in adverse impacts at an ecosystem or population level and impacts ranked ***negligible***. <u>Summary</u> No important foraging or nesting BIA for marine turtles, fish or marine mammals overlaps the Operational Area. While the northern boundary of the Whale shark foraging BIA does overlap providing potential for whale sharks to be present, their presence is expected to be limited to transiting individuals, due to the size of the whale shark foraging BIA. Impacts overall to marine fauna are expected to be short term with rapid recovery and the consequence of operational discharges was assessed as ***negligible.***	
Consequence		**Ranking**

Sensitive Receptor	Impact description
Negligible	Acceptable

6.5.3 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			
011	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 or a pre-mobilisation inspection report (e.g. OCIMF OVID, IMCA CMID, ISM inspection) IOPP certificate	Vessel Master
012	Oily sludge is contained	Oily residue (sludge) is not discharged to sea but is contained and transferred to shore for disposal.	Oil Record Book	Vessel Master
	Cooling water			
013	Water cooled equipment on vessel is maintained in accordance with the PMS	Water cooled equipment/ machinery and heat exchangers maintained in accordance with the PMS	Pre-start inspection shows maintenance is scheduled and completed	Vessel Master
	Desalination brine			
014	Potable water systems are maintained	Potable water systems maintained in accordance with PMS	Pre-start inspection shows maintenance is scheduled and completed	Vessel Master
	Sewage and greywater			
015	Vessels >400 t STP meets operational needs and is operated in line with MARPOL requirements	Pursuant to MARPOL, vessels have 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	Vessel Master

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**
	Putrescible waste			
016	Garbage record book maintained	Vessels' garbage record book maintained to record quantities of food waste in accordance with MARPOL	Garbage Record Book	Vessel Master

6.5.4 ALARP assessment

Based on the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage liquid waste discharges from the VBA to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Acceptable as per Section 5. 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	For the longer duration activities such as the monitoring system installation transfers increase the risks of spills/ leaks and safety risks to personnel during transfer operations. 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. For the shorter-term activities such as the annual ROV monitoring, data retrieval and in-field observation it is possible that wastes could be stored onboard for the short duration of the activity. However, as discharges are permissible under MARPOL, the containment of those wastes is not considered to be more environmentally beneficial than the disposal of wastes onshore, and therefore may be discharged during the VBA.
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 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.
Installation of an active well monitoring system instead of the passive	Substitution	Yes	No	This system would require a longer period on location for installation and regular vessel visits to site for approximately 2 days every two weeks. This would therefore increase the operational discharges from the activity significantly over the course of each year.
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.

6.5.5 Acceptability assessment

The potential impacts of liquid waste discharges are considered acceptable in accordance with Section 5, 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 8 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 4), and no stakeholder concerns have been raised with regards to impacts from liquid waste discharges on sensitive receptors.
Legislation & Industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) objectives are met with regards to having appropriate management measures in place to minimise impacts and all wastes are disposed of or recycled at appropriate facilities in accordance with legislative requirements and agreed procedures. Maintenance management system implemented, compliance with relevant MARPOL requirements and certified equipment ensure discharges meet regulatory requirements and are acceptable with standards used globally.
Environmental context & ESD	The activity is located at distance from sensitive receptors and the coastline and no significant impacts on receptors are predicted. While there are liquid waste discharges to sea surface immediately around the vessel, 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: Section 6.5.1 and 6.5.2 assess the pathways and consequences of localized and degradation of water quality to the marine ecosystem; • Preservation of critical habitats: no impacts on Protected Areas or aggregations of sensitive receptors; • Assessment of key threats as described in species and Area Management/ Recovery plans: see Conservation and management advice' below; • Consideration of North-West Bioregional Plan: The Plan considers vessel marine discharges and effluents (with associated temperature, BOD and turbidity impacts) as potential concern to various KEFs (Seringapatam Reef and Commonwealth waters in Scott Reef complex, Rowley Shoals and Ningaloo Reef). No KEFs are impacted from operational discharges. Avifauna, dolphin, turtle, sea snakes, shark, and dugong are also mentioned in the NW Bioregional Plan but no BIA are predicted to be affected by the vessel discharges above 'negligible'; and • Principles of ecologically sustainable development (ESD): there are no impacts from operational discharges to biological diversity or ecological integrity and no irreversible damage with full recovery in the short term predicted.
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 RISK EMBAs, and the respective management plans and other published information. Impacts from liquid discharges will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state MPs. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable.

6.6 Spill Response Activities

6.6.1 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:
	• Source control;
	• Monitoring, evaluation and surveillance;
	• Protection and deflection;
	• Containment and recovery;
	• Shoreline clean-up;
	• Dispersant application;
	• Oiled wildlife response; and
	• Scientific monitoring.
	The Sea Eagle and Tahbilk Vessel Based Activity OPEP (TM-70-PLN-I-00005) (the 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 (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);
	• Operational discharges including those routine discharges (Section 6.5) 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 and contaminated waste.
	• 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.

6.6.2 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 VBA occurs.

Table 6-2: Impact assessment of spill response activities

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. Section 6.2 provides further detail on the nature of light impacts to fish, birds and marine turtles. 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 DBCA 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 Reef, Cartier Island, (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 Pygmy blue whale (distribution) BIAs overlaps the RISK EMBA and species may be vulnerable during their peak activity season (July–October; April - Aug) as they migrate north/ south through the RISK EMBAs (Section 3). 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 consistent with noise impacts from activities (***Negligible***). Section 6.3 provides further detail on these impacts from vessels. With respect to noise from onshore operations (mobile equipment and vehicles), nesting, roosting or feeding birds are considered the most sensitive to noise, in particular, shorebirds aggregating at Ashmore reef, Cartier Island, Kimberley and Indonesian coast lines. However, the equipment used is not considered to have excessive sound levels and following consultation with stakeholders such as the Department of Transport (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 ***Negligible***.
Atmospheric	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. 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***.
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

Sensitive Receptor	Impact description
	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. If 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 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, DEPWS 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** 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 and NT Oiled Wildlife Response Plans and the Kimberley Region Oiled Wildlife Response Plan. **Physical disturbance in protected areas** 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 considered ***Mino*r**.

Sensitive Receptor	Impact description
Invasive Marine Pests-IMP	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 pest is considered Major in the nearshore/ coastal environment, which is more conducive to establishment of invasive marine pests 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, it is considered that the additional impact of spill response activities on affected industries would be ranked ***Minor***.
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 7.6. 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 contact to shorelines, thus giving time for other response strategies to take effect and further reduce impacts.

6.6.3 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**
Spill response preparedness				
017	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 Management
018	AMOSC MSC/ AMSA MOU/ OSRL MSC valid for life of the EP	AMOSC & Oil Spill Response Limited (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	General Manager
019	Response personnel competent and trained in accordance with Jadestone Energy Training and Competency Management System (JS-60-PR-Q-0014) and Sea Eagle and Tahbilk Vessel Based Activity OPEP (TM-70-PLN-I-00005) 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
020	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 and OSRA (GF-70-PLN-I-00037)	Exercise schedule Exercising close out reports Training records	Emergency Response Lead
021	OPEP maintained to ensure spill response is appropriate to nature and scale of risk for life of EP	Spill response planning and preparedness are aligned with nature and scale of risk of this EP	Review confirms risks are aligned with the OPEP	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**
022	Vessel SOPEP is 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	SMPEP/ SOPEP	Vessel Masters
023	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
024	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	Emergency Response Lead
025	Sea Eagle-1 and Tahbilk-1 Addendum to Blowout Contingency Plan (TM-50-PLN-W-00001) in place	Blowout Contingency Plan in place that addresses loss of well containment actions as defined in the EP that minimise risk to personnel and reduce environmental impact	Blowout Contingency Plan	Drilling Manager
026	AMOSC Subsea First Response Toolkit (SRFT) 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 SRFT membership, appropriate insurance and an OTA Agreement with Oceaneering which allows access to equipment, dispersant stocks and technical support for subsea dispersant application	Current SRFT membership, insurance and OTA Agreement records	Country Manager
027	ROV support in place for SFRT activity	Contract in place to provide ROV services for SFRT	Current contract in place	Supply Chain Management

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
028	Labour hire contract in place for life of EP to source labour for spill response	Labour hire contract in place to provide access to personnel	Labour hire contract	HR Manager
029	Vessel availability for SFRT deployment is monitored monthly via Jadestone's nominated vessel broker for life of EP	Monitor the availability of vessels that are suitable for deployment of the SRFT for life of EP	Monthly Monitoring reports	Logistics Lead
030	Maintain contract with Jadestone's Waste Management Contractor for life of the EP	Waste management contract is maintained which enables access to waste storage facilities and waste transport	Contractor assessment records	Logistics Lead
031	Monitor status of Registered Operators with Approved Safety cases for MODUs for life of EP	Jadestone have a process for monitoring the status of Registered Operators with Approved Safety cases for MODUs	Monthly Monitoring reports	Logistics Lead
032	Contract and Equipment Access Agreement with Wild Well Control (WWC) for life of EP	Contract and Equipment Access Agreement with WWC are maintained providing technical support and equipment	Contract and Equipment Access Agreement with WWC	Supply Chain Management
033	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
034	Vessel availability for containment and recovery activity is monitored monthly via Jadestone's nominated vessel broker	Monitor the availability of vessels that are suitable for deployment of the Containment and Recovery strategy as defined in the OPEP	Monthly monitoring reports	Supply Chain Management

6.6.4 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 6-3**.**

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.

Table 6-3: ALARP for spill response activities

Strategy	Description	Environmental Benefits	Decision
Source control	Implementation of the vessel SOPEP	Reduce the volume of oil entering the marine environment	Adopt
	Implementation of Blowout Contingency Plan (JS-70-PLN-D-00001) to ensure a planned, predictable and ALARP response to a loss of well control.	Reduce the volume of oil entering the marine environment	Adopt
Subsea dispersants	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 subsea 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 determined in the IAP. 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, shoreline clean up and assessment technique (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	Adopt

Strategy	Description	Environmental Benefits	Decision
		that prevents the application of dispersant (which is unusual for the environment around the Montara field), this creates dispersion. The Oil Spill Modelling Report (RPS 2018) 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 50 g/m^2 and up to 58% when applied to oil thickness of 16 g/m^2. 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 potentially 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 determined in the IAP. 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	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	Reject

Strategy	Description	Environmental Benefits	Decision
	column in the form of smaller droplet sizes, biodegradation processes are enhanced.	limited effectiveness and is not considered to be a strategy requiring further planning and associated control measures.	
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 crude 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. Containment and recovery will only be undertaken when there is a net environmental benefit determined in the IAP. 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 RISK 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: • Protect sensitive receptors; • Deflect spills away from sensitive receptors or shorelines; or • 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. Protection and deflection will only be undertaken when there is a net environmental benefit determined in the IAP. 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

Strategy	Description	Environmental Benefits	Decision
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. 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. Shoreline cleanup will only be undertaken when there is a net environmental benefit determined in the IAP. Consequently, this strategy may not be applicable across all shorelines identified as being oiled but is considered a secondary strategy for targeted use.	Adopt
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 RISK 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 WA and NT Oiled Wildlife Response Plan 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 wellhead), at the location of the spill. The oil must be amenable to lighting e.g. unweathered, high lighter oil fractions and not prone to emulsification. When	Operational and oil constraints expected during a LOWC suggest in-situ burning is not feasible. For in-situ burning to be undertaken, oil must be thicker than 1-2 mm but diesel and Montara crude oil tend to have high evaporation rate and spread 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 the VBA.	Reject

Strategy	Description	Environmental Benefits	Decision
	conditions are favourable and conducted properly, in situ burning will reduce the amount of oil on water.		
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

6.6.5 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 8 and the OPEP demonstrate that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity including spill response arrangements.
Stakeholders & reputation	Stakeholder consultation has been undertaken (Section 4), and no stakeholder concerns have been raised with regards to spill response activities. Consultation included engagement with the State and National response agencies of DoT and AMSA, nearby operators, AMOSC, as well as commercial and recreational fishing industry bodies and fishers. No stakeholder concerns have been raised with regards to impacts of the spill response activities on relevant persons. During any spill response, a close working relationship with key regulatory bodies (e.g. DoT, DBCA, AMSA, DEPWS) 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 VBA is a loss of well control from Tahbilk-1 resulting in a spill of 236,149 m^3 over 77 days. The area over which the oil travels (>1 g/m^2) is predicted to occur at distances up to ~2,200km from the release location. The oil is primarily floating and entrained 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: pathways and proposed management are described under individual activities and aspects in Section 6.6.2; • Preservation of critical habitats: described under individual Tactical Response Plans, and ALARP measures considered (Section 6.6.4) to ensure response activities do not increase the risks to critical habitats from spills; • Assessment of key threats as described in species and Area Management /Recovery plan: see 'Conservation and Management Advise' below; • Consideration of North-West Bioregional Plan: no specific discussion of spill response activities but impacts such as light, noise, vessel discharges, collision with fauna etc are discussed individually under the planned aspects above. The toxicity to marine life from dispersants is noted. As such, the proposed management control to minimise impacts under this EP, are aligned with the objectives of the NW Bioregional Plan; and • Principles of ecologically sustainable development ESD: Operational NEBA assessments ensure the environmental impacts are neutral or positive; thus, potential impacts to biodiversity and ecosystem integrity minimised.
Conservation and management advice	Jadestone Energy will have regard to the representative values of the reserves and other information published and endeavour to ensure that priority is given to the social and ecological objectives and values, of any AMPs, or state MPs impacted by spill response

	activities to ensure that the objectives of the management plans are not contravened (Appendix B). Noting 'Emergency response' is permitted in all AMPs and State MPs. Actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with activities authorised under the OPGGS Act may be conducted in all zones. The Director will be notified in the event of an oil pollution incident that occurs within, or may impact upon, an Australian MP and, so far as reasonably practicable, prior to a response action being taken within a MP. The Management Plans for EPBC protected species that identify light, noise and other risks through Sections 6.1 – 6.6 apply here. The 'Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species' will be applied/used as guidance in the event of an oil spill.

7. UNPLANNED RISKS

This section of the EP describes the potential risks and environmental impacts from accidental events that may arise during the VBA and associated mitigation and management measures that will be implemented to reduce risks and impacts to as low as reasonably practicable and acceptable levels.

The environmental risk assessment process identified five accidental environmental risks. The pre-treatment and residual risk rankings are summarised in Table 7-1 and presented in detail throughout this section.

Table 7-1: Summary of the environmental risk assessment ranking for accidental events

Hazard	Residual Ranking
Marine pest introduction and establishment	Medium
Interaction with fauna	Low
Unplanned release of solids overboard	Medium
Unplanned release of non-hydrocarbon liquids	Low
Unplanned release of crude oil	Medium
Unplanned release of diesel	Low

7.1 Marine Pest Introduction

7.1.1 Description of hazard

Invasive Marine Pests (IMP)	Biofouling on immersed surfaces (e.g. ship hulls), floating/ immersible equipment and within internal seawater circulation systems, as well as ballast water, are potential pathways for invasive marine pests (IMPs) to translocate on vessels and equipment. There is the potential for support vessels to transfer IMPs from international waters into the Operational Area and for them to establish in the local environment. There is a smaller risk of transfer of IMPs from Australian waters. There is also a theoretical potential for IMPs to be transferred into Australian Territory and coastal waters via support vessels when commuting from the Operational Area to/ from State/ Territory or Commonwealth waters.

7.1.2 Impacts and risks

The introduction and establishment of IMPs can result in impacts on native marine fauna and flora, including:

- Competition, predation or displacement of native species;
- Alteration of natural ecological processes;
- Introduction of pathogens with the potential to impact human and/or ecological health;
- Reduction and/or competition with commercial fish and aquaculture species; and
- Increased requirement for maintenance of vessels and marine infrastructure.

Potential sources for the transfer and establishment of IMPs 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 and anchor cable lockers);

- Biofouling on equipment that routinely becomes immersed in water (including but not limited to equipment such as ROVs); and
- Discharge of high-risk ballast water taken up from international or domestic sources.

Ballast water is responsible for up to 30% of all IMP 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 IMP incursion:

- Colonisation and establishment of the IMP 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 IMP, followed by successful establishment of a viable new population which then constitute a 'pest' presence (Commonwealth Government, 2009).

Colonisation requires suitable environmental conditions for that particular species including water temperature, water depth, salinity and habitat type. As such, most exotic marine species introduced to Australian waters have distributions restricted to shallower coastal habitats. 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 2015).

Following their establishment, eradication of marine pest populations is often extremely difficult and costly, 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 focusses on 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-mediated IMP transfer risk presented by vessels, is influenced by a number of inter-playing factors. These factors include the type and age of the anti-fouling coating, operational and maintenance history since last drydocking (including where the vessel had been operating), length of time intended to operate in Australian coastal waters and whether the vessel has undergone biofouling inspection and/or cleaning prior to entering 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, as may be warranted, a Marine Biosecurity Inspection for the purposes of assessing the presence of known and potential IMPs to ensure compliance with Regulation 176. The responsible agency, the WA Department of Primary Industries and Regional Development (DPIRD) has promulgated a list of declared marine pest species.

None of the WA listed marine species of concern should be present on any vessel intended to visit WA waters due to legislated management requirements. In accordance with marine pest management guidelines (as enforced under the *WA Fisheries 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 vessels enter WA waters and ports;
- To minimise risk, a vessel should leave its last overseas port of call within seven days of the last anti-fouling coating application or IMP inspection, prior to direct transit to its target port/area in WA waters. If experiencing delays or deviations, you should seek advice from the Department; 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.

Ballast water

The Commonwealth Department of Agriculture (DoA: formerly the Department of Agriculture and Water Resources [DAWR]) is the lead agency for management of ballast water, with responsibility for the management of ballast water sourced both from international and domestic (i.e. Australian) locations. DoA introduced the Australian Ballast Water Management Requirements (DAWR 2017) that are enforced under the *Biosecurity Act 2015* (as amended). Under these arrangements, all vessels that intend to discharge ballast water in Australian waters are obligated to assess and manage their ballast water in accordance with DoA requirements. These arrangements prohibit the discharge of high-risk ballast water within Australian territorial seas (within 12 NM of the Australian territorial sea baseline) unless the ballast water has been managed to the satisfaction of DoA or is otherwise assessed to be 'low risk', and prior approval has been obtained for that discharge. By extension, all vessels, mobilised for the project and intending to discharge ballast water within the Australian territorial sea (i.e. within 12 NM of the Australian territorial sea baseline) will be required to manage ballast water to the satisfaction of DoA.

The DoA requires vessels that operate between Australian ports and offshore oil and gas installations within the Australian Exclusive Economic Zone (EEZ) to manage their ballast water before arrival at both the installation and the Australian port. The acceptable area for a ballast water exchange between an installation and an Australian port is in sea areas that are no closer than 500 m from the offshore installation, and no closer than 12 NM from nearest land.

Ballast water discharged in the same place where the ballast water is taken up is considered low risk. There is no requirement to manage ballast water that is taken up and discharged in the same place if the low risk water is at least 95 % from the 'same place' to be within one nautical mile of the point of uptake, or within the port limits of the same port.

Support vessels are required to adhere to Australian ballast water management requirements, as detailed in the *Australian Ballast Water Management Requirements, Version 7*. As such and assuming adherence to mandatory Australian requirements, no adverse effects are expected from the discharge of ballast water by vessels engaged in the VBA.

Sensitive Receptor	Impact description
Benthic habitats	The Operational Area benthic habitat comprises soft sandy sediments in 70 to 80 m water depth, open ocean conditions and lacking abundant light at this depth. The only hard substrate available is that associated with the wellheads. Given these conditions, the successful establishment of introduced species on the natural habitat is considered unlikely. There is a possibility of establishment on the artificial substrate in the area, but this too is considered to be unlikely. If IMPs were introduced and established successfully on the benthic habitat, it could result in an overall change in localised areas and some degradation of the ecosystem. The potential impact was assessed as ***Minor*** *effect; recovery in weeks to months; death of individuals* as impacts could result in potential mortality to fauna associated with the benthic habitat, with impacts likely localised to within approximately 1 km of the activity.
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 and reproduce in water depths of the Operational Area. However, if IMPs were established, it may have a ***Moderate*** impact - *Local effect; recovery in months to a year; impact to localised community.*
Likelihood assessment	
	Asian green mussel, American slipper limpet and Black striped false mussel were detected in Darwin marinas in 1999 and were successfully eradicated. No recognised marine pest species are known to be established in Darwin harbour. Vessels operating from Darwin are expected to have arrived there free of IMPs, it is therefore unlikely that they would acquire any pest species from Darwin. Furthermore, it is not likely that IMPs entering the Operational Area would establish on the benthic habitat (soft sediments). The water depth, open ocean conditions and lack of available light provides a very different environment to that within sheltered port and shallow coastal areas which have historically been colonised by IMPs. Some possibility exists of establishment on the artificial substrate in the area, including the pipeline adjacent to the Sea-Eagle-1 wellhead but if so, such colonisation would in all probability be confined to the artificial substrate. The likelihood of a potential introduction and establishment of IMPs is considered ***unlikely*** for this location with the intended controls in place.

Consequence	Likelihood	Ranking
Moderate	Unlikely	Medium

7.1.3 Environmental performance

Hazard		Marine Pest Introduction		
Performance outcome		**No introduction of marine species**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
035	Vessels comply with the Biosecurity Manual (JS-70-MN-G-00001)*	All vessels demonstrate compliance with the biosecurity manual requirements	Documented evidence of compliance with DAWE ballast water management requirements. Documented evidence of effective management of ship biofouling management, consistent with National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009).	Marine Superintendent

* The biosecurity manual (Submitted to NOPSEMA and Jadestone refers to its contents under Regulation 31) applies to all marine vessel operations undertaking VBA In the 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 Pests (IMP) into Australian Waters and the Operational Area through translocation vectors such as marine and petroleum vessels, immersible equipment and ballast water.

c) Ensure contracted vessels and vessel operators are aware of and apply the marine biosecurity requirements when chartered to execute their scope of work.

d) Ensure compliance with Commonwealth and State Australian Government legislation.

e) Detail the risk-based approach and mitigations used to reduce the risk of IMPs being introduced to the Operational Area to As Low as Reasonably Practicable (ALARP).

7.1.4 ALARP assessment

On the basis of the impact and risk assessment process completed, Jadestone considers the control measures described above are appropriate to manage the risk of IMPs being introduced and getting established to the level of ALARP. The residual risk ranking for this potential impact is Medium. Good industry practice has been applied for the situation or risk. Additional controls were considered but rejected as 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 only from Australian waters	Eliminate	No	No	Wherever possible, domestic vessels will be sourced, but this may not always be feasible. Delays to activities can result from non-availability of suitable vessels if only drawn from Australian waters. Regardless, all vessels are subject to IMP risk assessment and must manage their ballast water and biofouling in accordance with regulatory requirements. Minimal benefit gained given the implemented controls ensure only low IMP 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 objective is to ensure that vessels engaged in VBA are free of IMPs at the time of mobilisation. Accordingly, the residual risk of IMP is considered low due to inspection and cleaning controls and the need for any follow-up inspections of vessels 75 days after arrival is negated. If any IMP enters the Operational Area, the nearest habitat are the wellheads or the benthic habitat (sandy seabed) and the environment is hostile compared to sheltered port and shallow coastal areas which have historically been colonised by IMPs.
Application of new anti-fouling coating to all vessels prior to contract commencement	Engineering	No	No	Substantial additional cost, potential delay to commencement of activity. Little benefit given the requirement to rank as low risk using the IMP 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 biocides are prohibited from use in Australia.

7.1.5 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 8 demonstrates that Jadestone's HSE Management System is capable of continuously reviewing and updating activities and their practices to reflect the requirements of marine pest management in Australian waters.
Stakeholder & reputation	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised. Jadestone will continue to liaise with WA Department of Primary Industries

	and Regional Development (Fisheries) on current requirements for the management of the risk of marine pest introduction in WA and NT waters.
Law and industry best practice	The implementation of a Biofouling Management Plan and the maintenance of a Biofouling Record Book are consistent with 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. Ballast water management will be consistent with the requirements of the Biosecurity Act 2015, as detailed in the *Australian Ballast Water Management Requirements, Version 7*.
Environmental context & ESD	Section 7.1.2 notes it is unlikely that IMPs entering the Operational Area will establish and propagate. The potential residual risk is considered acceptable after consideration of: • Potential impact pathways: section 7.1.1 and 7.1.2 assess risks from biofouling and ballast water; • Preservation of critical habitats: activities are remote from Protected Areas and shallow water, protected environments where the establishment of IMPs is more likely; • Assessment of key threats as described in species and Area Management/ Recovery plans: See 'Conservation and management advice' below; • Consideration of North-West Bioregional Plan: The NW Bioregional Plan mentions the potential for Asian green mussels *Perna viridis* to cause damage in Commonwealth waters of the NW Marine Region, but these mussels typically prefer habitat up less than about 12 m deep. The proposed management actions align with the NW Bioregional Plan objectives by minimizing the risks; and • Principles of ecologically sustainable development (ESD): the proposed management of biofouling and ballast water risks minimizes the likelihood to adverse effects on biodiversity and ecosystem integrity from invasive species.
Conservation and management advice	Application of guidelines detailed in the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009), and in the IMO Guidelines for the Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive Aquatic Species. Jadestone has had regard to the representative values of the protected areas within the Operational Area, and the respective management plans and other published information. Impacts from any hypothetical successful establishment of marine pests will not impact on any of the social and ecological objectives and values, of any AMPs, or state MPs. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable.

7.2 Interaction with fauna

7.2.1 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.

7.2.2 Impacts and risks

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 Appendix B). Other fauna such as fish and sea snakes are more likely to avoid vessels and so are considered at low risk of potential strike and will not be discussed further.

Marine Mammals

Cetaceans are naturally inquisitive and 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). The data indicates deaths are more likely associated with container ships and fast ferries. Collisions between vessels and cetaceans are more frequent on continental shelf areas where high vessel traffic and cetacean habitat occur simultaneously (WDCS 2006).

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 on collisions between ships and whales (Laist et al. 2001) 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 reaction of whales to the approach of a vessel is variable. Some species remain motionless when in the vicinity of a ship while others are known to be curious and 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).

The Conservation Management Plan for the Blue Whale (DoE 2015) identifies vessel strike as a threat to the species.

Marine Turtles and Sharks (Whale Sharks)

Marine fauna like turtles and whale sharks that are present in shallow waters or surface waters are susceptible to vessel strike due to their proximity to the vessel (hull, propeller or equipment), presence at the surface (breathing, basking etc) 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).

Marine birds

Should listed or migratory bird species transit the Operational Area, the worst-case consequence of a bird strike with a helicopter would be a fatality of individuals with no lasting effects to populations.

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. 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. Four listed threatened and migratory species of cetacean potentially occur or have habitat in the Operational Area: the sei whale, blue whale, fin whale and humpback whale. There are no known key aggregation areas located within or immediately adjacent to the Operational Area; with the Pygmy blue distribution BIA the nearest at about 64km away. The likely worst-case consequence from a support vessel strike to a marine mammal would be the fatality of a single adult, but no effect to

Sensitive Receptor	Impact description
	populations. With the controls implemented to reduce likelihood of impacts to marine mammals, potential disturbances are expected to be ***Minor*** – *Minor effect; death of individuals.*
Marine reptiles	Turtles are susceptible to vessel strikes when resting on the surface and surfacing 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 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 having habitat in the Operational Area; loggerhead, green, leatherback, hawksbill, olive ridley/Pacific ridley and flatback turtles (Section 3). Marine turtles are predominantly oceanic species except in the nesting season when they come ashore. There are no shorelines near the Operational Area, but turtles may transit the Operational Area to forage on nearby shoals with the closest nesting areas 106 km away (green turtle, Cartier Island). Vessel strike is an identified impact within relevant conservation and recovery plans for marine turtles. However, vessel strikes are unlikely in the Operational Area where vessels are travelling at low speeds. The worst-case consequence was assessed as the potential mortality of an individual adult but no effects on the population size at either a local or regional scale i.e. ***Minor*** - *Minor effect; recovery in weeks to months; death of individuals.*
Whale sharks	Although the Whale shark's skin is thicker and tougher than other shark species, the species may be more vulnerable to boat strike as they spend a significant amount of time close to the surface (DEH 2005a). The most northern part of whale shark foraging BIA overlaps the Operational Area. However, only occasional individuals are expected to occur as there are no Whale shark aggregations (such as the Ningaloo Reef aggregation) within the region. A whale shark management plan (No. 57) (2013) is in place and directs the management of whale sharks with specific reference to whale shark interaction in reserves – particularly Ningaloo Marine Park. This plan provides a code of conduct for vessels that are purposely interacting with whale sharks (for tourism purposes) and requests a 250m separation from whale sharks. By implementing a minimum 300m distance, Jadestone's activity will be complying with this recommendation. The worst-case consequence was assessed as **Minor** due to the potential mortality to an individual adult – *Minor effect; recovery in weeks to months; death of individuals.*
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. Flights occur in the daylight and not within major roosting areas, thereby reducing potential interactions and subsequent impacts. Collisions are therefore assessed as **Minor** due to the potential mortality to individual adults– *Minor effect; recovery in weeks to months; death of individuals).*
Likelihood assessment	
Unlikely	Vessel speeds within the Operational Area are low and are required to be less than 5 knots within the 500 m PSZ established around the wellhead for certain activities. Hence the chance of a vessel-cetacean collision resulting in lethal outcome is reduced. Due to the general low vessel speeds, warning noise of helicopters and lack of any significant bird or cetacean/reptile aggregations nearby, the chance of a vessel collision with marine fauna and bird strikes resulting in a lethal outcome is reduced as individuals are expected to take avoidance behaviour. Worst case risks are on an individual level and the risk ranking with controls in place (Section 7.2.3) was assessed as ***unlikely***.

Sensitive Receptor	Impact description	
Consequence	**Likelihood**	**Ranking**
Minor	Unlikely	Low

7.2.3 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**
007	Vessels will comply with EPBC Regulations 8.05 and 8.06	Support Vessel Masters will comply with relevant parts of EPBC Regulation (2000): Reg. 8.05 & 8.06 respectively, where safe to do so: Within the caution zone for a cetacean (including a calf) (within 300 m of a cetacean), the Vessel Master must operate the vessel at a constant speed of less than 6 knots and minimise noise; and If a calf appears within an area that means the vessel is then within the caution zone of the calf, the Vessel Master must immediately stop the vessel and turn off the vessel's engines or disengage the gears or withdraw the vessel from the caution zone at a constant speed of less than 6 knots. The above requirements will also apply to whale sharks if they are sighted within 300m of the vessel.	Vessel Masters provided and required to operate in accordance with the 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) Induction includes whale shark avoidance requirements	Vessel Master
036	Potential for collision with marine fauna reduced by vessels operating at speeds aligned 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.	Vessel Master
037	Competency and Training Management System (JS-60-PR-Q-00015) provides a process for ensuring that Contractors and Services Providers have the appropriate level of HSE capability	Online induction includes information on speed limits in the PSZ and requirements on interacting with marine fauna	Induction Records (Vessel Masters)	Marine Superintendent

038	Marine fauna collisions reported to National Ship Strike Database	Any vessel collision with a whale in the Operational Area is submitted to the National Ship Strike Database at: https://data.marinemammals.gov.au/report/shipstrike Death or injury to EPBC Act listed marine fauna (including cetaceans or whale sharks) from vessel collision are recorded/reported to NOPSEMA and DAWE in line with regulations	Vessel collision incident report Database entry number	HSE Manager

7.2.4 ALARP assessment

Based on the impact and risk assessment process completed, Jadestone considers the control measures described above are appropriate to manage the risk risk of fauna strike 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 or reduce frequency of vessels and helicopter use	Eliminate	No	No	Vessels and helicopters are required during VBA and there are no practicable alternatives. The potential for interaction between vessels and fauna cannot be eliminated, however the risk is low given the location, low volume of vessel and helicopter activity and low speeds and helicopter noise acts as a deterrent.
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 monitoring of the wellheads.
Installation of an active well monitoring system instead of the passive	Substitution	Yes	No	This system would require a longer period on location for installation and regular vessel visits to site for approximately 2 days every two weeks. This would therefore increase the potential for interaction with marine fauna from the activity significantly over the course of each year. The passive system is therefore considered to be more acceptable.
Use of marine fauna observers on all vessels to identify fauna close to vessels	Administrative	No	No	Vessel Masters will complete an environmental induction which includes the applicable requirements. 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 reduce the potential for impacts on marine fauna.

7.2.5 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 8 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 4), 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 a small area at the northern end of the Whale shark BIA. Risks 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: Section 7.2.2 describes the consequences and likelihood of vessel strike; • Preservation of critical habitats: location remote from Protected Areas and aggregations of most vulnerable cetaceans, dugongs and reptiles with proposed management minimizing residual risk to individuals; • Assessment of key threats as described in species and Area Management /Recovery plans: see 'Conservation and Management Advice' below; • Consideration of North-West Bioregional Plan: The NW Bioregional Plan ranks vessel strike to cetaceans, dugongs, turtles within BIA as a 'high risk of significant impact'. No specific actions were raised; hence the management controls are considered sufficient to maintain a residual consequence ranking of negligible; and • Principles of ecologically sustainable development ESD: as worst-case consequences will not impact population levels of protected species, no impacts on biodiversity or ecosystem integrity are predicted.
Conservation and management advice	**Recovery Plan for Marine Turtles in Australia, (DoEE, 2017).** The Recovery Plan for marine turtles in Australia (DoEE, 2017) identifies the following risk - Vessel Disturbance. It requires that risk of vessel strikes is evaluated and, if required, appropriate mitigation measures are implemented. This EP and the proposed controls are consistent with this advice. **Conservation Management Plan for the Blue Whale, 2015-2025.** The Management Plan identifies the following risk – 'Vessel Disturbance". It requires that risk of vessel strikes is evaluated and, if required, appropriate mitigation measures are implemented. This EP and the proposed controls are consistent with this advice. **Conservation Advice for Humpback Whales (*Megaptera novaeangliae*) DoE 2015.** The Conservation Advice 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 RISK EMBAs, and the respective management plans and other published information. Interactions with fauna may have a minor impact on any of the social and ecological objectives and values, of AMPs, or state MPs. However, with controls in place to minimise the likelihood (to protect protected fauna), this is considered consistent with the objectives of the conservation advice or management plans (Appendix B) and considered Acceptable.

7.3 Unplanned Release of Solids

7.3.1 Description of hazard

Solid waste release	An unplanned release of solids to the environment has the potential to occur from: • Waste overboard from vessel operations (e.g. overfull and/or uncovered bins); • Lifting resulting in dropped objects; and •

7.3.2 Impacts and risks

Solids overboard has the potential to pollute marine habitats and injure or kill fauna through entanglement, ingestion or exposure (Ryan et al. 1988). The effects are dependent on the size and material.

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 fauna through ingestion or absorption by individual fish, cetaceans, marine reptiles and seabirds. 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 as 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 however, only low numbers are likely to be present. The accidental release of waste may result in injury or even death to individuals but is not expected to result in a threat to population viability; hence the consequence to marine fauna was assessed as ***Minor*** given the likely objects dropped overboard, the transient nature of marine fauna at this location and lack of foraging habitat within the Operational Area.	
Benthic habitats	Benthic habitats have the potential to be impacted by accidental spills of solids resulting in possible damage to or loss of soft sediment communities within the area affected. The potential impact may be short term to long term depending on the waste type, degradation rate, and volume. The extent of physical seabed damage will be limited to the size of an inert dropped object and given the size of standard materials lifted overboard, impacts are expected to be very localised. There are no sensitive or unique marine habitats in the Operational 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 and beyond the Operational Area, the consequence to benthic communities would be a highly localised, negligible, and reversible change to a very small proportion of the overall benthos. The consequence of an unplanned release of solid waste on benthic habitats was assessed as ***Minor***.	
Other users	Buoyant solid waste accidentally released to the marine environment 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 that could be dropped overboard.	
Likelihood assessment		
Likely	The control measures and checks will 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. As such, the likelihood of releasing solids to the environment resulting in a negligible consequence is considered ***likely***.	
Consequence	**Likelihood**	**Ranking**
Minor	Likely	Medium

7.3.3 Environmental performance

<table>
<tr><th colspan="2">Hazard</th><th colspan="3">Unplanned discharge of solid waste</th></tr>
<tr><th colspan="2">Performance outcome</th><th colspan="3">Zero unplanned discharge of solid wastes into the marine environment</th></tr>
<tr><th>ID</th><th>Management Control</th><th>Performance standards</th><th>Measurement criteria</th><th>Responsibility</th></tr>
<tr><td>039</td><td rowspan="2">Waste generated during VBA will be managed in accordance with MARPOL 73/78 Annex V Regulation 9 and the vessel’s Waste Management Plan as required</td><td>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.</td><td>Garbage Record Book shall be maintained on all facilities in accordance with MARPOL 73/78 Annex V Regulation 9</td><td rowspan="3">Vessel Masters</td></tr>
<tr><td>040</td><td>Hazardous solid wastes will be managed in accordance with Marine Orders – Part 94 (Marine Pollution Prevention – Packaged Harmful Substances), Navigation Act 2012 and Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Part III) requirements, and Environmental Protection Regs (Controlled Waste)</td><td>A waste register will be maintained to show that hazardous wastes are being collected and returned onshore for disposal</td></tr>
<tr><td>041</td><td>Vessel lifting procedures implemented for ROV launch or monitoring equipment installation</td><td>All personnel involved with lifting equipment operations and maintenance receive adequate training and are competent appropriate to their level of responsibility</td><td>Training records and competency matrix</td></tr>
</table>

7.3.4 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 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
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 hazardous solids is not feasible; therefore, the risk from unplanned releases remains, but consequences are negligible.
Substitute any hazardous chemical use with non-hazardous chemical use	Substitute	No	No	Where appropriate, selection of chemicals or materials to achieve low or no environmental effect is made. Some hazardous waste is unavoidable from the use of batteries, lights etc. and therefore there are limited opportunities for substitution.
Installation of an active well monitoring system instead of the passive	Substitution	Yes	No	This system would require a longer period on location for installation and regular vessel visits to site for approximately 2 days every two weeks. This would therefore increase the possibility of an unplanned release significantly over the course of each year due to the increased frequency of vessels and activities in the field. The passive system is therefore considered to be more acceptable.
None identified	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.
None identified	Administrative	N/a	N/a	None identified. Maintenance management system implemented, compliance with relevant and appropriate MARPOL and legislative requirements, and certified equipment.

7.3.5 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 8 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 4), and no stakeholder concerns have been raised with regards to impacts from solid waste generation or unplanned discharges on sensitive receptors.

Laws, standards and industry best practice	Maintenance management system implemented, compliance with relevant and appropriate MARPOL and legislative requirements, certified equipment. No further controls were identified. The APPEA Code of Environmental Practice (CoEP) (2008) objectives are met with regards to all solid wastes, chemicals and other wastes are disposed of or recycled at appropriate facilities in accordance with legislative requirements and agreed procedures.
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 region 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: consequences and likelihood of pathways are assessed in section 7.3.1 and 7.3.2; • Preservation of critical habitats: the drilling location is remote from Protected Areas and aggregations of protected and migratory species that could be impacted above 'negligible' from solids discharges; • Assessment of key threats as described in species and Area Management /Recovery plans: see 'Conservation and management advice' below; • Consideration of North-West Bioregional Plan: The NW Bioregional Plan considers marine debris (such as entanglement and ingestion) a threat to turtles, dolphin, dugong, and various KEF. The proposed management controls are aligned with minimizing this risk; and • Principles of ecologically sustainable development ESD; with the proposed management controls, any worst-case impacts would not affect population levels, hence no impacts to biodiversity or ecosystem integrity are predicted.
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: • Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale); • 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.

7.4 Unplanned Release of (Non-Hydrocarbon) Liquids

7.4.1 Description of hazard

Unplanned discharge of liquids	Non-hazardous and hazardous liquids and chemicals are routinely transported to and from, stored and used aboard vessels, therefore, there is potential for these to be accidentally spilled to the marine environment. The maximum volume of non-hydrocarbons (such as solvents and detergents) released from the deck is likely to be small and realistically limited to the volume of individual containers (e.g. IBCs/ drums etc i.e. ~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 on board. Hazardous industrial liquid wastes may include radioactive materials, paint and thinners, waste oil, proprietary cleaning agents and chemicals for chemical injection. Dropped objects are discussed under Section 7.3. Accidental liquid releases may occur during any season at any time. Some chemicals may persist in the marine environment.

7.4.2 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, toxicity, persistence and bioaccumulation potential. Also, exposure may vary depending on the dilution and dispersion potential of the chemical, or whether the chemical floats/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.

For the purposes of this impact assessment, evaluation of the worst-case credible release scenario, that of 1 m^3 of a chemical accidentally discharged to the marine environment, has been evaluated.

Sensitive Receptor	Impact description
Water Quality	If non-hydrocarbon liquids are accidentally discharged, it is expected that the plume will largely disperse at sea surface due to the prevailing currents away from the release point and be diluted rapidly in the receiving waters. Potential impacts will include a temporary and highly localised increase in turbidity and decline in water quality with recovery likely within 24-hours. The potential for toxicity to marine fauna is limited due to the temporary exposure and low toxicity resulting from the rapid dilution in the marine environment. 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, and full recovery of water quality predicted within days.
Benthic Habitat	Reduction in water quality is expected to occur for a very short duration; as such any affects to benthic habitats are expected to be localised and temporary, given the water depth and the high dispersion of any potential marine pollutant in an open-ocean environment. 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 demersal species or benthic habitats on the seabed at impact concentrations. Sub-lethal or lethal effects from unplanned discharges at the seabed on marine fauna, is considered ***unlikely***

Sensitive Receptor	Impact description
	given the expected low concentrations and short exposure times. The consequence of an unplanned release of non-hydrocarbon liquids was assessed as ***Negligible –*** based on 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 degradation (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 will be dependent on the nature of the liquid released, toxicity and other chemical properties such as biodegradation and bioaccumulation potential. The Operational Area overlaps the Whale shark BIA but aggregations such as those found in Ningaloo are unlikely. Potential impacts to water quality are likely to be limited to the immediate vicinity (tens to hundred metres) of the release point and are not expected to affect overall population viability of these protected species. 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 depending on characteristics and volumes of the spilt chemical and the sea state, and, are likely to be limited to the immediate vicinity and unlikely to affect overall population viability or have economic impacts. 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	The control measures and checks proposed will ensure that the risks of unplanned releases of liquids to the marine environment are 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 ***unlikely*** based on the presence of bunding around non-hydrocarbon liquid containers, and drainage systems and volumes /types of liquids aboard but the fact that accidental losses to the environment have occurred within the industry.

Consequence	Likelihood	Ranking
Negligible	Unlikely	Low

7.4.3 Environmental performance

Hazard		Unplanned discharge of solid waste		
Performance outcome		**Zero unplanned discharges into the marine environment**		
ID	**Management Control**	**Performance standards**	**Measurement criteria**	**Responsibility**
042	Vessels are compliant with Marine Order 94 to prevent any packaged harmful substances from entering the marine environment	Safety data sheet (SDS) available for all chemicals to aid in the process of hazard identification and chemical storage and disposal management	SDS available on vessels	HSE Manager Marine superintendent Vessel master
043		Chemicals managed in accordance with SDS in relation to safe handling and storage, spill-response and emergency procedures, and disposal considerations	SDS available on vessels	
044	Vessels are compliant with Marine Order 93 to prevent any contaminating liquids and chemicals from entering the marine environment	Vessel chemical management is compliant with Marine Order 93: • Having a valid International Pollution Prevention Certificate; • Reporting marine incidents to AMSA – An incident involving a discharge from a vessel of a mixture containing a liquid substance, carried as cargo or as part of cargo in bulk, must be reported to AMSA via AMSA Form 196 (Harmful Substances Report form) within 24-hours; • Enacting a compliant Shipboard Marine Pollution Emergency Plan; • Using a compliant Cargo Record Book; and • Washing vessel tanks in accordance with the Pollution Prevention Act.	Valid International Pollution Prevention Certificate Valid SOPEP/SMPEP Cargo Record Book	
045	Spill kits on the vessel are present in areas of high spill risk	Spill kits are: • Located near high risk spill areas. • Intact, clearly labelled and contain adequate quantities of absorbent materials with waste managed as per vessel Waste Management Plan	Pre-start inspection	

7.4.4 ALARP assessment

<table>
<tr><td colspan="5">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.</td></tr>
<tr><th>Rejected control</th><th>Hierarchy</th><th>Practicable</th><th>Cost effective</th><th>Justification</th></tr>
<tr><td>No use of hazardous materials or production of wastes</td><td>Eliminate</td><td>No</td><td>No</td><td>Liquid 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 hazardous materials and waste is not feasible; therefore, the residual risk of unplanned releases remains but is low.</td></tr>
<tr><td>Substitute any hazardous chemicals use with non-hazardous chemicals</td><td>Substitute</td><td>No</td><td>No</td><td>Where appropriate selection of chemicals or materials to achieve low or no environmental effect is made. Some hazardous liquids are unavoidable with limited opportunities for substitution.</td></tr>
<tr><td>Installation of an active well monitoring system instead of the passive</td><td>Substitution</td><td>Yes</td><td>No</td><td>This system would require a longer period on location for installation and regular vessel visits to site for approximately 2 days every two weeks. This would therefore increase the possibility of an unplanned release significantly over the course of each year due to the increased frequency of vessels and activities in the field. The passive system is therefore considered to be more acceptable.</td></tr>
<tr><td>None identified</td><td>Engineering Isolation</td><td>N/a</td><td>N/a</td><td>All waste bins have lids and wastes are segregated at the time of disposal. No other engineering controls were considered.

Safeguards will be implemented as required, by the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and MARPOL Annexures I, II and III. Such safeguards include designated storage and handling areas, correct stowage, accurate labelling and marking, SDS information, spill clean-up equipment and containment (e.g. bunds). No other potential controls were identified.

The Activity is remote from sensitive receptors and coastlines.</td></tr>
<tr><td>None identified</td><td>Administrative</td><td>N/a</td><td>N/a</td><td>Maintenance management system implemented, compliance with relevant and appropriate MARPOL and legislative requirements, certified equipment. No further controls were identified.</td></tr>
</table>

7.4.5 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 8 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 4), and no stakeholder concerns have been raised regarding impacts from unplanned discharges of non-hydrocarbon liquids.
Laws, standards and industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) principles are met with regards to complying with relevant laws and regulations, and meeting industry's objective to maintain a social licence to operate. MARPOL requirements are internationally recognised in the shipping industry to manage the potential for pollution.
Environmental context & ESD	While unplanned liquid discharges could occur from the activity, the risk assessment process indicates credible discharges would have a temporary and localised impact on marine waters and will not result in significant impacts to marine fauna. The residual risk is considered acceptable after consideration of: • Potential impact pathways: Section 7.4.1 and 7.4.2 assesses the likelihood and consequences to water quality and marine habitats, flora and fauna from liquid spills; • Preservation of critical habitats: the location is remote from Protected Areas and aggregations of sensitive receptors; • Assessment of key threats as described in species and Area Management /Recovery plans: see 'Conservation and management Advice' below; • Consideration of North-West Bioregional Plan; the Plan regards chemical pollution/ contamination from oil and gas activities and vessels as a pressure on biodiversity, ecosystem function or integrity, social amenity or human health. This EP is aligned with the objectives of the NW Bioregional Plan by minimizing the risks of spills; and • Principles of ecologically sustainable development: the likelihood and consequence of the worst-case credible liquids spill is not predicted to impact above individual marine fauna or localized habitats; hence biodiversity and ecosystem integrity are not at risk.
Conservation and management advice	Minimising chemical discharge is an action identified by the Recovery Plan for Marine Turtles in Australia 2017-2027. This requires that best practice industrial management is implemented to minimise impacts to marine turtle health and habitats. A marine chemical spill is unlikely to result in population effects due to the controls in place for secure storage and on-board clean-up of spills, transient nature of marine fauna and the remote open ocean environment. There are no relevant management requirements in the recovery plan to implement for this hazard.

7.5 Unplanned Release of Hydrocarbons – Worst Case Scenarios

7.5.1 Worst case credible spill scenarios

Worst case hydrocarbon spill scenarios due to an unplanned event resulting in a Montara crude oil spill to the marine environment were identified during the preparation of the WOMP. Table 7-2 summarises the worst-case credible scenarios due to loss of containment event. Refer Table **2-1** for the well locations.

To determine the maximum worst-case credible spill volumes for each identified spill scenario, Jadestone has considered the AMSA (2015) guideline: *Technical guideline for preparing contingency plans for marine and coastal facilities* and NOPSEMA Bulletin #1 Oil Spill modelling (April 2019). 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 most likely be released in the event of a spill.

Sea Eagle-1 and Tahbilk-1 were temporarily abandoned by their respective original operators, and since that time there have been no observations of compromised well integrity. Further work is required before they can be classed as abandoned and until then monitoring of the wells is considered good oilfield practice. There is a low risk of hydrocarbons to surface with the existing mitigations in place. However, in line with the Jadestone Well Engineering Standards and the WOMP requirements in the OPGGSA a blowout contingency plan is necessary, and a relief well would be required for Level 3 Source Control. The most credible scenario is a pinhole leak from either well, requiring in-field remediation, this is in-line with offset experience across the industry and would trigger the release of the tethered communication module on the monitoring system.

If a leak is detected during annual ROV monitoring or by the remote monitoring system, time will be required to investigate the leak and plan for the plugging of the well. The most likely scenario is that small bubbles would be observed as the first indication that the barrier envelope is compromised. In such an event, an urgent planned well intervention campaign would be undertaken to enter the well and restore the barrier envelope. Depending on well condition and field development intentions, this may or may not result in well abandonment. A planned response process which includes preparation and submission of a WOMP, Vessel Safety Case Revision, procurement of equipment and services would take 6-12 months to respond to. Of this time, it is assumed that critical path time is due to vessel availability and mobilisation timing. If this factor is omitted, time to respond to the well could be as low as 15 weeks. A time breakdown is provided in Appendix J and is based on a prioritised schedule as usually experienced by the Australian Industry. Within the worst case 6–12-month time period, the discharged volumes would be significantly below those that represent LOWC volumes described below.

To ensure conservatism, a worst-case scenario of a full-bore loss of well control has been modelled for the EP which is also recommended by the IOGP (2019).

Table 7-2: Worst case hydrocarbon spill scenarios modelled due to a loss of well control event

Well	Surface or Subsea	Liquid release volume (m^3)	Gas release volume (Sm^3)	Release Duration
Sea Eagle-1	subsea	47,364	8,020,498	22 days
Tahbilk-1	subsea	236,149	1,062,150,676	77 days

Table 7-3: Worst case credible diesel spills to the marine environment due to a loss of containment event

Scenario	Maximum Worst Case Credible Spill	Release Durations
Release of diesel from vessel due to vessel collision	<250 m^3	5 hours

For the purposes of determining potential impacts, the volume of 906 m^3 has been used as this has been modelled previously for the Montara field and allows for larger vessels that may be required for monitoring system installation activities.

7.5.2 Hydrocarbon analogue for Sea Eagle-1 and Tahbilk-1

The Montara crude analogue was selected for Sea Eagle-1 and Tahbilk-1 as a full assay was not available for these fields.

Both the Montara field and Tahbilk fields hydrocarbons are contained in the Upper Jurassic Cycle IV reservoir, deposited in a shallow marine environment. The Tahbilk field can be reasonably expected to share a similar hydrocarbon to the deposit kitchen similarities.

The Sea Eagle field hydrocarbons are contained within the Early to Middle Jurassic Plover Formation, which was deposited in a more proximal environment than the Rowan Formation penetrated wells in the Tahbilk fields.

The use of analogy in the oil and gas industry is common. The use of analogues are commonly used for resource assessments, where both the producing field and the yet to be developed field share similar rock and fluid properties and can be used to determine the characteristics of pressure, temperature, reservoir drive mechanism, original fluid content, oil gravity, reservoir size, gross thickness, pay thickness, net-to-gross ratio, lithology, level of heterogeneity, porosity and permeability.

7.5.3 Credible worst-case scenarios

From the scenarios listed in Table 7-2 and Table 7-3, stochastic modelling was used to determine the greatest extent for exposure from each fraction of hydrocarbon (surface, shoreline, dissolved and entrained) to form the conservative combined RISK EMBA for all seasons for all identified scenarios (See Appendix B).

The LOWC scenario from a subsea release at Tahbilk-1 results in the greatest volume of oil and highest concentrations and shoreline loadings at all exposure thresholds due to the duration of the spill as Sea-eagle-1 was modelled to self-kill after 22 days. The surface diesel spill from a vessel collision is the greatest diesel spill (refer Section 7.7). Therefore, the RISK EMBA represents the greatest possible extent of each fraction and has been used to determine the area which identifies all the relevant environmental receptors to inform the hydrocarbon impact assessment.

7.5.4 Duration of LOWC worst case credible scenario

The worst-case credible scenario for an oil spill in the EP is a LOWC from Tahbik-1. The killing of the well using a relief well is the primary source control response, whereby a critical control is the timeframe for rig availability. To appropriately assess the timeframe to kill the well, Jadestone has undertaken a review of feasible rig availabilities and activities associated with relief well planning. This review found that 77 days is the number of days from the point of loss of containment to the point that the source is contained.

The 77 days' timeframe to kill the worst case well blow out scenario is based on the actual 54 days taken to drill the 2009 Montara relief well and kill the blow out. Based on the multiple suitable rigs available, to mobilise within 23 days to location and then spud the relief well and kill the well within 77 days is very realistic; and thus the 77 days response time used for the spill modelling in the EP is ALARP.

Table 7-4 indicates a range of options for rig locations, mobilisation and relief well response times. With Multiple relief well rig options being available, this reduces the probability of no rig or a delayed rig (availability not within the predicted timing) to a very low level. The loss of one rig option will result in a review of the other options to ensure coverage is still adequate and the 77 days is achievable. Given the water depth is ~80-90m, the use of a jack-up MODU is preferred and would be much simpler to position within the field. However, it has been confirmed that the majority of moored semi-submersible MODUs in the region can also work in these water depths, and so if necessary, should also be considered to drill a relief well as a second option to a jack-up MODU.

Table 7-4: Relief Well Options and Timeframes

Activity	Feasible Rig Options		
	Jack Up Rig stacked in Singapore	Suitable Semi-submersible rig in North-west Shelf area	Suitable Semi-submersible rig in Bonaparte or Browse basins
	Days	Days	Days
Prepare to Tow – includes suspending previous well.	7	9	9
Pull anchors	n/a	3	3
Tow to Location	14	8	3
Run anchors	n/a	3	3
Drill relief well and kill blowout well	54	54	54
Total	**75**	**77**	**72**

7.5.5 Discounted scenarios

Refuelling of helicopters on the helideck of vessels was discounted as a credible spill scenario to the marine environment due to the high volatility of aviation fuel.

A dragged anchor or misplaced anchor scenarios are discounted as the vessel will not be using anchors.

Refuelling of vessels will not occur within the operational area, therefore minor spills during bunkering operations were discounted.

The Swift manifold and 14" production flowline are located approximately 50 m from the Sea Eagle-1 wellhead. There is no known infrastructure within the proximity of the Tahbilk-1 wellhead. Damage to the Swift subsea manifold and 14" production flowline resulting in a release of hydrocarbons are further described in the NOPSEMA accepted Montara Operations EP (MV-90-PLN-I-00001). Given the size of vessels and the equipment being used for these VBA, there is not considered a credible risk of dropped objects impacting on the subsea infrastructure resulting in a loss of containment. Therefore, the potential scenario is not discussed further.

7.6 Worst Case Crude Oil Spills

7.6.1 Description of hazard

Crude oil release	A loss of well control during the life of this EP due to failure of a barrier either wellhead resulting in a release of crude oil at subsurface due to: • Loss of function downhole of safety critical equipment (loss of barriers); and • Damage to subsea well infrastructure (well valves, wellhead) or existing flowlines. Hydrocarbons may be released to the marine environment at the subsea wellheads (seabed) In a worst-case credible loss of well control scenario, large quantities of hydrocarbon (worst-case oil release 236,149 m^3 Montara crude) will be released to the marine environment until well control can be re-established.

7.6.2 Montara Characteristics

The properties of Montara crude oil and its weathering behaviour are detailed in the OPEP (Appendix A5), in Section 2.8 of this EP and in Section 4.1 of the OPEP.

7.6.3 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 GHD (2021). Far-field spill modelling was carried out with SINTEF's Oil Spill Contingency and Response (OSCAR) system (version 12.0). OSCAR is a system of integrated models that quantitatively assess the fate and transport of hydrocarbons in the marine environment.

The results for each hydrocarbon component and scenario were combined to create a total RISK EMBA to accommodate the modelling results.

A summary of the modelling method is described below.

1. **Stochastic approach**: The model was configured in stochastic mode to simulate the transport, spreading and weathering of specific oil types under the influence of changing meteorological and oceanographic forces. The start dates for the stochastic simulations were staggered approximately fortnightly across five years of hydrodynamic and wind data. A total of 150 individual 'realisations' made up the full stochastic simulation set for each of the spill scenarios.

   For each set of 150 stochastic realisations, OSCAR spatially tracked the surface oil, total submerged oil in the water column, dissolved oil and oil on shorelines. The 'total submerged oil' is comprised of dissolved oil and entrained oil (or droplets), and therefore provides a conservative (over) representation of the NOPSEMA (2019) thresholds for entrained oil.

2. **Modelling analogue**: Oil spill modelling in OSCAR is undertaken by selecting a hydrocarbon analogue from within the SINTEF Oil Library that provides the best match to the expected (target) hydrocarbon. SINTEF's NORNE (1998-13) was selected as the modelling analogue for Montara Crude. The whole oil properties are comparable across all parameters and it was selected as the most appropriate analogue. In addition, the comparison of the distillation curves of NORNE (1998-13) and Montara Crude match reasonably well, suggesting the hydrocarbons would have similar weathering behaviour. NORNE (1998-13) is a more persistent oil, with lower percentage mass recovered at the same temperature compared with Montara Crude. NORNE (1998-13) is therefore a conservative selection as a modelling analogue for Montara Crude on the basis of the distillation curve comparison.

3. **Contact thresholds**: oil spill models can 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 EMBAs will be influenced by the thresholds set in the hydrocarbon spill modelling.

4. **Data generated**: To present the large amount of simulated data in a meaningful way, contact thresholds are applied to each of the hydrocarbon components and OSCAR generates statistical spatial outputs of the instances when and where each threshold was exceeded. For example, if a contact threshold of 100ppb is applied to the dissolved component, the stochastic output from OSCAR will present the area of effect (potentially impacted) and associated probabilities (amongst other statistics) for which the concentration of dissolved hydrocarbons exceeded 100ppb at any model grid cell during any of the realisations

5. **Probability contours**: the 'contact probability' is a statistic applied to stochastic simulations that indicates the percentage of realisations that a threshold was exceeded at any instant, during any realisation, at a particular location. The thresholds may be an instantaneous concentration (ppb) or

a mass per unit area (g/m2).4As an example, a contact probability of 60% at a location means that the threshold was exceeded for at least one time step in 60% of stochastic realisations.

6. **Completion of modelling**: each of the simulations was run for a period of five weeks following the end of spill track allowing for the fate of dispersed hydrocarbons to be evaluated.
7. **Scaling Analysis of Shoreline Loading of Small Islands**: Five small Australian islands (Cartier Island, Ashmore Reef, Adele Island, Montalivet Island and Cassini Island) have smaller characteristic length scales than the minimum model shoreline length (~8.7 km which is the diagonal length of the ~6km model cells for the LOWC scenario). A scaling analysis to reduce the simulated shoreline loading onto the larger modelled islands was used to estimate a more realistic loading onto the actual small island dimensions on the basis of the model output. The shoreline scaling factors are presented in Table 7-5.

Table 7-5: Small Island Scaling factors

Receptor Name	Scaling factor (%)
Cartier Island	7
Ashmore Reef	19
Adele Island	37
Montalivet Island	72
Cassini Island	45

7.6.4 Exposure pathways and impact thresholds

To assess environmental effects from an unplanned hydrocarbon release, four separate hydrocarbon components that pose differing environmental risks were evaluated (refer Table 7-6):

- 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 (biological organism) 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 was determined by contemporary scientific knowledge. Appendix F provides a summary of the contact thresholds applied, and represents a consistent, logical and robust approach in the selection of oil exposure values.

7.6.5 Modelling results of the LOWC scenario

Modelling results for potential exposure to surface, water column and stranded hydrocarbons are described in Table **7-7** and depicted in Figure 7-1. The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that Jadestone propose to have in place during the campaign to reduce volumes and/or prevent hydrocarbons from reaching sensitive areas.

Table 7-6: Summary of the contact thresholds applied in the impact assessment of the hydrocarbon spill modelling

Floating oil (g/m^2)		Shoreline Oil		Entrained oil (ppb)		DAHs (ppb)	
1	Low (approximates range of socio-economic effects and establishes planning area for scientific monitoring)	100	Moderate (loading predicts area likely to require clean-up effort)	100	High (as appropriate given oil characteristics for informing risk evaluation)	50	Medium (approximates potential toxic effects)
10	Moderate (approximates lower limit for harmful exposures to birds and marine mammals)						

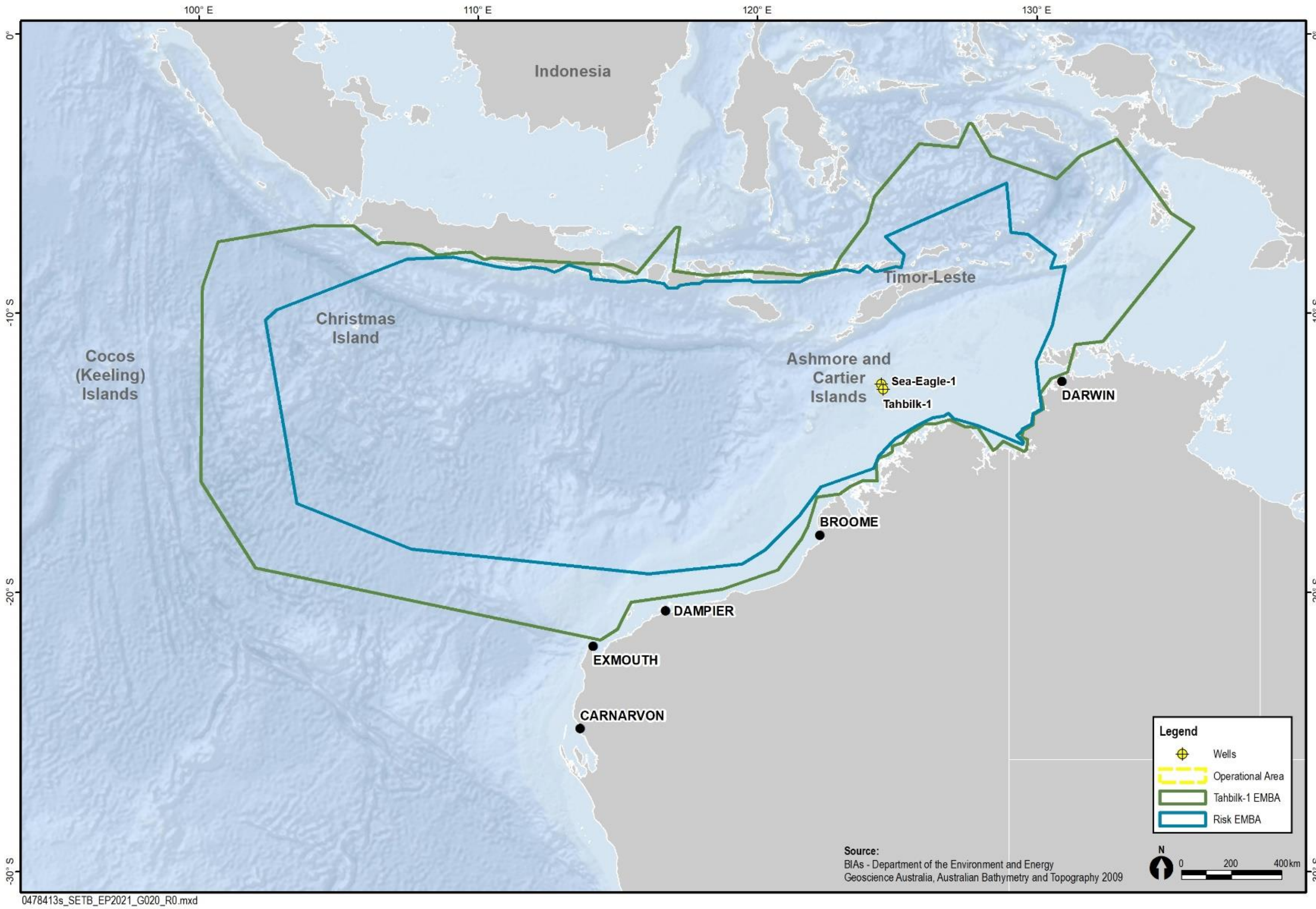


Figure 7-1: Predicted moderate exposure RISK EMBA within the overall Tahbilk-1 low exposure RISK EMBA

Table 7-7 Worst case Tahbilk-1 LOWC modelling results summary

Scenario	**Montara crude (236,149m³), Tahbilk-1 subsea spill. Source GHD 2021**
Shoreline	Shoreline loading above the moderate threshold (100 g/m²) was predicted to extend to ~850km to the south. Shoreline accumulation above the moderate threshold (100 g/m²) was predicted at a large number of environmental receptors as follows: • Across all shorelines is predicted, a maximum accumulated shoreline load of 3,685tonnes, a minimum arrival time of 3.6days and a maximum length of oiled shoreline of 923km. • High to very high contact probabilities of 60-96% occurred at Indonesia, Nusa Tenggara Timur, Ashmore Reef, Scott Reef North, Scott Reef South, Cartier Island and Seringapatam Reef. Large maximum accumulated shoreline loads were predicted at these locations including 2,284 tonnes at Indonesia, 2,205 tonnes at Nusa Tenggara Timur,1,026 tonnes at Scott Reef North, 1,108 tonnes at Scott Reef South and between 24tonnes and 464tonnes at the other receptors. Minimum arrival times of shoreline loading at these locations ranged between 4days at Cartier Island to 18days at Scott Reef North. Maximum predicted lengths of shoreline accumulation were between 600 m at Cartier Island and 592 km at Indonesia. • Moderate contact probabilities of 10-28% were predicted at Maluku, Nusa Tenggara Barat, Timor-Leste, Adele Island, Cassini Island and Imperieuse Reef. Maximum accumulated shoreline loads at these receptors were between 26tonnes at Imperieuse Reef and 1,287tonnes at Maluku. Minimum arrival times of shoreline loading at these locations ranged between 22days at Cassini Island to 70days at Imperieuse Reef. Maximum predicted lengths of shoreline accumulation were between 4km at Cassini Island and Adele Island to 409km at Maluku. • Low probabilities of contact (<10%) were predicted at several other receptors.
Surface	Surface oil above the moderate threshold (10 g/m²) was predicted to occur at distances over ~400km to the west of the release location. Surface oil impacts at the moderate threshold include: • A 100% contact probability was predicted at Sharks BIA, North-West Slope Trawl Fishery, Western Skipjack Fishery and Western Tuna and Billfish Fishery, with maximum time-averaged oil concentrations between 42 and 43g/m2and a minimum arrival time of less than 1day • A very high contact probability of 94% was predicted at Seabirds BIA and Vulcan Shoal. Maximum time-averaged oil concentrations were 42g/m² and 28 g/m², respectively, and had minimum arrival times of 3 and 1 days, respectively. • High contact probabilities of 35 -65% were predicted at Marine Turtle BIA, Whales BIA, Ancient Coastline at 125m Depth Contour, Ashmore Reef and Cartier Island and surrounding Commonwealth Waters, Carbonate Bank and Terrace System of the Sahul Shelf, Continental Slope Demersal Fish Communities, Barracouta Shoal and Cartier Island. Maximum time-averaged oil concentrations range between 21g/m² and 33g/m² and a minimum arrival time of 4 to 10 days. • Moderate contact probabilities of 10-25% were predicted at Cartier Island MP, Kimberley MP, Oceanic Shoals MP, Heywood Shoal, Johnson Bank, Ashmore Reef and Sahul Bank. Maximum time-averaged oil concentrations at these receptors ranged from 14g/m² to 27g/m², while minimum arrival times ranged from 10 to 20 days. • Low contact probabilities (<10%) were predicted at Ashmore Reef MP, Dugong BIA, Northern Prawn Fishery, Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex, Baldwin Bank, Barton Shoal, Hibernia Reef, Holothuria Banks, Penguin Shoal, Scott Reef North, Seringapatam Reef, Van Cloon Shoal, Woodbine Bank, Indonesia and Nusa Tenggara Timur, with maximum time-averaged concentrations of 10–21g/m² and minimum arrival times of 19 to 92days.

Scenario	Montara crude (236,149m^3), Tahbilk-1 subsea spill. Source GHD 2021
Total submerged oil (entrained plus dissolved oil)	Total submerged oil at the moderate threshold (100 ppb) was predicted to occur across a large area of the portions of the Indian Ocean between Australia and Indonesia, with sparse scattering extending up to ~2,500 km from the release location, but the majority remaining within ~800km. Total submerged oil impacts at the moderate threshold (100 ppb) include: • Very high contact probabilities of 82-100% were predicted at Sharks BIA, North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery, Western Tuna and Billfish Fishery, Whales BIA, Seabirds BIA and Marine Turtle BIA. Maximum time-averaged concentrations at these receptors ranged between 410ppb and 970ppb, with minimum arrival times of 0.1-3days. • High contact probabilities of 33-65% were predicted at CSDFC, Ashmore Reef and Cartier Island and surrounding Commonwealth Waters, Barracouta Shoal, Cartier Island MP, Cartier Island, and Carbonate Bank. Maximum time-averaged concentrations at these locations ranged between 420ppb and 517ppb, with minimum arrival times of 2 days for all receptors except Barracouta Shoal, which had a minimum arrival time of 1 day (26 hours). • Moderate contact probabilities of 11-32% were predicted at Oceanic Shoals MP, Vulcan Shoal, Northern Prawn Fishery, Woodbine Bank, Ancient Coastline, Ashmore Reef MP, Johnson Bank, Sahul Bank, Argo-Rowley Terrace MP and Ashmore Reef. Maximum time-averaged concentrations at these locations ranged between 171ppb and 301ppb, with minimum arrival times of 1-24 days. • Low contact probabilities (<10%) occurred at a large number of receptor locations
Dissolved	Dissolved hydrocarbons at the moderate threshold (50 ppb) were predicted to extend a maximum distance of ~50 km from the release location. Dissolved oil impacts at the moderate threshold (50 ppb) include • Sharks BIA, North-West Slope Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery and Western Tuna and Billfish Fishery were predicted to be contacted at the with a 93% contact probability. • Maximum time-averaged concentrations at all receptors was 152 ppb and minimum arrival time of 0.1 days (2.4 hours).

7.6.6 Impacts and risks

The environmental consequences of a loss of well control are highly variable, dependent 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 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);
- Physical damage and/or disturbance to unique KEF and AMP values; and
- Socio-economic, human health impacts and reputational damage.

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).

7.6.7 Level of Impact on Sensitive Receptors within the moderate RISK EMBA

Table 7-8 lists key potential impacts to sensitive receptors present in the moderate RISK EMBA. Appendix H summarises the scientific monitoring plans potentially activated in response to predicted contact, and Appendix I details the SMP framework.

Table 7-8: Potential impacts to sensitive receptors present in the moderate RISK EMBA

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 contacted by stranded oil include intertidal coral reefs, cays, sandy shorelines, 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 into 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 B and could be impacted by surface oil. Stranded oil was predicted to contact sandy beaches along the WA/NT coast and coasts of Indonesia and Timor Leste (Figure 7-1). These locations have the potential to provide habitat for EPBC Act listed reptiles and seabirds but also

habitat for invertebrates including polychaetes, molluscs, marine crustaceans, semi-terrestrial crustaceans and insects. Potential impacts to reptiles and seabirds are discussed under marine fauna below.

De La Huz et al. (2005) investigated the impacts of the Prestige oil tanker spill off the Galician coast on 17 exposed sandy beaches. The study investigated species richness of polychaetes, molluscs, marine crustaceans, semi-terrestrial crustaceans and insects on the affected beaches, by comparing the total number of species in each group before and after the oil spill. The investigation identified that the most affected beaches lost up to 66.7% of the total species richness after the oil spill and dry sand areas received the highest volumes of hydrocarbons ashore.

Quantitative spill modelling conducted by GHD (2021) predicted that during the unlikely event of an uncontrolled well blowout the maximum accumulated oil ashore >100g/m^2 would be 1,453 tonnes at the Joseph Bonaparte Gulf (NT), and ~2,200 tonnes at Indonesia and Nusa Tenggara Timur coastlines (International). Based on the earliest predicted shoreline contact of 3.6 days at Cartier Island and 7 days to Ashmore Reef (where mangroves are known to occur) it is anticipated that the majority of shorelines will be exposed to weathered Montara crude waxy sheets or flakes that are biodegradable and generally of lower toxicity than the oil itself, due to containing less of the more toxic lighter hydrocarbon fractions, which tend to be lost through volatilisation. Therefore, impacts on sensitive receptors at sandy beaches are limited to the physical effects from the presence of such waxy residues and coating as opposed to toxicity effects.

Thomas (1978 cited in French-McCay 2009) observed recovery of invertebrates after three years on sandy beaches oiled by the 1970 Arrow spill of Bunker Oil. Additionally, Judd et al. (1991 cited in French McCay 2009) observed dune vegetation recovery after three years following removal experiments.

Timeframe to recover

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 saltmarshes

Sensitivity

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 surface 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

Quantitative spill modelling conducted by GHD (2021) predicted that during the unlikely event of an uncontrolled well blowout the maximum accumulated oil ashore >100g/m^2 would be 1,453 tonnes at the Joseph Bonaparte Gulf (NT), and ~2,200 tonnes at Indonesia and Nusa Tenggara Timur coastlines (International). Based on the earliest predicted shoreline contact of 3.6 days at Cartier Island and 7 days to Ashmore Reef, oil reaching coastal mangrove communities is expected to be weathered. It is therefore anticipated that shorelines will be exposed to Montara crude wax, which could coat mangrove breathing pores and cause some sub-lethal effects from toxicity. These mangroves are identified as KPI values within many of the respective management plans. Floating crude oil could reach salt marsh areas (e.g. North Kimberley MP), which are often landward of mangrove communities, on high spring tides.

Timeframe to recover

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. However, if a shallow entrained/dissolved hydrocarbon plume were to intercept a mass, synchronous spawning event, recently spawned gametes and larvae would be particularly vulnerable to oil spill effects. Being generally positively buoyant they would be exposed to surface spills. Under most circumstances, impacts on plankton are expected to be localised and short term; however, if an entrained/dissolved surface expression reached a coral or fish spawning location during a spawning event, localised short to medium term impacts could occur.

Commercial target fish species have been reported to spawn in offshore waters within the moderate RISK EMBA, with spawning and juveniles most likely to occur around reefs and bays in nearshore shallow waters (Section 4). The southern bluefin tuna in the Indian Ocean, spawning ground extends between northern WA and Java from 7° S to 20° S, approximately 200 km to the west of the Operational Area. Spawning occurs between August and April (with a peak period from October to February) (DOE 2015b). In the unlikely event of a spill occurring, there is potential for a reduction in successful fertilization and larval survival as a result of elevated entrained and to a lesser extent the dissolved hydrocarbons (Given the area of overlap of impact concentrations compared to the whole spawning grounds, any incidental impacts to fish larvae beyond the predicted area for impact are unlikely to be of consequence to fish stocks, particularly compared with significantly larger losses through natural predation and fishing.

Potential impact from modelled event

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 moderate RISK EMBA. The moderate RISK 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 most plankton concentrate and closest to the spill source. Larvae within small areas of the KEF – Continental Slope Demersal Fish Communities have a 95 % probability that a part of the KEF could be exposed to total submerged oil ≥100 ppb, but likelihood is lessened significantly depending on the timing, species and location of the spawning.

Recovery timeframe

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 surface 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 coating 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

Benthic habitats in the moderate RISK EMBA that may be impacted by entrained oil include soft sediments and benthic fauna, coral reef, sponges, macroalgae and seagrasses. The nearest shoals to the Montara field are Goeree and Vulcan Shoals, approximately 28 km to the southwest, Eugene McDermott Shoal (approximately 41 km south) and Barracouta Shoal (approximately 39 km northwest).

The Barracouta and Vulcan Shoals plateau at approximately 20- 50 m depth (Heyward et al. 2011a). Occasional higher ground rises to within approximately 10 m of the sea surface, hence not be contacted by a surface slick. Contact with total submerged oil above the 100ppb concentration threshold is predicted at a number of reefs, shoals and banks with a probability ranging from <1 to 88.7% (Barracouta shoal) in the moderate RISK EMBA. Consequently, impacts to benthic habitats are possible in shallow water areas. Exposure to dissolved aromatics above the 50 ppb threshold is predicted at Vulcan shoal but with a very low (3.3%) probability. Potential impacts may vary significantly, depending on, shoal location and depth, spill volume and season.

In the event of exposure, filter feeders present at submerged reefs and shoals, including corals, are at risk of ingesting entrained hydrocarbons and absorb dissolved aromatics with lethal and various sub-lethal effects. The latter include alteration in respiration rates, decreases infilter feeding activity, reduced growth rates, biochemical effects, increased predation, reproductive failure and mechanical destruction by waves due to inability to maintain a hold on substrate (Ballou et al. 1989; Connell and Miller 1981).

Emergent regionally important coral reef communities, including protected areas at Ashmore Reef MP, Cartier Island MP (approximately 149 km and 106 km respectively from the Montara field), Seringapatam Reef, Browse Island, Scott Reef and International coastlines may be impacted by exposure to surface hydrocarbons and have contact with total submerged hydrocarbons above the 100 ppb threshold. Cartier Island MP is the most exposed with a probability of 25.3% of surface oil >10g/m^2, and 82% probability of total submerged oil >100 ppb.

Exposure to dissolved aromatics above the 50 ppb threshold is not predicted at any receptors other than fisheries and the whale shark BIA.

Any contact by oil at coral reef locations during spawning events (October/November) has the potential to cause significant population level impacts.

The Montara Environmental Monitoring Program included a study to determine the level of impact of any Drilling Activity spill incident on the marine life of various submerged banks, shoals and coral reefs that are within the moderate RISK EMBA (Heyward et al. 2010, 2011a). Key findings of this study identified that shoal and reef communities showed no obvious signs of recent disturbance attributable to the spill.

A review of the depth at which submerged reefs and shoals in the area surrounding the title area reach a plateau indicates that the area of highest biodiversity is at a water depth of 20 to 40 m which is where entrained oil may be present at above impact thresholds.

Within the moderate RISK EMBA, seagrasses occur along the mainland coastline of the Northern Territory and Western Australia and within the protected coastal areas of islands, including Barracouta Shoal and Vulcan Shoal located approximately 28 km southwest supports up to 36% seagrass cover (*Thallasodendron ciliatum*) (Heyward *et al.* 2010),the Tiwi Islands, outer Darwin Harbour and in the waters surrounding the Van Diemen Gulf adjacent to Arnhem Land (Roelofs et al. 2005) and Buccaneer Archipelago located north of the Dampier Peninsula (Wells et al. 1995). Ashmore Reef MP seagrass supports a small dugong population (Whiting and Guinea 2005).

A significant loss of seagrass was recorded at Vulcan Shoal in 2011 when compared with data from surveys conducted in 2010, six months after the Montara oil spill. The cause of seagrass loss at Vulcan Shoal cannot be determined, however is noted that a delayed effect from the Montara incident resulting in a change sometime between 6 and 18 months after the incident is considered unlikely to be due to the Montara spill (Heyward et al. 2011a).

Recovery Timeframe

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 and degree of exposure (duration and concentration).

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 basking on the surface or 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 contact nests. Entrained and dissolved oil may harm to internal anatomy if ingested, irritation or damage 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 sea snakes due to exposure to hydrocarbons is based on impacts due to heavy oils. Impacts due to exposure to DAHs are less understood. One information source provides a case study detailing a spill of 440,000 gallons of aviation gasoline nearby to an island supporting approximately 1,000 green turtles that aggregate and nest at the atoll in the west Pacific Ocean annually (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 sea snakes are not expected. Impacts to turtle hatchlings may occur however due to the risk of them becoming entrained in a parcel of water allowing them to be continuously exposed to toxic hydrocarbons for an extended period

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 contact 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

The moderate RISK EMBA intersects with a number of nesting, inter-nesting and foraging BIAs for Threatened and Migratory marine turtle (Figure 7-1). Significant habitats, in particular nesting areas, include Ashmore Reef MP and Cartier Island MP, Cassini Island, Sandy Islet (Scott Reef), Browse Island and Dampier Archipelago. Surface concentrations above 10 g/m^2 are predicted to reach the nesting BIAs for green turtles (Ashmore Reef MP and Cartier Island MP) in a minimum time of 10.4 and 19.5 days, and other turtle BIAs within 5.6 days.

Quantitative spill modelling conducted by GHD (2021) predicted that the surface oil will be highly weathered before shoreline contact is made and only waxy residues of a lesser toxicity are expected to accumulate on the shoreline. Turtles on the shoreline, in particular, hatchlings may be impacted by exposure to weathered hydrocarbons where impacts are more likely to be physical coating rather than acute toxicity. However, it is noted that while less toxic to eggs and embryos than freshly spilled oil, weathered oil residues can still have significant impacts on hatchlings and adult turtles including acute toxicity, impaired movement and normal bodily functions (Shigenaka, 2003 and increased vulnerability to predation.

Both hatchlings, juveniles, and adult turtles can be affected through the ingestion of tar balls typically through starvation from gut blockage, decreased absorption efficiency, absorption of toxins, and buoyancy problems caused by the build-up of fermentation gases (floating prevents turtles from feeding and increases their vulnerability to predators and boats) (Shigenaka, 2003). However, turtles have been shown to have a well-developed hepatic system of enzymes (cytochocrome P450-1A) to metabolise organic contaminants and aid in elimination from the body. Glutathione transferases (a cellular defence against electrophilic DNA damage by such toxicants as PAHs) have also been isolated from green sea turtles. Therefore, when turtles are exposed to PAHs in crude oil in low dosages, endogenous mechanisms exist to enhance elimination of xenobiotics compounds out of the organism (Gagnon and Rawson, 2010).

Based on the above information, it is anticipated that in the unlikely event of an uncontrolled well blowout turtles, in particular hatchlings, may be impacted by exposure to hydrocarbons. Stranded oil with its proximity to sandy beaches with known turtle nesting habitats, in excess of the threshold, may have effects on populations, turtle nesting and juveniles

Two species of listed sea snakes were identified that may occur in, or have habitat in the moderate RISK EMBA, short-nosed sea snake and leaf-scaled sea snake, both critically endangered. Sea snakes are known to occur at several locations in the moderate RISK EMBA including Cartier Island and Hibernia Island with established populations of several species present (Guinea, 2013). Sea snakes have also been reported in high abundance at Ashmore Reef in the past, but recent evidence has shown a significant decline in numbers. Based on colour patterns of the sea snake species observed during a recent survey there is thought to be very little gene flow between reefs implying that if a species is lost from a reef, 189uthorized189n189n may take several years (Guinea, 2013). The short-nosed sea snake is known from Ashmore Reef and the leaf-scaled sea snake is known from both Ashmore Reef and the reefs off Cartier Island. Montara Commission of Inquiry reported one dead sea snake as a result of the Montara oil spill in 2009 (PTTEP AA 2010), during which surface hydrocarbons were present for more than 74 days, with an accumulative area exposed to Montara crude wax and sheen of 95,554 km^2 (PTTEP AA 2012). However, a range of sub-lethal impacts and further mortalities may have occurred. **Recovery Timeframe** 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 multiple 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). 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 moderate RISK 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 contact 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 moderate RISK EMBA during the foraging activity occurring in July-November each year, albeit in low densities. 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. It is noted that the area exceeding dissolved thresholds for impact is to approximately 50 km from the release site (albeit at a very low probability, non-continuous concentrations that vary with depth and direction) and this area is only a portion of the full extent of the whale shark BIA. However, the probability of some of the Shark BIA being exposed to dissolved and total submerged oil above impact thresholds is 100%.

The NW Marine Bioregion 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 moderate RISK EMBA are also part of protected areas such as AMPs or KEFs and may also be targeted in the commercial fishing industry.

Recovery Timeframe

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

Following the Montara blowout, the Montara Environmental Monitoring Program included a study to determine effects of the spill incident on commercial fish species in Australian waters (Gagnon and Rawson 2012). The results of this study identified evidence of exposure of targeted fish species to petroleum hydrocarbons within the vicinity of the Montara well head platform, but limited signs of adverse health or reproductive effects related to hydrocarbon exposure, as captured fish were in good physical condition (Gagnon and Rawson 2012). Based on this evidence from within the same geographical region, in the unlikely event of an uncontrolled well blowout, significant impacts on fish are considered to be unlikely. Potential impacts to commercial fish spawning are considered below with other planktonic communities.

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, 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 moderate RISK EMBA are more likely to occur in the area during the northern migration period in June/July and southern migration in Sep/Oct so a sea surface plume (>10 g/m^2) of oil might contact humpback whales as they migrate. Similarly, pygmy blue whales may encounter a sea surface plume (>10 g/m^2) as they pass through the area during their northern migration in May–August.

Dugongs are distributed off the northern coast of WA, extending around the Northern Territory coastline. Established seagrass habitats including Vulcan Shoal, Ashmore Reef, Cartier Island and shallow waters along the mainland coastline and islands of Australia and Indonesia may provide dugong habitat. A small percentage of the Dugong foraging BIA around the Dampier Peninsula also overlaps the moderate RISK EMBA, therefore putting them at risk of contact with a sea surface plume (>10g/m^2) whilst foraging in this area.

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. Dugong populations may be indirectly affected by the loss of seagrasses meadows impacted by entrained or dissolved oil phases at a number of shoals and island locations.

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 moderate RISK EMBA for DAHs include whales and dugongs 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 marine mammals 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 moderate RISK EMBA include threatened and migratory whales and dolphins, and potentially dugongs. The risk of a LOWC is present at any time in the year and may overlap with pygmy blue whale migration and humpback whale migration and calving as well as dugong foraging, calving and breeding. Crude oil may contact whales and dugongs during these life stages when the fauna are less likely to move away from affected areas if undertaking critical breeding activity.

Surface concentrations above the impact threshold of 10 g/m^2 are predicted from the stochastic modelling to reach the BIA for Pygmy blue whale in a minimum time of 6 days. The likelihood of contact for some part of the BIA is predicted to be 100 % for exposure to concentrations of surface oil >10g/m^2. Dugong BIA has a 0.7% probability of exposure to surface oil >10g/m^2. For coastal dolphin species (Australian snubfin and Indo-pacific humpback dolphins), surface concentrations greater than 10 g/m^2 are not predicted to reach BIAs.

Total submerged hydrocarbons may reach parts of the BIAs for pygmy blue whales with a probability 100% at concentrations above the thresholds for impact, and 30% probability for dugong BIAs, whilst the dolphin Bias have a 3.3% probability of contact with total submerged hydrocarbons >100ppb. Dissolved hydrocarbons are not predicted to contact marine mammal BIAs. As such, individuals may pass through areas with exposure to elevated concentrations along parts of their migratory routes and therefore be affected.

Recovery Timeframe

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 impeded migration and calving. Recovery of individual cetacean 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 haemolytic anaemia, 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

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. In particular, Ashmore Reef, Cartier and Browse Islands support internationally significant numbers of breeding seabirds and migratory shorebirds with all species variously listed under the EPBC Act. Ashmore Reef is also a Ramsar wetland of international importance. Up to 33 migratory shorebirds species and 18,000 individuals have also been documented using the reserves (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 moderate RISK EMBA during their annual migrations. A number of BIAs in addition to Ashmore Reef, Cartier and Browse Islands for seabirds have been identified within the moderate RISK EMBA. Surface concentrations above the impact threshold of 10 g/m^2 could reach seabird BIAs in a minimum time of 3.4 days at 95% probability.

The full extent of shoreline habitats exposed to accumulated concentrations greater than the 100 g/m^2 threshold is illustrated in Figure 7-1. It has been estimated that as little as four microliters of petroleum contaminating a fertile egg can cause the embryo to die (AMSA 1998), and there is potential for serious impact of oiling of birds from shoreline hydrocarbon contact should the nest be within tidal reach.

Given the earliest shoreline contact, during any season is 3.6 days at Cartier Island, hydrocarbons are expected to have weathered resulting in stranded hydrocarbons containing lower amounts of toxic volatile components.

However, weathered oil has been shown to reduce hatching success in exposed mallard eggs (Finch et al. 2011), and adverse effects from the leaching of PAHs from weathered oil have been observed years after the Exxon Valdez oil spill (Esler et al. 2002, 2010). Shorebirds foraging and feeding in intertidal zones are at potential risk of exposure to shoreline hydrocarbons, potentially causing acute effects.

Following the Montara well release in 2009, petroleum-based products were reported in the vicinity of Ashmore Reef MP and Cartier Island MP. Small numbers of oiled seabirds were recovered both at sea and on the islands at Ashmore Reef, although search effort was limited (Clark and Herrod 2016). In a post-impact study of the effects of the spill on bird populations, the total number of seabirds breeding at Ashmore Reef was found to increase after the spill event when compared to pre-impact data (Clark and Herrod 2016). This trend also applied to breeding populations of individual seabird species. Declines in non-breeding seabirds during were detected and some of these declines met the a priori definition of significant impact. As breeding populations increased over the same time period, Clark and

Herrod (2016) conclude that these declines likely reflect variability in seasonal response rather than evidence for significant impact arising from the Montara oil spill. Declines in migratory shorebird numbers were detected at Ashmore Reef following the spill, however, this response was anticipated given ongoing declines of migratory shorebirds throughout the flyway. When compared with control sites at Eighty-mile Beach, WA, the decline in numbers was not found to be significantly different and therefore no significant impact as a result of the Montara spill. **Recovery Timeframe** 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 multiple years.
Socio economic
Sensitivity *Floating* Surface oil may impact upon socio-economic receptors including the oil and gas industry, commercial shipping, fisheries (commercial and traditional)/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. Response activities can require temporary exclusion zones. A sheen of oil (1g/m^2) may be visible slightly further than the RISK EMBA for biological impacts boundary and impact on the values of a MPs or tourism beaches. Many of the protected areas have 'wilderness' and 'seascapes' identified as values, 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 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 clean-up 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. Generally, there is little recreational fishing that occurs within the moderate RISK EMBA due to its distance from land and deep waters. Recreational day fishing is concentrated around the population centres of Broome, Derby and Wyndham, as well as other readily accessible coastal settlements which are generally at the edge of the moderate RISK EMBA some distance away from the well location. These areas are predicted through stochastic modelling to be reached by a surface slick above the visible threshold of 1 g/m^2. Commercial fisheries that transect the moderate RISK EMBA predominantly operate in shallower waters with generally low levels of fishing activity reported (AFMA 2012) (Section 3.6).

The MOU, within the Australian Fishing Zone encompasses Scott Reef and associated reefs, including Seringapatam Reef, Browse Island, Ashmore Reef, Cartier Island and various banks within the moderate RISK EMBA. These areas are predicted through stochastic modelling to be reached by a surface slick above the impact threshold of 10 g/m^2. Under the MOU, Indonesian and Timorese fishermen are legally permitted to harvest marine products using traditional methods. The peak fishing season is between August and October with fishers departing the region at the onset of the northwest monsoon season. Therefore, traditional fishing could be affected by impacts to fish and benthic habitats (discussed in the above subsections). It is noteworthy that after the Macondo oil spill, the multi-species tuna fishery landings had recovered within one-year (Carroll et al. 2016) and the shrimp (prawn) harvest rebounded only two years after the spill. Inaccurate negative public perceptions towards a fishery following a spill could be mitigated at the time by positive marketing as was effective after Macondo. The overall consequence ranking for fishing from exposure to hydrocarbons is ***Major*** with recovery predicted in multiple years. Most recreational and tourism activities in the region occur predominantly in WA State and NT waters. Coastal waters north of Broome, WA through to the eastern cape of East Arnhem, are predicted through stochastic modelling to be reached by a surface slick above the threshold of 1 g/m^2. Limited tourism activities occur at Scott Reef, Ashmore Reef and Cartier Island (Section 3.6), which are predicted to be reached by a surface slick above the threshold of 10 g/m^2. Natural features visited by tourist fishing charters and bird watching tours may therefore be affected in the event of a well blow out. Shoreline exposure has the potential for localised short-term impacts to marine-based tourism and recreation in the area. Modelling predicts 6% probability that shoreline loads >10 g/m^2 will occur at the Joseph Bonaparte Gulf (NT) and Kimberley Coast. The earliest predicted shoreline contact is 47.6 days at Joseph Bonaparte Gulf (NT) on the mainland, all other shorelines with shorter time to contact are uninhabited offshore islands. As such, stranded oil is expected to weather naturally and breakdown with assistance of ocean currents and as a result, only waxy residues of a lesser toxicity are expected to accumulate on the shoreline. Tourism also has the potential to be impacted if exclusion zones are implemented where AMSA's spill response strategy overlaps with key visiting areas. Alaska's tourism economy took approximately two years to recover from the Exxon Valdez (BOEM, 2017). The Eastern Research Group (2014) reported that while the Macondo spill had had a significant impact on several areas of tourism in the short term and had wide-ranging impacts across the Gulf, the tourism economy has rebounded to pre-spill levels within four years. The overall consequence ranking for tourism and recreation activities from exposure to hydrocarbons is ***Moderate.*** For the low level of commercial shipping activity transiting the moderate RISK EMBA, exposure risk is limited to surface slicks potentially oiling vessel hulls and requirements to deviate around exclusion zones during the response activities. Similar exposure is predicted for Defense activities such as Customs Coastwatch, Navy and Customs vessels operating in the RISK EMBA as well as for Petroleum Exploration and Production operators in the Timor Sea. Overall consequences to shipping, defense and other Oil and Gas Operators is ranked ***Minor*** with recovery in weeks to months***.*** **Recovery Timeframe** 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 may be based on tainting disappearing. Reputation may be impacted nationally with persistent national coverage, with full recovery taking multiple years. **Consequence** The consequence of a loss of well control event on socio-economic receptors was assessed as **Majo**r given impacts on the values of tourism and fisheries may take multiple 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 MP values fauna including listed dugongs, sea snakes (protected), fish, avifauna and other marine mammals. Impacts to these receptors are described under individual receptors.

Potential Impact from Modelled Event

AMPs

The following AMPs are present within the moderate RISK EMBA and have potential to be exposed to surface oil >10g/m^2: Cartier Island MP (25.3 %), Ashmore Reef MP (7.3%), Oceanic Shoals MP (16 %), Kimberley MP (18 %). Surface oil could be expected to accumulate at some locations (e.g. Cartier Island and Ashmore Reef have >95% probabilities of exposure to shoreline oil >100g/m^2.

Elevated total submerged hydrocarbons above moderate impact thresholds (>100ppb) are predicted in the Cartier Island MP (82%), Ashmore Reef MP (68.7%), Kimberley MP (88%), Oceanic Shoals MP (65.3%), and Argo Rowley Terrace MP (72.7%) and Joseph Bonaparte Gulf (4%). Entrained hydrocarbons could therefore impact on the potential values and includes all marine fauna as described within this table, marine habitats and socio-economic receptors. Elevated dissolved hydrocarbons above moderate threshold values are not predicted to occur in AMPs.

With the deeper (>30m) MP features, the geomorphological features are unlikely to be affected by entrained hydrocarbons, but the receptors may be affected by the change in water quality and impacts to the food chain. However, shallower features within MPs 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 – such as the Kimberley MP, 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

The minimum time before exposure to surface hydrocarbons above the impact threshold of 10 g/m^2 for any protected area is predicted to be 14.5 days at the North Kimberley MP. The minimum time before shoreline accumulation at the impact threshold of 100 g/m^2 is 47.6 days for the Kimberley coast. Considerable weathering of hydrocarbons will therefore occur before reaching the protected areas.

There are five marine parks within the moderate RISK EMBA: Lalang Garram / Camden Sound MP, North Lalang-Garram MP, Rowley Shoals MP and North Kimberley MP. Values associated with these marine parks include marine fauna and coral reefs, mangroves, saltmarshes and sandy beaches. These values may be contacted by total submerged oil (but not dissolved oil) above the moderate threshold values which would potentially impact the receptors as described in this table. The values of these marine parks are described in Appendix B.

World, National and Commonwealth Heritage Places

There are no World Heritage Areas within the moderate RISK EMBA. The West Kimberley is the only national heritage place within the moderate RISK EMBA.

The minimum time before exposure to surface hydrocarbons above the impact threshold of 10 g/m^2 is predicted to be 11 days at the Kimberley MP. The minimum time before shoreline accumulation at the impact threshold of 100 g/m^2 is 47.6 days for the Kimberley coast.

Threatened Ecological Communities

No Threatened Ecological Communities are present within the moderate RISK EMBA.

Wetlands

Wetlands identified within the moderate RISK EMBA include Ashmore Reef, Mermaid Reef, Hosnies Spring, Moyle Floodplain and Hyland Bay System and The Dales. 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, with impact consequence depending on each site's access to open ocean, degree and duration of oiling and the degree of weathering of the arriving oil.

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 – as discussed individually above. There are a number of KEFs that are overlapped by the moderate RISK 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 and the Exmouth Plateau. The minimum time before exposure to surface hydrocarbons above the impact threshold of 10 g/m^2 for any KEF is predicted to be 4 days for the Carbonate bank and terrace system of the Sahul Shelf and Ancient Coastline at 125m Depth Contour. 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. Contact with total submerged hydrocarbons above the 100 ppb threshold is predicted at all the KEFs in the moderate RISK at probabilities ranging from <1% to 67%, therefore the values associated with these KEFs may be affected as described above in this table. Exposure to dissolved aromatics above the 50 ppb threshold is not predicted at any KEFs. **Recovery Timeframe** Recovery of benthic habitats within Protected Areas 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 such as corals with longer restitution times within these protected areas may take decades to recover.

Overall Consequence	**Likelihood**	**Ranking**
Critical (worst-case of all above receptors)	Unlikely – Heard of in the exploration and production industry. IOGP 434-02 Blowout Frequencies (IOGP, 2019) contains data based upon oil and gas industry experience for well abandoned wells which are described as permanently abandoned, temporarily abandoned and long-time plugged wells. Event frequencies quoted are 2.3x10^{-5} which is based on 2 incidents occurring from 1994 to 2014 in the US Gulf of Mexico OCS and based on 123907 abandoned well-years. This demonstrates that this is an unlikely occurrence that has been heard of in the industry. This supports the selection of a likelihood category of *unlikely*.	Medium

7.6.8 Priority receptors

For spill response planning purposes, priority receptors were identified from the sensitive receptors using the criteria outlined in Section 5. In a spill event, the IAP, NEBA and planning process takes over; utilising real-time operational data and focusing operations on locations to be contacted (which will be a subset of what is planned for). This allows for preparedness and planning for the most credible scenarios whilst retaining flexibility in response to manage an event.

Eleven priority receptors for spill response have been determined from the deterministic run for the worst-case modelling results (Table 7-9).

Table 7-9: Priority receptors rationale

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
Scott Reef	• Predominantly intertidal receptor apart from small dry emergent areas such as Sandy Islet on South Scott Reef	• Shoreline loading volumes • High value • >5% probability of contact
Seringapatam Reef	• Predominantly intertidal receptor apart from small dry emergent areas	• Shoreline loading volumes • High value • >5% probability of contact
Cassini Island	• Cassini Island	• Shoreline loading volumes • >5% probability of contact
Adele Island	• Adele Island	• Shoreline loading volumes • >5% probability of contact
Clerke reef	• Predominantly intertidal receptor apart from small dry emergent areas such as Bedwell Islet	• Shoreline loading volumes • Minimum time to contact • High value • >5% probability of contact
Imperieuse Reef	• Predominantly intertidal receptor apart from small dry emergent areas such as Cunningham Islet	• Shoreline loading volumes • High value • >5% probability of contact
Timor Leste	• Timor Leste	• Shoreline loading volumes • High value • >5% probability of contact
Indonesia	• Indonesia	• Shoreline loading volumes • High value • >5% probability of contact
Joseph Bonaparte Gulf NT	• Joseph Bonaparte Gulf Northern Territory	• Shoreline loading volumes • High value
Kimberley Coast	• Kimberley Coast	• Shoreline loading volumes • High value

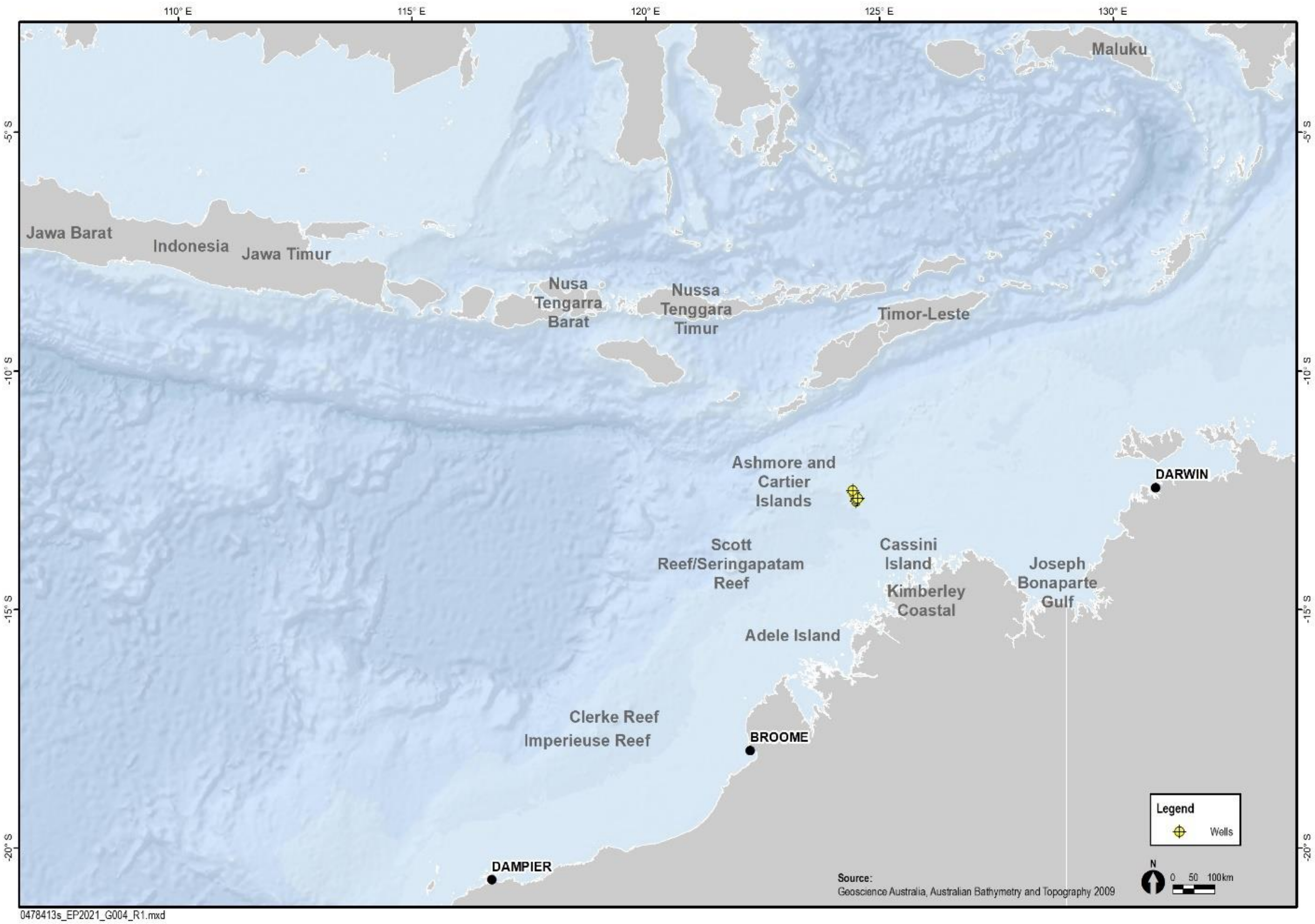


Figure 7-2: Priority receptors

Table 7-9 lists the rationale for the Priority Receptor selection (also refer Section 5) and Appendix G 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 7-10).

7.6.9 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 7-10 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 7-10: Impact of selected spill response strategy on the environmental values of Protection Priorities

Protection Priority environmental values	No controls	Source control	Dispersant (surface / Subsea) *	Operational Monitoring	Containment and recovery	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife Response	Scientific Monitoring
Environmental Outcomes	- Reduce oil volumes from reaching the shoreline to as low as reasonably practicable - Prioritise sanctuary zones and KPI species and habitats (as per marine park management plan if relevant) - Reduce impacts to marine and coastal fauna through the implementation of the WA Oiled Wildlife Response Plan								
Ashmore Reef / Cartier Island									
Seabirds									
Mangroves								n/a	
Emergent reefs								n/a	
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		
Protected Areas									
Wetlands								n/a	
Socio-economic									
Seringapatam and Scott Reef									
Seabirds									
Emergent reefs								n/a	
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		
Protected Areas									
Socio-economic									
Imperieuse Reef									
Seabirds									

Protection Priority environmental values	No controls	Source control	Dispersant (surface / Subsea) *	Operational Monitoring	Containment and recovery	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife Response	Scientific Monitoring
Environmental Outcomes	- Reduce oil volumes from reaching the shoreline to as low as reasonably practicable - Prioritise sanctuary zones and KPI species and habitats (as per marine park management plan if relevant) - Reduce impacts to marine and coastal fauna through the implementation of the WA Oiled Wildlife Response Plan								
Emergent reefs								n/a	
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		
Protected Areas									
Socio-economic									
Clerke Reef									
Seabirds									
Emergent reefs								n/a	
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		
Protected Areas									
Socio-economic									
Adele Island									
Seabirds									
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		
Protected Areas									

Protection Priority environmental values	No controls	Source control	Dispersant (surface / Subsea) *	Operational Monitoring	Containment and recovery	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife Response	Scientific Monitoring
Environmental Outcomes	**- Reduce oil volumes from reaching the shoreline to as low as reasonably practicable - Prioritise sanctuary zones and KPI species and habitats (as per marine park management plan if relevant) - Reduce impacts to marine and coastal fauna through the implementation of the WA Oiled Wildlife Response Plan**								
Socio-economic									
Cassini Island									
Seabirds									
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		
Protected Areas									
Socio-economic									
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 Areas									
Wetlands								n/a	
Socio-economic									
Kimberley Coast									
Seabirds									
Mangroves								n/a	
Turtle nesting beaches									
Coral reefs						n/a	n/a	n/a	

Protection Priority environmental values	No controls	Source control	Dispersant (surface / Subsea) *	Operational Monitoring	Containment and recovery	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife Response	Scientific Monitoring
Environmental Outcomes	**- Reduce oil volumes from reaching the shoreline to as low as reasonably practicable - Prioritise sanctuary zones and KPI species and habitats (as per marine park management plan if relevant) - Reduce impacts to marine and coastal fauna through the implementation of the WA Oiled Wildlife Response Plan**								
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a		
Protected Areas									
Wetlands								n/a	
Socio-economic									
International waters (Timor Leste and Indonesia)									
Seabirds									
Mangroves								n/a	
Emergent reefs								n/a	
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-economic									
Legend		Beneficial Impact							
		Possible beneficial impact dependent upon the situation (e.g. Timeframes and metocean conditions to dilute entrained oil)							
		Negative impact							
	n/a	Not applicable for the environmental value							

7.6.10 Environmental performance

Environmental Risk		**Unplanned release of crude oil**		
Overall Performance Outcome		**No reportable spill of hydrocarbon to the marine environment.**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
046	Implementation of the Jadestone Drilling Management System – Well Operations Management Plan	Overall well activity management processes and life cycle activities undertaken including well integrity performance monitoring and well integrity incidents excursion management in accordance with the NOPSEMA accepted WOMP.	Valid WOMP (at present only 2 year validity)	Country Manager
			Annual ROV Monitoring Report Records of monitoring system installation and maintenance	Well Integrity Committee
047	Blowout Contingency Plans (JS-70-PLN-D-00001)	Intervention actions undertaken in accordance with the Blowout Contingency Plan.	Records confirm the Blowout Contingency Plan was implemented.	Country Manager
048	Implement Oil Pollution Emergency Plan (OPEP)	In the event of a Level 2 or Level 3 spill, compliance with OPEP including develop and implement an IAP using the processes described within the OPEP.	Response records confirm OPEP was adhered to and an IAP was developed and implemented.	IMT Lead
049	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
050	Post spill scientific monitoring program undertaken	Monitor impacts and recovery of the values and sensitivities identified in this EP in accordance with the OSMP.	Monitoring reports indicate no long-term impacts to the values and sensitivities identified in this EP.	IMT Lead

7.6.11 ALARP assessment

Since no well intervention is planned under this EP, there is a very low likelihood of a loss of well control occurring, but the possibility cannot be excluded and a worst case well release has been assumed as recommended by IOGP (2019).

The combination of the standard controls (which reduce the likelihood of the event happening), and the spill response strategies (which reduce the consequence) together aim to reduce potential impacts from a hydrocarbon spill. An oil spill response review was undertaken and a summary of the rationale behind the spill response measures selected is provided in Table 6-3.

Spill Response Controls

For a Level 1 oil spill, containment and clean-up is assisted through the bunding system provided around equipment and the regular inspection programs. Spills are responded to as per emergency and spill response procedures which are practised through regular spill/ emergency response drills on the rig and vessels. In the event that diesel is not contained through the barriers and procedures onboard the vessel, the OPEP, which outlines the detailed response and logistical requirements necessary to combat a worst-case spill, will be implemented to reduce the impacts of a crude oil spill to ALARP.

A Net Environmental Benefit Analysis (NEBA) will be used to determine which spill response strategies are appropriate for a given spill scenario and is an integral part of the IAP process. Source control, operational monitoring activities and spill response strategies considered for a Level 2/3 spill are shown in Table 7-10.

The spill response strategies have undergone a robust evaluation and environmental risk assessment process. The applicability of the control to the spill scenario and establishing requirements for each control to ensure its effectiveness in meeting the EPO was also undertaken.

The assumption was that existing controls were ineffective (i.e. 100% probability the spill occurred) and each control would be exposed to the full volume of oil under the maximum credible worst-case scenario. This approach promoted a level of conservatism in the proposed control strategies, and, in particular, the measures for determining the effectiveness of controls and the requirements to achieve the level of effectiveness.

The ALARP assessment for the level of resourcing required for each of the spill response strategies adopted is provided in Table 7-11, based on the capability described in the OPEP. This considers the incremental benefit of increasing resourcing levels for each spill response strategy and the associated upfront costs. The effectiveness of each of these response strategies has been increased to a point where further sacrifice made would result in a disproportionately small reduction in environmental benefit.

From this assessment, it is considered that through the resourcing arrangements outlined within the OPEP and in Section 6.6.3 (including spill response equipment and personnel from internal and external sources including via the AMOSPlan, AMSA, OSRL, other operators and other national suppliers) the spill response strategies and control measures reduce spill risk to ALARP.

Table 7-11: ALARP assessment for increasing the level of resourcing in the OPEP for spill response strategies

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 vessels beyond a Level 1 response Section 8 of OPEP	Reduce volume or speed of spill entering marine environment.	Significant cost would be incurred for Jadestone to alter the contractual arrangements to increase capability with consideration for equipment, storage, maintenance, crew training and safety of crew when deploying gear.	The vessel has the response capability as described in the SOPEP and geared towards a Level 1 incident. The SOPEP is to provide shipboard notification and response procedures for stopping or minimizing the unexpected discharge of oil from a vessel without compromising the safety of the crew, the vessel or the environment. Unexpected discharge includes the discharge of oil during vessel operations, or vessel casualty. It is consistent with the National Plan that vessels have a level 1 capability. For Jadestone to increase the 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 vessels' 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 hydrocarbons to the environment.	Accepted industry standard as aided by APPEA MOU	Jadestone can select, obtain conceptual agreement with owners or operators of MODUs prior to risk activities. Jadestone monitors availability of selected feasible MODUs. This is detailed in Appendix H of the BCP. This assures rig availability within the response time for a relief well as stated in this document (Section 7.5.4).	Yes
Source control – Monitor status of Registered	Potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.	Part of the process of planning for the relief well options.	Jadestone can, as part of the above selection process, monitor the status of Registered Operators for rigs operating within Australia, and those outside of Australia. This allows for a prioritised selection of rigs	Yes

Operators/ Approved Safety cases for rigs			in the event of a response with priority given to those with an existing safety case for working in Australia.	
Source control – Jadestone to become a signatory to the APPEA MOU for mutual aid to facilitate and expedite the mobilisation of a relief well	Potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.	Accepted industry Standard	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 enables Jadestone to obtain conceptual agreement of suitable relief well drilling rigs, and aids in arranging conceptual agreements for access to additional equipment.	Yes
Source control – standby MODU available in-field year round 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 207uthori. $255 million for a MODU to be on standby infield 365 days a year. If adopted this cost is paid regardless if there is a loss of containment event or not.	A MODU on standby close to the wellheads 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, the MODU would be required to be on standby 24/7 over the entire year as a loss of containment could occur at any time– this is not feasible. 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 surface 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 wellhead 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	Potentially reducing the time to start the application of subsea	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	Yes

construction class vessels that would be required to deploy SFRT	dispersants, resulting in a reduction of surface oil and shoreline loading		SFRT, if required. This would potentially provide availability to a suitable vessel to deploy the SFRT quicker.	
Aerial surveillance – additional dedicated aircraft and observers	Limited environmental benefit by having additional dedicated resources -increase identification of marine fauna presence.	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 spatial extent of the spill is more dependent on tidal influences than the wind. The two-passes per day 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 given the need is met through vessel sharing and surveillance will also be conducted through a number of complementary operational monitoring strategies (aerial surveillance, tracker buoys	In the event that additional dedicated vessels are required due to data gaps, resources are available. The cost of the additional vessels will be added to the cost of the response.	There is no benefit in having additional dedicated surveillance vessels given surveillance can be performed from any vessel and these duties will be shared amongst spill response vessels. 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. Tracker buoys require maintenance which can be scheduled from the	Additional buoys are available through AMSA and AMOSC within days. There is no additional	Tracking buoys are one tactic in the operational monitoring strategy. The number of buoys immediately available is sufficient to cover tracking of oil given the other response activities that will be undertaken.	No

	Montara CPF as part of the spill response equipment	upfront cost for accessing these secondary buoys.	Therefore, there is no value in increasing tracker buoy numbers and therefore the arrangements in the OPEP are considered ALARP.	
Fluorometry – purchase or hire of additional fluorometers	The purpose of fluorometry is to: 1) inform the location and concentration of entrained oil plumes; 2) inform the scientific monitoring; 3) provide validation for trajectory modelling predictions and tracker buoys. Additional fluorometers may limit missed data opportunities. Fluorometry will target subsea plumes approaching those sites that have the greatest potential for environmental impact (i.e. the most sensitive areas with the highest predicted concentration of entrained oil). Any additional fluorometers would be deployed to other sensitive areas in the RISK EMBA and once those fluorometers have confirmed presence of entrained oil, these units can be moved to other areas. Therefore, it is considered there is little additional environmental benefit in having more fluorometers.	Jadestone can access 5 subsea gliders with fluorometers through Blue Ocean Monitoring (via Astron) and additional fluorometers through CSIRO. This is considered sufficient for upfront planning. Additional tow behind fluorometers can be sourced from CSIRO if apparent there are data gaps that can't be filled by existing arrangements. This would not be an upfront cost, but the need and costs would be assessed after a spill event.	The existing arrangements are considered sufficient to meet fluorometry purpose. Additional fluorometers can be arranged and deployed should the need arise this is not considered time critical and the additional benefit is considered low. Therefore, there is no value in increasing fluorometry numbers and therefore the arrangements described in the OPEP are considered ALARP	No
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	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.	No

		involve ongoing costs in the order of hundreds of thousands each year.	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.	
SCAT – additional resources to increase number of SCAT	Shoreline Clean up and Assessment Technique (SCAT) is a systematic method for surveying an affected shoreline after an oil spill. SCAT is designed to support decision-making for shoreline clean up. It is flexible in its scale of surveys and in the detail of datasets collected 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 moderate RISK EMBA will be contacted. The potentially oiled shorelines are 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 25 teams which can be deployed across the shorelines for accessible locations, which exceeds the 16 teams required. The minimum time to contact for SCAT is 3.6 days at Cartier Island, which is enough time for Jadestone to determine the direction of the spill, deploy SCAT and gather information for the IMT. The existing arrangements are considered sufficient to meet SCAT purposes and provide flexibility due to redundancy. 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.	No
Chemical dispersant application – additional resources to that in the OPEP	Potential for further reduction of surface 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,	Additional resources include: Dispersant costs of \$10,000 per m³. FWADC aircraft \$15,000 per aircraft per day.	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 surface 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 response	No

	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 water column. This could have negative flow-on social and economic consequences e.g. recreational and commercial fishing, diving.	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 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 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. 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 and 16.7 shows that Jadestone has access to enough dispersant through national and international stockpiles to exceed the required need for a LOWC involving Sea Eagle -1. For a LOWC event involving Tahbilk-1, Jadestone has access to enough dispersant until week 10, whereby, 839 m^3 of dispersant will be required to be manufactured to meet the volume of dispersant required for weeks 11 and 12. The volume of dispersant required to be manufactured is within the manufacturing capacity ranges. 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 at most up to 6 FWADC, 1 Hercules or 1 Boeing 727 and up to 5 vessels would be required to meet the maximum volume of dispersant required. 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 and then meet and exceed the need from Day 4 onwards. Access to more dispersant than needed for the Sea Eagle-1 LOWC scenario 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/WHP in the Montara field**. Storing sufficient resources for dispersant	

			application on the FPSO/WHP to spray on the spill at source could result in faster dispersant application at source, until the Chemical Dispersant Plan resources are deployed. The FPSO and WHP do 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. 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 field or in the vicinity could begin spraying dispersant within 12 hours at the spill site. Although the amount of dispersant able to be stored on deck is limited, it would enable dispersion to start until the Chemical Dispersant Plan resources are deployed. Having a dedicated vessel stationed in the field enhances the spill risk associated with the activity, and given that the required volume of dispersant can be met by Day 4, this risk is considered to out-weigh any marginal environmental benefit. 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 24/7/365 standby with dedicated crew would result in a faster chemical 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 equipped vessels and supporting resources (crew, maintenance, berthing etc) and 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. 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 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 Day 3. 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 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. 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 can mobilise up to 15 containment and recovery units within Week 1 which will meet the demand for the duration of the Tahbilk-1 LOWC scenario, and from Day 5, for the Sea Eagle-1 LOWC scenario. 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 the required need within the first week of a spill event. 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. Even when the priority receptors are focussed on, the intrusion caused by equipment deployment and maintenance 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 the need for containment and recovery arrangements described in the OPEP are considered ALARP.	No

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 location. If required, additional equipment will be sourced and the additional cost borne by Jadestone.	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 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. Given the remoteness of the locations with shoreline contact modelled, there is considered limited benefit for pre-deployment of resources as this would create unnecessary environmental disturbance (both for placement of resources and continuing maintenance) and	No

			unnecessary safety risks. In addition, the cost of doing this is disproportionate to the environmental 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 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	The cost of additional resources is not considered the limiting factor; the limiting factor is considered to be the ability to use resources at the physical location. If required, additional personnel and machinery will be sourced, and the additional cost borne by Jadestone.	Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event. 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 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. Given the remoteness of the locations with shoreline contact modelled, 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	No

	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 damage and could be a negative impact.		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 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 6 (refer WAOWRP and NTOWRP). OWR aims to prevent/reduce the impact to marine fauna (e.g. 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 (personnel, experts, facilities, plans etc).	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 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.	No

			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; and • commission additional OWR training in WA is grossly disproportionate to the risk. The Activities 24/7/365 and significant costs would be 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 potentially a Level 6 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	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.	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 can resource a plan that meets the nature and scale of the event within realistic timeframes.	No

	having 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.	If required, additional resources will be sourced, and the additional cost borne by Jadestone.	The arrangements described in the OPEP are considered ALARP.	

Further ALARP demonstration – Engineering Risk Assessment – Evaluation of Alternate Control Measures & Associated Comparative Assessment – undertaken to further evaluate a range of control measure options in relation to the prevention of a blow-out scenario	Hierarchy of control	Control Measure Options	Comparative Assessment of Risks, Cost & Benefit for Control Measure Options	Apply
	Elimination	Do not undertake monitoring activity	Until the wells are plugged and abandoned, there is a low likelihood of a loss of containment, therefore the monitoring activity is required to ensure any leak is detected as soon as practicable.	No
	Substitution	Utilise different monitoring systems to undertaken surveillance	Other monitoring systems were reviewed during a scoping study for feasibility, longevity and serviceability. Of these the remaining two options are presented in the EP but with further study required. In the meantime regular monitoring via vessel and annual ROV monitoring will continue. No indications of any barrier failures have been noted at either wellhead and therefore annual monitoring is considered ALARP until the feasibility studies are complete.	No
	Engineering	Use of a subsea cap and containment system in the event of a blowout.	1.The installation of a subsea capping and containment system is not feasible the wellheads as they are anticipated to have insufficient bending strength capacity and fatigue life due to the wellhead system and slimline well designs used. 2.The water depth of the wells is too shallow for the Wild Well recommended minimum water depth need for capping stack installation of 120m.	No
		Offset technology for the deployment of capping stack	Offset Installation Equipment (OIE) is not feasible in the blowout scenario, as the related Capping Stack weights exceed the bending strength and fatigue life of the wellheads. In addition, the OIE system is unproven technology with a long lead time as it is located at OSRL in Italy.	NA

7.6.12 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 8 demonstrates that Jadestone's HSE Management System is capable of continuously reviewing and updating activities and practices during the operation, including spill response arrangements. Alignment with Jadestone Well Integrity Manual Alignment with Jadestone Drilling Management System Alignment with Jadestone Well Integrity Assurance Management System
Stakeholder & reputation	Stakeholder consultation has been undertaken (see Section 4), including engagement with the Director of National 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.	
Legislation and Industry good practice	Alignment with Jadestone Drilling Management System – Well Integrity Manual (D41-504807-WC): The Manual is part of the Jadestone Drilling Management System and documents the policies, processes and tools to be followed to ensure the integrity of the well during all stages of a well life cycle, including suspension.	Well integrity Manual
	Well Operations Management Plan (NOPSEMA Accepted) The primary purpose of the WOMP is to reduce the potential for any loss of well control. It includes a suite of tools and procedures to proactively manage lifecycle well integrity from design to abandonment for planned and unplanned events; early identification of potential hazards and indicators that may lead to a breach of well integrity resulting in a major accident event.	WOMPs
	OPEP In the event of an uncontrolled well blow out, the OPEP will be initiated. This includes development of an Incident Action Plan (IAP). The IAP will detail the response mechanisms and priority areas for protection based on the actual circumstances of the event, taking into account the spill trajectory, weather conditions, but also importantly safety considerations. Key activities to be addressed by the IAP include a review of the Net Environmental Benefit Assessment (NEBA), re-modelling of oil spill trajectory modelling with relevant spill and environmental data, and ongoing consultation with affected/involved parties that may be required. Response strategy options that will be evaluated in the event of a hydrocarbon spill include: • Monitor and evaluate • Dispersant application • Containment and recovery • Protection and deflection • Shoreline clean-up • Responding to oiled wildlife	OPEP
	Jadestone Blowout Contingency Plan / Jadestone Crisis and Emergency Response Plan The Jadestone Blowout Contingency Plan (JS-70-PLN-D-00001) covers Initial Organisation and Operations, including the Phases of Responsibility, Initial Response Levels, Intervention Action Plans, Notifications and Contacts, and Incident Command Systems. It also covers Source Control Organisations and Resources. For Sea Eagle-1 and Tahbilk-1, a specific Addendum to the Blowout Contingency Plan (TM-50-PLN-W-00001), describes Source Control responses considered and the detailed planning and studies done in support of these responses. Source control responses reviewed are Relief wells, Subsea First Response Toolkit (SFRT) and Capping Stacks. In the unlikely event of a well blowout during the life of this EP, the drilling of a relief well is the primary source control strategy.	Jadestone Blow-Out Contingency Plan

	For relief wells, the main considerations are: a) selection of the appropriate rigs (need multiple options) is based on the rig location, an approved Australian Vessel Safety Case, rig availability, 222uthorized222n timing, minimum water depth operability, dynamic kill capability (rig pump and pit sizing); and b) planning of relief well design, relief well directional design, sourcing the related equipment needed for the well design (Wellheads, Casing, Mud, etc) in the required time frame For the SFRT, the main consideration is: **8)** the effective and efficient 222uthorized222n of the equipment to Darwin and the availability of suitable vessels for use of the SFRT. For these wellheads, a capping stack is not considered feasible as discussed in Section 7.6.11 above. As mentioned above, the considerations, related plans and studies are listed in the Well Specific Addendum to the BC (Appendix G of the BCP).	
	<u>Petroleum industry oil spill response</u> In order to respond to a threatened or actual subsea oil discharge or well control incident, Jadestone has a Memorandum of Understanding (MoU) with other oil and gas operators that have drilling rigs in the vicinity of the proposed activities that could be made available should the drilling of a relief well become necessary. An approximate relief well schedule is detailed in the table below.	Jadestone MOU
Environmental context & ESD	The worst-case credible crude spill scenario for the Drilling Activities is a result of a loss of well control with up to 236,149 m^3 released from within the Operational Area from Tahbilk-1. The potential impact is considered acceptable after consideration of: • Potential impact pathways: Section 7.6.6 and 7.6.7 assess potential pathways and risks from exposure to surface, entrained, dissolved and accumulated oil ashore.; • Preservation of critical habitats: Section 7.6.7 and 7.6.8 describe the modelling predictions of locations where protected areas and sensitive receptors may be exposed to oil, at what concentrations and for what durations; • Assessment of key threats as described in species and Area Management /Recovery plans: See 'Conservation and management advice' below; • Consideration of North-West Bioregional Plan; The NW Bioregional Plan considers hydrocarbon spills as a threat to marine conservation values. This EP aligns with the requirement of the NW Bioregional Plan to assess potential impacts and to have an Oil Spill Contingency Plan in place; and • Principles of ecologically sustainable development: Given the predicted behavior and weathering of the crude, the location of the Drilling Program and the prevention and recovery plans, the risks from oil exposure are not predicted to impact population levels of marine fauna and communities. Biodiversity and ecosystem integrity impacts are predicted to recover fully in the long term as suggested by the Montara 2009 spill.	
Conservation and management advice	Jadestone will have regard to the representative values of the reserves and other conservation advice published and endeavor to ensure that priority is given to the social and ecological objectives and values, of any AMPs, or state marine parks impacted by unplanned crude release to ensure that the objectives of the management plans are not contravened (Appendix B). 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 222uthorized under the OPGGS Act may be	

	conducted in all zones. The Director will be notified in the event of an oil pollution incident that occurs within, or may impact upon, an Australian Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. Protected areas within the RISK EMBA predicted to potentially be impacted by crude above threshold levels have been identified as Priority receptors (Section 7.6.8). 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.
Interim Recovery Plan for the Threatened Migratory Shorebirds visiting Western Australia	In a LOWC scenario, habitat important for Threatened Migratory Shorebirds would be identified and given high priority for protection. Any spill response activities (Section 6.6) would be managed to reduce further potential environmental impacts. This is consistent with the conservation advice.
Wildlife conservation plan for migratory shorebirds (Commonwealth of Australia 2015c)	In a LOWC scenario, habitat important for the migratory birds would be identified and given high priority for protection. Any spill response activities (Section 6.6) 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).*
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 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	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 Pristis pristis (largetooth sawfish)	The Conservation advice for large tooth 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 large tooth 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 6.6) that generate marine debris are also managed to reduce further potential environmental impacts. This is consistent with the conservation advice.

Sawfish and river shark multispecies recovery plan	The sawfish and shark multispecies recovery plan identifies Habitat degradation and modification as risks: The advice requires measures to reduce adverse impacts of habitat degradation and/or modification to be considered which could result in the event of a LOWC scenario.
Australian Marine Parks	Australian Marine Parks are established by proclamation under the *EPBC Act* for the purpose of protecting and maintaining biological diversity in the parks. Environment plan (EP) must be consistent with the Australian Marine Park Management plans. There are 12 AMPs within the RISK EMBAs. In all cases where an activity has potential to impact or present risk to AMPs, regardless of whether the activity is inside or outside a park, the EP should evaluate how these impacts and risks will be of an acceptable level and reduced to as low as reasonably practicable (ALARP). Actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with mining operations authorised under the OPGGS Act may be conducted in all zones. The requirement is that The Director should be notified in the event of an oil pollution incident that occurs within, or may impact upon, an Australian Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. Consultation to notify the Director of Parks when the proposed response activities is completed as part of the Consultation process (Section 4, Section 8). 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 8). As such this EP is consistent with the Australian Marine Park Management plans.

7.7 Worst Case Diesel Spill

7.7.1 Description of hazard

Diesel spill	Release of diesel may occur from vessel collision within the Operational Area. The worst-case diesel spill scenario is due to collision of a vessel with a third-party vessel resulting in damage to a fuel oil tank and diesel released to the ocean. The maximum worst-case credible spill volume of diesel has been calculated as 250 m^3 based on the largest fuel oil tank on the proposed vessels.

7.7.2 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, the degree and location of tank damage and tank volume. Reviewing the potential vessels that may be used and the largest fuel tank size provides a spill volume of <250 m^3 for typical vessels. For the purposes of determining potential impacts, the volume of 906 m^3 has been used as this has been modelled previously for the Montara field.

Table 7-12: Credible diesel releases to the marine environment

Scenario	Maximum Credible Spill	Release duration	Credibility justification
Release of diesel due to vessel collision	Based on AMSA (2015) 'other vessel collision' – volume of largest fuel tank = 250 m^3 (based on a typical operations and support vessels with a ruptured wing tank);	5 hours	For the purposes of determining potential impacts, the volume of 906 m3 has been used as this has been modelled previously for the Montara field, and provides a conservative assessment of potential worst-case risks.

7.7.3 Diesel characteristics

Marine diesel is typically 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%. Viscosity is 4.0cP (at 25°C) and density of approximately 829.1kg/m^3 at 25°C.

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 Drilling Activities Operational Area; 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.

7.7.4 Modelling Approach

A diesel spill scenario of 906 m^3 was modelled by RPS for a spill within the vicinity of the VBA Operational Area (i.e. where most vessel traffic will occur) to determine the dispersion behaviour of the released hydrocarbon within the marine environment. The modelling considered 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 7.6.2 with respect to crude oil spill modelling.

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.

7.7.5 Diesel modelling results

Surface oil results

Results of the stochastic modelling indicated that surface sheens of surface 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.

Surface 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 (846 ppb).

The AMPs predicted to be impacted by entrained diesel >100 ppb include:

- Oceanic Shoals MP;
- Ashmore Reef MP; and
- Cartier Island MP.

The KEFs predicted to be impacted by entrained diesel >100 ppb:

- 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 50 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 7-3 to Figure 7-5 for the environment that may be affected due to a diesel spill of 906 m^3.

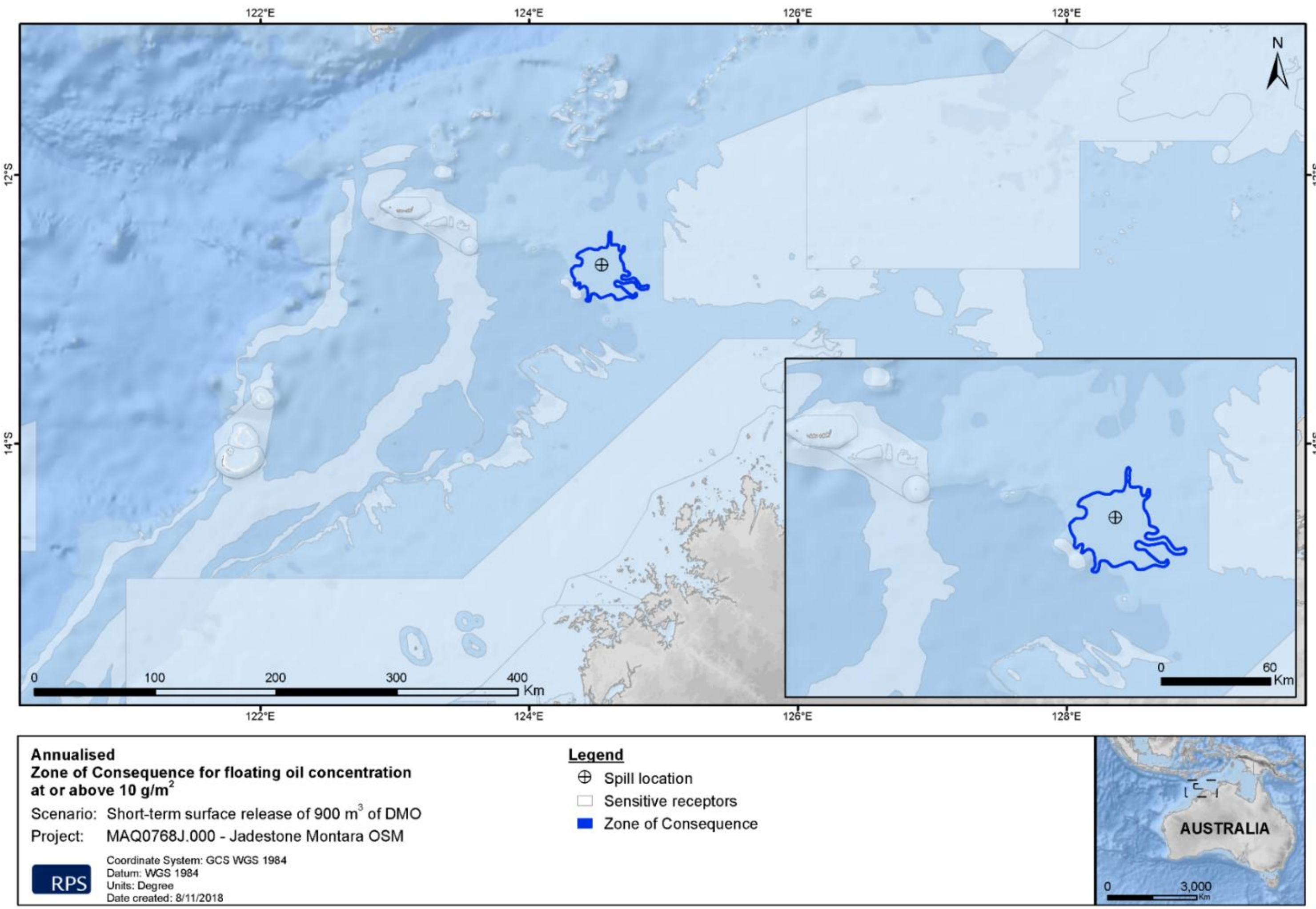


Figure 7-3: Predicted RISK EMBA for floating oil worst case

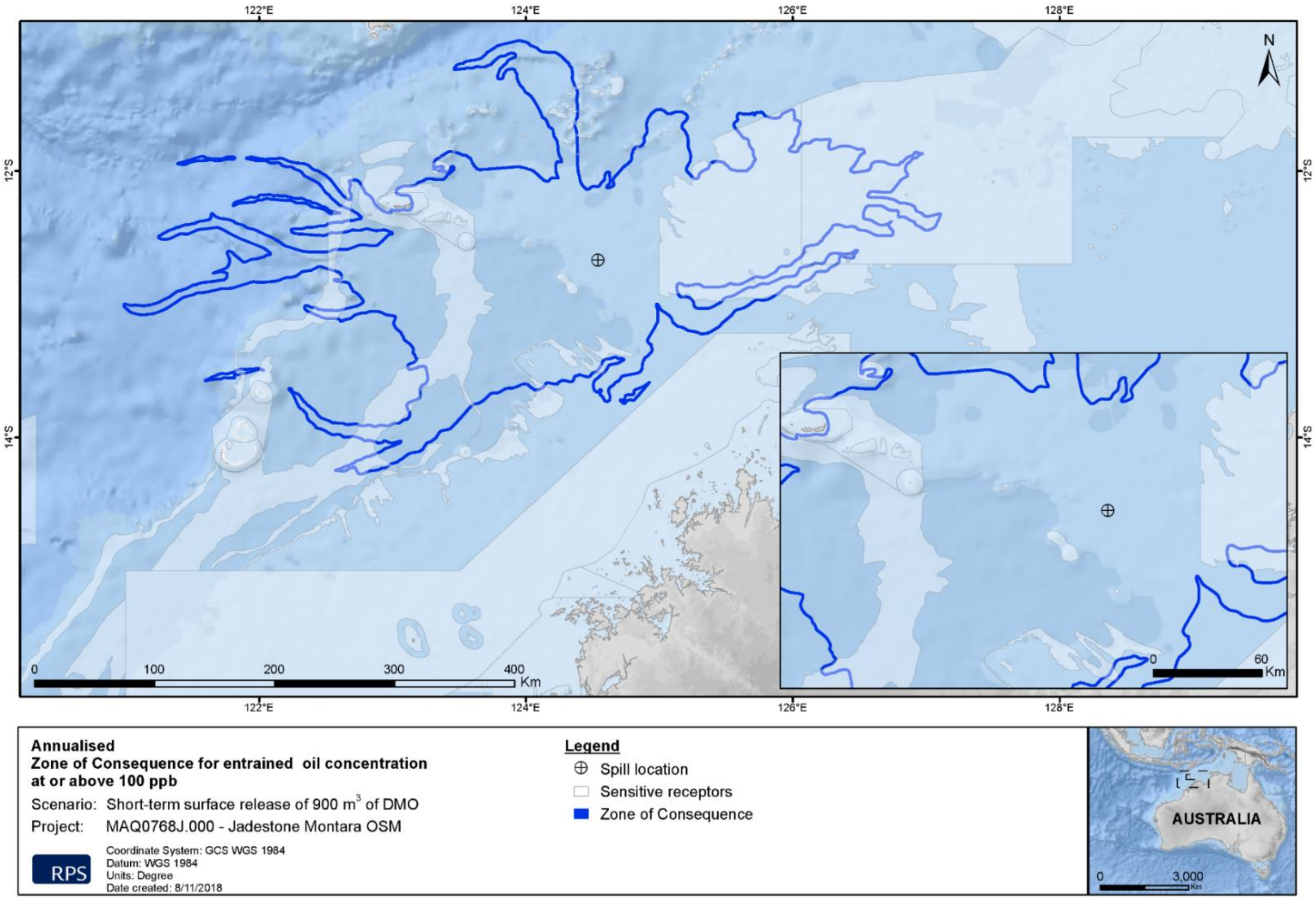


Figure 7-4: Predicted RISK EMBA for entrained oil worst case

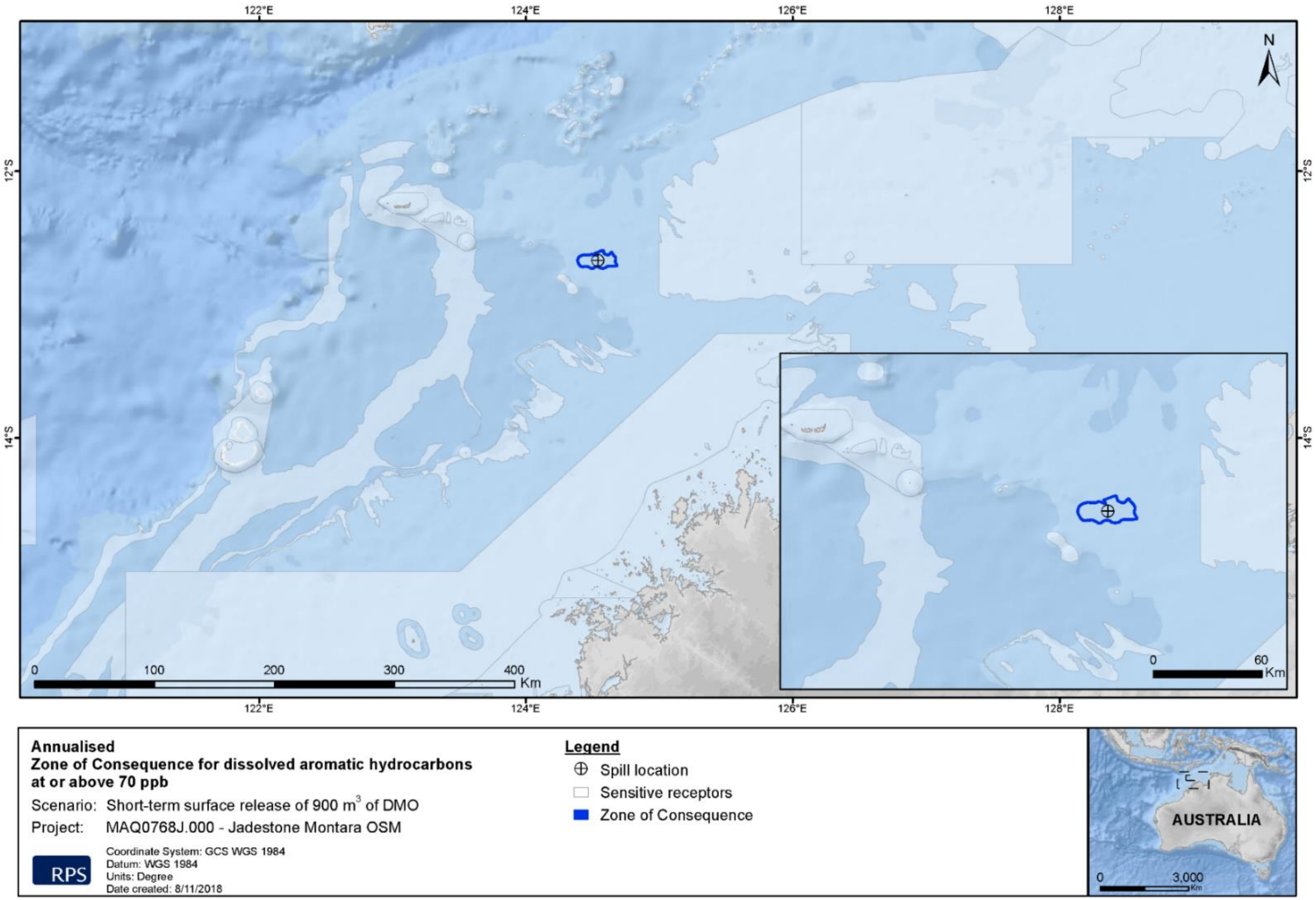


Figure 7-5: Predicted RISK EMBA for dissolved aromatic hydrocarbon worst case

7.7.6 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 7-13. For further information on the habitats, marine organisms and socio-economic receptors refer to Appendix B and Section 3.

Table 7-13 Potential Impacts to sensitive receptors from a diesel spill

Receptors	Potential Impacts from a diesel spill		
	Floating and/or shoreline	**Entrained**	**Dissolved**
Plankton	*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.		
	Impact assessment to receptors within the RISK 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 RISK 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.		
Benthic habitat and communities **(Including deepwater habitats and shallow shoals)**	n/a – Benthic habitats not exposed to surface or surface oil	*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.	

<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"></td><td></td><td colspan="2">Epifauna associated with hard substrates such as ascidians and sponges may experience direct toxicity through ingestion.</td></tr>
<tr><td colspan="3">Impact assessment to receptors within the RISK EMBA
There are a number of shoals within the RISK 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>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>
</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 RISK EMBA
Marine mammals present within the diesel RISK 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 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 RISK EMBA
Threatened and migratory marine reptile species may occur within the diesel spill area RISK EMBA as turtles are widely dispersed at low densities across the region 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 RISK 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>
</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 rowspan="2">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). 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>
<tr><td colspan="3">Impact assessment to receptors within the RISK 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>Avifauna</td><td>Potential impacts from surface oil
Estimates for the minimum thickness of surface 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</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>
</table>

Receptors	Potential Impacts from a diesel spill		
	Floating and/or shoreline	**Entrained**	**Dissolved**
	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.		
	Impact assessment to receptors within the RISK EMBA Threatened and migratory seabirds and shorebirds that may occur within the RISK EMBA may have foraging, feeding, breeding and or nesting habitat in the vicinity of the RISK EMBA. The RISK 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 RISK EMBA: Oceanic Shoals MP, Ashmore Reef MP and Cartier Island MP.		
State Marine Parks	There are no State Marine Parks within the diesel RISK EMBA.		

<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>World, National and Commonwealth Heritage Places</td><td colspan="3">There are no World, National and Commonwealth Heritage Places within the diesel RISK EMBA.</td></tr>
<tr><td>Threatened Ecological Communities</td><td colspan="3">There are no threatened ecological communities within the diesel RISK EMBA.</td></tr>
<tr><td>Wetlands of International Importance</td><td colspan="3">There are no wetlands of international importance within the diesel RISK EMBA.</td></tr>
<tr><td rowspan="2">KEFs</td><td>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.</td><td colspan="2">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.</td></tr>
<tr><td colspan="3">Impact assessment to receptors within the RISK EMBA
There are three KEFs which are overlapped by the diesel RISK 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</td></tr>
<tr><th>Consequence</th><th>Likelihood</th><th colspan="2">Ranking</th></tr>
<tr><td>Minor</td><td>Unlikely – Heard of in the exploration and production industry. ITOPF has calculated that for the last 50 years the average number of incidents involving medium sized (7-700 tonnes) oil spills from vessels globally has decreased by over 90% and since 2009 stands at a yearly average of 6.6 spills per year globally. With the controls that are in place as detailed in</td><td colspan="2">Low</td></tr>
</table>

Receptors	Potential Impacts from a diesel spill		
	Floating and/or shoreline	Entrained	Dissolved
	this EP, the likelihood of a significant collision resulting in hydrocarbon release is therefore considered *unlikely*.		

7.7.7 Environmental performance

Environmental Risk		Unplanned release of diesel		
Performance Outcome		**No spill of diesel to the marine environment from vessel collision**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
051	No vessel to vessel bunkering	Vessel to vessel refuelling will not occur within the operational area	Fuel record books demonstrate no in-field refuelling	Vessel Master
052	Shipboard Oil Pollution Emergency Plan requires: • Valid SOPEP/SMPEP • Timely exercises undertaken	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/SMPEP	Vessel Master
053		Drills undertaken as per SOPEP	Exercise records	Vessel Master
054	Implement Sea Eagle and Tahbilk Vessel Based Activity OPEP (TM-70-PLN-I-00005)	In the event of a tier 2 or tier 3 oil spill, implement to reduce environmental impacts	Incident Log	IMT Lead
055	Jadestone Energy's Competency and Training management System (JS-60-PR-Q-00014) requires External Contractors to comply with project processes and procedures and have the appropriate level of HSE capability	Vessel personnel trained and assessed competent in accordance with their role requirements as aligned with Recruitment Assessment Templates or Contractors equivalent Competency Assessment system	Records of competency	Vessel Master Drilling Manager
056	Vessel navigation aids and equipment meet regulatory and safety requirements by aligning with Navigation Act 2012	Vessels will comply with maritime safety and navigation requirements including: • International Regulations for Preventing Collisions at Sea 1972 (COLREGS); • Chapter V of Safety of Life at Sea (SOLAS); • Marine Order 21 (Safety of navigational and emergency procedures) (as appropriate to vessel class);	Records confirm that required navigation equipment is fitted to all vessels to ensure compliance with maritime safety and navigation requirements.	Vessel Master

Environmental Risk		Unplanned release of diesel		
Performance Outcome		**No spill of diesel to the marine environment from vessel collision**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
		• Marine Order 30 (Prevention of collisions) (as appropriate to vessel class); • Vessels to maintain radio channels and other communication systems.	Records confirm vessels maintain communication systems.	
057	In the event of a vessel collision resulting in a loss of diesel, environmental impacts will be reduced to ALARP through the implementation of response strategies.	In the event of a Level 2 or Level 3 spill, compliance with the OPEP including develop and implement an IAP using the processes described within the OPEP.	Response records confirm the OPEP was adhered to and an IAP was developed and implemented.	IMT Lead

7.7.8 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
Use alternative energy sources	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.
Installation of an active well monitoring system instead of the passive	Substitution	Yes	No	This system would require a longer period on location for installation and regular vessel visits to site for approximately 2 days every two weeks. This would therefore increase the possibility of an unplanned release significantly over the course of each year due to the increased frequency of vessels and activities in the field. The passive system is therefore considered to be more acceptable.
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 hoses, no further administrative controls were identified.

7.7.9 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 8 demonstrates that Jadestone's HSE Management System is capable of continuously reviewing and updating activities and practices during the VBA, including spill response arrangements.
Stakeholder & reputation	Stakeholder consultation has been undertaken (see Section 4), including engagement with the State and National response agencies of DoT and AMSA, commercial and recreational fishing industry bodies and fishers. No concerns have been raised with regards to impacts of a diesel spill by relevant persons. During any spill response, a close working relationship with key regulatory bodies (e.g. DoT, DBCA, AMSA, DEPWS) 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 VBA is a result of a support vessel collision with a third-party vessel in the operational area. Surface oil may contact Browse Island. Entrained oil is predicted to contact the KEFs – Carbonate Bank and Terrace System of the Sahul Shelf, Continental Slope Demersal Fish Communities and Ancient Coastline at 125m depth contour as well as several shoals (Barracouta, Vulcan and Goeree Shoals). The potential impact is considered acceptable after consideration of: • Potential impact pathways: Section 7.7.6 (and 7.6.4) assesses the likelihood and consequence of the exposure of sensitive receptors to entrained, dissolved and surface diesel; • Preservation of critical habitats: Section 7.7.5 assesses the worst-case exposure of protected habitats given three AMPs may be impacted (Oceanic Shoals MP, Ashmore Reef MP and Cartier Island MP). Sensitive receptors at risk include protected seabirds, shorebirds, marine fauna, intertidal and shoreline habitats • Assessment of key threats described in species and Area Management /Recovery plans: See 'Conservation and management advice' below; • Consideration of North-West Bioregional Plan: The NW Bioregional Plan considers hydrocarbon oil spills (i.e. not specifically diesel) as a threat to marine conservation values. This EP aligns with the requirement of the NW Bioregional Plan to assess potential impacts and to have an Oil Spill Contingency Plan in place; and • Principles of ecologically sustainable development ESD: Given the nature of diesel, the location of the Drilling Program and the prevention and recovery plans, the risks from diesel exposure are not predicted to impact population levels of marine fauna and communities. Biodiversity and ecosystem integrity impacts are predicted to recover fully.
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 241uthorized 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.

8. IMPLEMENTATION STRATEGY

As required under Regulation 14(1) of the OPGGS 2009 (Environment) Regulations, Jadestone must provide an implementation strategy that will ensure:

- All environmental impacts and risks of the activity will be continually identified and reduced to a level that is ALARP;
- Control measures identified in the EP are effective in reducing the environmental impacts and risks of the activity to ALARP and acceptable levels;
- That environmental performance outcomes and environmental performance standards are met;
- Arrangements are in place to respond to, and monitor impacts of, oil pollution emergencies; and
- Stakeholder consultation is maintained through the activity as appropriate.

To meet these requirements the implementation strategy outlined in this EP includes the following:

- Details on the systems, practices and procedures to be implemented (Section 8.1);
- Key roles and responsibilities (Section 8.2);
- Training, competencies and ongoing awareness (Section 8.2.3);
- Monitoring, auditing, management of non-conformance and review (Sections 8.3 and 8.4);
- Incident response including Oil Pollution Emergency Plan (Section 7.6 and OPEP);
- Record keeping (Section 8.4.2); and
- Stakeholder consultation (Section 4).

As Titleholder, Jadestone is responsible for ensuring that the drilling activities to occur within the Operational Area are managed in accordance with this EP, as well as the implementation strategy, the Jadestone HSE Policy and the Business Management System.

8.1 Jadestone Business Management System

Jadestone applies an integrated Business Management System that is aligned with ISO 55000: Asset Management. This covers all activities and includes provision for the systematic management of environment and safety and all other business functions. The Jadestone Business Management System ensures alignment between company objectives and the activities associated with operation of the Montara facilities in a structure that is illustrated by Figure **8-1**.

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 **8-2**).

Figure 8-1: Business management system structure

Figure 8-2: Business activities and objective functions

The objective functions are organised into 'Lead', 'Core' and 'Help', which describe how the intent of the business is delivered. The Lead functions are the activities that provide direction to the Core functions, which represent the life cycle of oil and gas activities. The purpose of the Lead functions is to enact and inform strategy and to guide the Core functions in the delivery of their activities.

Delivery of HSE management and performance is fully integrated (including implementation of the EP) throughout the objective functions relevant to 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.

8.1.1 Operational Excellence

'Operational Excellence' provides the systems, tools and processes which ensure that all learning experiences that have the potential to improve 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 **8-3**.

The Operational Excellence function addresses the key points of:

- Capturing of lessons learnt;
- Review of lessons learnt; and
- Incorporation of knowledge in future work.

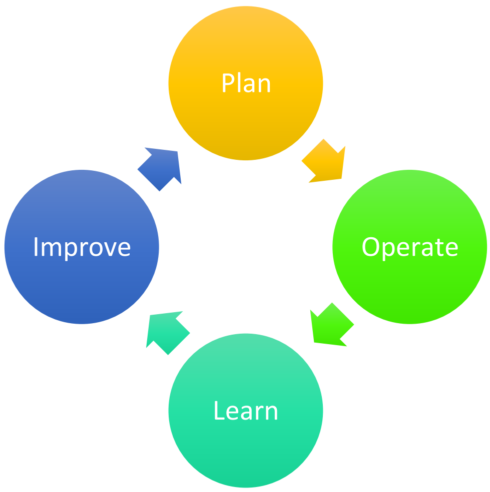


Figure 8-3: Operational and excellence business functions

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 the Computerised Maintenance Management System (CMMS). Processes, procedures and systems are improved based on the historical lessons learnt and applied in subsequent phases.

8.1.2 Value Discipline

The 'Value discipline' function represents the processes – including annual budgeting, capital funding – that ensure value and capital requirements are met and support the management system functions delivering their business objectives including HSE performance. Commonly HSE performance is a proxy for business performance and therefore HSE management is of interest to the Value discipline function of the management system.

8.1.3 People

The Jadestone Energy Competency Assurance Framework provides the formal systems, tools and processes which ensure that personnel are appropriately trained and competent to complete assigned tasks to an expected standard. Competency assurance is a necessary component of any approach to reduce safety, integrity and environmental risks to a level that is ALARP.

The Competency Assurance Framework addresses the key points of:

- Competency requirements (qualification, experience and training) are maintained for all Jadestone Energy positions where the incumbent is required to undertake, supervise, review or verify critical tasks or where the incumbent has the technical authority to approve critical documents;
- Competent persons are members of the workforce who meet the competency requirements for the respective positions to perform critical tasks without direct supervision;
- Candidates being considered for appointment in a critical position are assessed against the applicable competency requirements before being formally appointed;
- Incumbents must be reassessed against the competency requirements as per the required frequency stipulated in the competency matrix; and
- All contractors with personnel in the field are prequalified in accordance with the Contractor Management Framework.

Jadestone Energy personnel are subject to the provisions of the Jadestone Competency Assurance Framework which outlines the training, development and assessment requirements necessary to ensure that all employees have the relevant knowledge and skills required to conduct their activities in a safe and environmentally responsible manner.

A training and skills matrix has been developed for all positions which identifies responsibilities, training and competency requirements. Personnel will complete relevant training and hold qualifications and certificates for their specific role (e.g. well control certificates, rigging and crane operator certificates etc.). Training records will be retained.

8.1.4 Stakeholder Management

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

Relevant Persons consultation for this activity will be ongoing and Jadestone will work with stakeholders before, during and after the activity. Ongoing consultation serves a number of purposes:

- Provisions of updates on activity progress;
- Close out of communication commitments made during pre-start consultation;

- A platform to notify relevant persons of any deviations to the activity details originally provided during pre-start consultation;
- A platform to communicate with relevant persons during an emergency;
- Development of open communication channels with key relevant persons; and
- Provision of broader information relating to Jadestone that is not necessarily company specific.

While ongoing consultation with relevant persons and other stakeholders can be beneficial it is important not to overwhelm with too much information creating stakeholder fatigue.

Ongoing consultation activities build upon Jadestone's consultation for the activity. Section 4 outlines the processes that will be followed to ensure a standard approach to interacting with relevant persons during the life of the EP, including revision of relevant persons' list and process for dealing with feedback during this period. As part of ongoing consultation Jadestone will undertake the following activities (Table **8-1**).

Table 8-1: Standard consultation actions

ID	Activity	Frequency and method	Responsibility
058	Provide response organisations with a copy of the OPEP	Email response organisations	ER Lead
059	Notification of commencement (first monitoring activity) and cessation of activity to NOPSEMA and DMIRS (petroleum.environment@dmirs.wa.gov.au)	Within 4 weeks of commencement date and at cessation	Regulatory Compliance Lead
060	Notification of AMSA Joint Rescue Coordination Centre (JRCC) of commencement and cessation of activity	48–24-hours from commencement of operations	HSE Manager
061	Notification of commencement of activity to Australian Hydrographic Office (datacentre@hydro.gov.au)	4 working weeks prior to operations (first monitoring trip) commencing	Regulatory Compliance Lead

In addition, Jadestone will undertake additional triggered consultation as outlined below, should an unplanned event occur (Table **8-2**).

Table 8-2: Triggered consultation actions

ID	Trigger	Action	Responsibility
062	Feedback received from relevant person	Follow consultative process outlined in the Consultation for Environmental Approvals procedure	HSE Manager
063	Deviation to the planned activity from those originally provided in consultation	• Notification to relevant persons (including AHO and JRCC) • Notify AMP Director General if any change to risk within AMPs.	HSE Manager

ID	Trigger	Action	Responsibility
064	Oil spill event	• Notification to response agencies and government agencies by phone. • Attempt to electronically notify all relevant persons listed Table 4-3 as soon as possible. • Ongoing updates and communication in accordance with requirements and response procedures. • Notification of DPIRD via environment@fish.wa.gov.au within 24-hours of incident report. • Notify AMP Director General within 24-hours of incident report and prior to spill response activities within AMP on 0419 293 465. To include titleholder details, time and location of the incident, proposed response arrangements and locations as per the OPEP, Confirmation of providing access to relevant monitoring and evaluation reports when available and contact details for the response coordinator.	IMT Leader
065	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
066	Biosecurity incident: suspected marine pest or disease	Notification of DPIRD via biosecurity@fish.wa.gov.au or 1800 815 507 within 24-hours.	HSE Manager
067	Change to infrastructure that affects PSZ	Notify the Australian Hydrographic Office of activities and infrastructure for inclusion in Marine Notices	HSE Manager

In the event of a tier 2/3 hydrocarbon spill, Jadestone will notify all identified relevant persons within 72 hours of the event (refer Table 4-3). In addition, if any scientific monitoring programs (SMPs) are triggered during the spill response the following steps will be undertaken.

Step 1: Confirm relevant persons

For the SMP that has been triggered, review relevant persons with a direct interest in either the area monitoring will be undertaken or values that may be affected.

As a minimum, if any SMP is triggered then the following relevant persons will be consulted with:

- Director of National Parks;
- WAFIC (based on WAFIC advice on behalf of individual fishers);
- Indigenous bodies;
- Department of Biodiversity, Conservation and Attractions (WA) and/or Department of Environment and Natural Resources (NT); and
- DPIRD (Fisheries) and/or DPIF (NT).

Step 2: Relevant person notification of activation

Prior to SMP activities being undertaken (10 days where possible), email or phone notification to identified SMP relevant persons including:

- Summary of activities/methodology to be undertaken;
- Location of activities;
- Approximate timing of activities; and
- Contact details with invitation for comment.

Step 3: Updates

Updates as required while SMP being undertaken.

Step 4: Relevant person notification of termination

Ten days prior to the cessation of the SMP activities, notify relevant persons of:

- Proposed date of cessation;
- Summary of results (or date when results will be available and invitation to be provided copy); and
- Contact details with invitation for comment.

8.1.5 Risk Management

Jadestone has an integrated approach to risk management to cover all its business activities.

The Risk Management function provides a view of risk that is independent of 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 8.4.2.

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 8.4).

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.

8.1.6 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.

8.1.7 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.

8.2 Key Roles and Responsibilities

As per Regulations 14(4) and 14(5), a clear chain of command setting out the roles and responsibilities of personnel involved in 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 8.2.1 Organisational Chart: outlines the key roles involved in the VBA;
- **Section 8.2 Role responsibilities**: summarises the responsibilities of each key role involved in the VBA;
- **Section 8.2.2 Communication requirements**: outlines how personnel fulfilling key roles are made aware of their responsibilities as described in the EP; and
- **Section 8.2.3 Assessment of Competency and Training**: outlines how Jadestone assesses and evaluate the competencies and training requirements of personnel responsible for achieving the commitments with this EP.

8.2.1 Organisational Structure and Responsibilities

The organisational structure for the activity is presented in Figure **8-4**.

Each position has a position description outlining their HSE role and responsibilities, accountabilities and reporting lines (**Table 8-3**). 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.

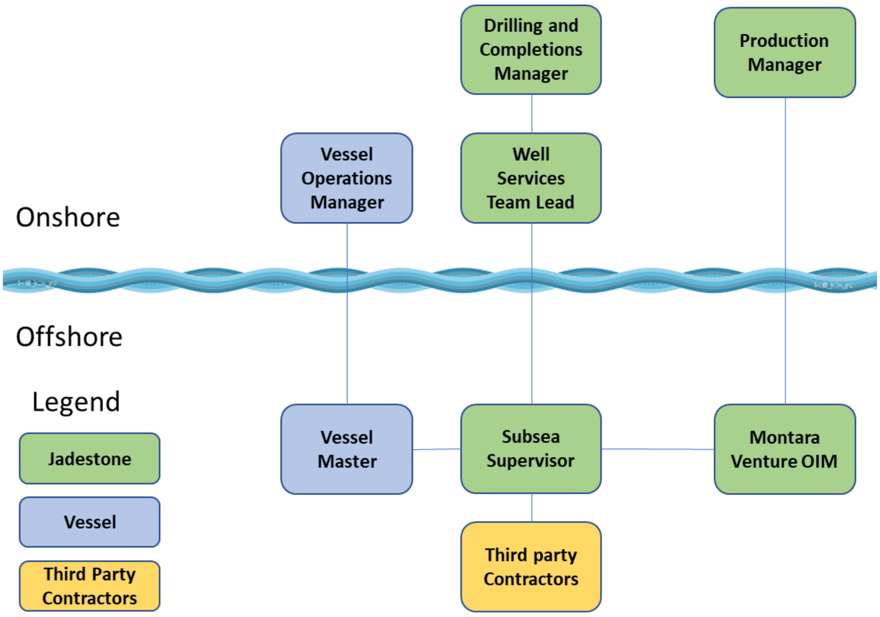


Figure 8-4: VBA organisation chart

Table 8-3: 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.
Drilling and Completions Manager	• Responsible for ensuring that JSE policies, management principles and standards are followed in the well design and operational phases. • Responsible for ensuring that best practices are used in the planning and execution of wells during the campaign. This includes ensuring that lessons learned in previous campaigns are applied to this current campaign. • Ensure that the requirements of this EP are implemented
Well Services Lead	• Responsible for offshore inspection and monitoring operations meeting environmental performance and compliance requirements of the EP. • Coordinate all IMR activities are undertaken by Company personnel and its contractors in accordance with approved programmes and appropriate legislation as detailed in this EP. • Ensure that all operational, technical and environmental incidents during IMR operations are reported to the Drilling and Completions Manager • Responsible for regular reporting through daily reporting formats. • Manage HSE hazards and risks related to IMR activities by ensuring procedures and risk reduction processes have been employed for all activities under their control.
JSE Subsea Engineer	• Responsible for ensuring correct procedures and practices are followed. • Responsible for HSE and operational support for all phases of VBA operations. • Ensures the Program is executed in compliance with JSE policies and is communicated, verbally and in writing, to the appropriate representatives on board the vessel. • Acts as JSE's senior representative and manages all JSE contractors on board the vessel. • Reports directly to the JSE Drilling Superintendent on all matters.
Marine superintendent	• Overall responsibility for vessel contracting and management
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 in the field. • Overall responsibility for spill response in the field.

Role	Key Responsibilities
HSE Manager	• Ensures review of daily, weekly and monthly reporting, as applicable, from the vessel. • Ensures environmental department liaison with the VBA 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.
Vessel 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.

8.2.2 Communication of Responsibilities

The primary mechanism for ensuring personnel involved in the VBA 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 below); and
- online induction prior to attending the field.

All personnel are required to complete an online induction that contains environmental components prior to arrival at the operational area. 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;
- Procedures for reporting of any environmental incidents or hazards;
- Waste management requirements;
- Overview of incident response and spill management procedures, including roles and responsibilities;
- Roles and environmental responsibilities of key personnel; and
- Direction on where to find copies of the EP and OPEP.

8.2.3 Competencies and Training

Jadestone Energy's Contractor Management Framework (JS-90-PR-G-00002) provides a process for ensuring that Contractors and Services Providers have the appropriate level of HSE capability. The assessment of Contractors and Service Providers competency provides a sound level of assurance that all key third-party personnel involved in 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.

8.3 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 6 and 7 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 this EP.

The collection of data from environmental performance monitoring activities forms the basis of demonstration that the commitments as listed are being met, that specified mitigation measures are in place to manage environmental risks, and that they remain working, and contribute to continually reducing risks and impacts to ALARP and acceptable levels.

8.3.1 Routine Monitoring

The purpose of monitoring and inspections is to record performance data and routinely check conformance with environmental performance standards and achievement of environmental performance outcomes defined by the EP. Routine inspection activities (desk and/or vessel based) 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 **8-4** details the quantitative records that are maintained for all emissions and discharges during routine or emergencies within the Operational Area as per Regulation 14(7) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*.

Table 8-4: Summary of routine monitoring

Measurement	Frequency	Monitoring Strategy	Record
Ballast water discharges	Intermittently – discharge events recorded as they occur	Discharges determined from ballast water record log	Ballast water records
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; and oily waste/ sludge.	Vessel records volumes on manifest	Invoicing process checks vessel manifest against waste disposal records of service provider, and evidence of disposal	Manifest documents Oil Record Book Garbage Record Book
Emissions from vessel engines.	Daily	Estimated from fuel usage	Fuel bunkering records

8.3.2 Audits

An audit is a systematic examination and evaluation against defined criteria and performance indicators to determine whether activities/ processes and related results conform to planned arrangements, whether these arrangements are implemented effectively, and if they are suitable to achieve Jadestone's performance outcomes and requirements.

Environmental audits provide assurance that the systems and processes in place to deliver the EP (i.e. the implementation strategy) are suitable and effective. The Jadestone Audit Manual (JS-90-PR-G-00003) describes the planning and conduct of audit activities.

8.3.3 Non-compliances and Corrective Actions

Non-conformances from audits, inspections, 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.

8.3.4 Reporting

Table 8-5 details the approach to routine environmental performance reporting to the Regulator. Reporting activities relating to reportable and recordable incidents will be as per Regulations 26, 26A, 26AA and 26B.

An additional reporting requirement to notify NOPSEMA in the event that the monitoring system detects hydrocarbons has been included. It is noted that the details surrounding the release of hydrocarbon will be confirmed with an ROV survey and the incident then classified as a reportable and recordable incident as per Regulations 26, 26A, 26AA and 26B.

8.4 Continuous Improvement (Operational Excellence)

The review of environmental performance includes an assessment of:

- Review of compliance with environmental performance outcomes and performance standards, and adequacy of measurement criteria;
- Function of environmental management controls relevant to reportable and/or recordable incidents;
- Monitoring data and trends;
- Results of audits and incident investigations;
- Inspection and checklist approaches; and
- Adequacy of monitoring, inspections and audits.

The results of the review and any identified improvements or recommendations will be incorporated into processes and procedures used for 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 5).

Any opportunities for improvements identified through the risk assessment (i.e. new controls adopted) will be evaluated via a Management of Change process prior to the EP, procedures or processes being modified.

Table 8-5: Summary of reporting requirements

Regulation	Requirement	Required Information	Timing	Type	Recipient
Before the Activity					
Regulation 29(1) & 30 – Notifications	NOPSEMA must be notified that the Activity is to commence.	Complete NOPSEMA's Regulation 29 Start or End of Activity Notification form for both notifications.	At least 10 days before the Activity (installation of the monitoring system) commences	Written	NOPSEMA
During the Activity					
Regulation 16(c), 26 & 26A – Reportable Incident	NOPSEMA must be notified of any reportable incidents For the purposes of Regulation 16(c), a reportable incident is defined as: • An incident relating to the Activity that has caused, or has the potential to cause, moderate to significant environmental damage • Types of reportable incidents are described in Table **9-1**.	The oral notification must contain: • All material facts and circumstances concerning the reportable incident known or by reasonable search or enquiry could be found out; • Any action taken to avoid or mitigate an adverse environmental impact due to the reportable incident; and • The corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.	As soon as practicable, and in any case not later than 2 hours after the first occurrence of a reportable incident, 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
N/a	Notify NOPSEMA in the event that the well monitoring system is triggered	Time, date and well location. Following ROV survey investigation, the incident will be classified as a reportable or recordable incident and NOPSEMA will remain informed via these regulatory processes.	Within 24 hours of Jadestone being notified of the triggered release	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 14 (2) & 26C – Environmental Performance	NOPSEMA must be notified of the environmental performance of the Activity	Report must contain sufficient information to determine whether or not environmental performance outcomes and standards in the EP have been met	Annual report submitted within 3 months after the anniversary of the reporting period, with the period commencing on the dated Regulation 29 notification form	Written	NOPSEMA
Regulation 25A Plan ends when titleholder notifies completion	NOSPEMA must be notified that the Activity has ended and all EP obligations have been completed	Notification advising NOPSEMA of end of the Activity	Within six months of the final Regulation 29 (2) notification	Written	NOPSEMA

8.4.1 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 triggered 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 (GA-60-STD-Q-00001);

- Approval of a change internal to Jadestone requires confirmation that impacts and risks have been assessed and appropriate reduction measures implemented (if required) to manage risk to ALARP and impacts to acceptable levels;
- All approved changes that affect the EP 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.

8.4.2 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.

8.5 Emergency Preparedness and Response

Under the Environment Regulations 14(8) the Implementation Strategy must contain an oil pollution emergency plan and provide for the updating of the plan containing adequate arrangements for responding to and monitoring oil pollution. These details are contained within the OPEP, which is part of this EP, and details the 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 made accessible to all personnel. The relevant incident response procedures and manuals are detailed in the OPEP.

The Montara Incident Response Plan (MV-70-PLN-F-00001), Incident Management Team Response Plan (JS-70-PLN-F-00008) and associated manuals are regularly updated with the revised contact details of relevant organisations and individuals included. They are also frequently tested to determine where they can be improved. The Incident Management Team Response Plan (IMTRP) sets out the structure, organisation and activation, or trigger processes for responding to an incident as well as detailing the schedule for exercising and testing the major hazard incidents and OPEP response and preparedness. The IMTRP also includes as an appendix the Oil Spill Response Arrangements (OSRA). The OSRA sets out the initial actions, notifications and responses once the IMT has triggered an oil spill response.

The Incident Management Exercise & Testing Program (JS-70-PR-F-00001) provides more information on planning and testing cycles. As a minimum, Jadestone conducts quarterly IMT drills, an annual major oil spill exercise, six-monthly oil spill response functional workshops, as well as ad-hoc exercises to coincide with specific project campaigns. The HSE (Emergency Response) Lead maintains an IMT exercise program.

Wherever practical, the IMT exercises, including oil spill responses, may involve support from other agencies, contractors and oil & gas operators as part of resource sharing initiatives. Records of emergency exercises, including OPEP commitments are assessed against measurement criteria and recorded in Jadestone's CMMS BASSnet.

In addition, assurance actions to meet OPEP requirements such as review of Scientific Monitoring capabilities, Waste Contractors compliance and availability of oil spill response vessels and aircraft are scheduled in BASSNet or contractual obligations.

Emergency response, including oil spill arrangements, as part of the implementation strategy are reviewed every 12 months. The scope of the review will be determined by the associated trigger for review. The triggers for the review are:

- document control notification;
- any significant change in the OPEP;
- any change in the risk assessment; and
- significant findings or any requirements from after-action review of drills or incidents.

9. REPORTING

9.1 Routine Reporting

Table **9-1** details the approach to routine environmental performance reporting to the regulator. Reports will be of sufficient detail to demonstrate whether specific environmental performance outcomes and standards have been met.

9.2 Incident Reporting

Table **9-1** defines the differences between a reportable and recordable incident. It also defines reporting protocols for initial notification of a reportable incident, written reportable incident reporting and monthly recordable incident reporting. The Incident and Hazard Reporting Procedure (JS-60-PR-F-00016) incorporates reporting timeframes for incidents depending on their environmental impacts.

Table 9-1: Routine and incident reporting requirements

Requirements	Timing
Routine Reporting	
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; • If the remote monitoring system has been triggered; • Introduction of an IMP; • Harm or mortality to an EPBC listed marine fauna; • 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

Department of Agriculture, Water and the Environment (DAWE) DAWE will be notified of the following incidents: • Harm or mortality to Commonwealth EPBC Act Listed Marine Fauna (attributable to the operations activity). • Spills of hydrocarbons or environmentally hazardous chemicals more 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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APPENDICES

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Sea Eagle-1 and Tahbilk-1 Vessel Based Activity Environment Plan

TM-50-PLN-I-00004

Rev 2

APPENDIX A - RELEVANT LEGISLATION

APPENDIX A: RELEVANT LEGISLATION

Convention on Biological Diversity (1992)

The objectives of the convention are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.

United Nations Framework Convention on Climate Change (1992)

The objective of the convention is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system. Australia ratified the convention in December 1992 and it came into force on 21 December 1993.

International Convention on Oil Pollution Preparedness, Response and Co-operation (1990)

This convention sets up a system of oil pollution contingency plans and cooperation in fighting oil spills.

Vienna Convention on the Protection of the Ozone Layer (1985) and the Montreal Protocol; on Substances that Deplete the Ozone Layer (1987)

The Convention (ratified by Australia in 1987) and the Protocol (ratified in 1989) concern the phasing out of ozone depleting substances.

United Nations Convention on the Law of the Sea (UNCLOS) (1982)

Part XII of the convention sets up a general legal framework for marine environment protection. The convention imposes obligations on State Parties to prevent, reduce and control marine pollution from the various major pollution sources, including pollution from land, from the atmosphere, from vessels and from dumping (Articles 207 to 212). Subsequent articles provide a regime for the enforcement of national marine pollution laws in the many different situations that can arise. Australia signed the agreement relating to the implementation of Part XI of the Convention in 1982, and UNCLOS in 1994.

Bilateral Agreements on the Protection of Migratory Birds

Australia has negotiated bilateral agreements with Japan (Japan-Australia Migratory Birds Agreement [JAMBA], 1974), China (China-Australia Migratory Birds Agreement [CAMBA], 1986) and the Republic of Korea (Republic of Korea – Australia Migratory Birds Agreement [ROKAMBA], 2007) to protect species of migratory birds with international ranges.

In November 2006, the East Asian-Australasian Flyway Partnership (Flyway Partnership) was launched in order to recognise and conserve migratory waterbirds in the East Asian – Australasian Flyway for the benefit of people and biodiversity.

Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention) (1979)

This Convention was concluded in 1979 and came into force on 1 November 1983. The Convention arose from a recommendation of the United Nations Conference on the Human Environment (Stockholm, 1972), and aims to conserve terrestrial, marine and avian species over the whole of their migratory range. It commits “Range States” to take action to conserve migratory species, especially those under threat. It is an umbrella agreement under which subsidiary regional agreements are established.

International Convention for the Protection of Pollution from Ships (1973) and Protocol (1978)

This Convention and Protocol (together known as MARPOL) build on earlier conventions in the same area. MARPOL is concerned with operational discharges of pollutants from ships. It contains five Annexes, dealing respectively with oil, noxious liquid substances, harmful packaged substances, sewage and garbage. Detailed rules are laid out as to the extent to which (if at all) such substances can be released in different sea areas. The legislation giving effect to MARPOL in Australia is the Protection of the Sea (Prevention of Pollution from Ships) Act 1983, the Navigation Act 2012 and several Parts of Marine Orders made under this legislation.

Australian and New Zealand guidelines for fresh and marine water quality (ANZECC/ARMCANZ 2000)

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.

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.

Offshore Petroleum and Greenhouse Gas Storage Act 2006

The *OPGGSA 2006* (OPGGSA) entered into force in 2008, superseding and repealing the previous offshore petroleum legislation – the *Offshore Petroleum Act 2006* (OPA) and the *Petroleum (Submerged Lands) Act 1967* (PSLA).

Facilities located entirely in Commonwealth offshore waters are controlled by the Commonwealth OPGGSA and its regulations, including but not limited to the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (OPGGS (E) Regulations).

The Act, and its regulations, is currently administered by the Joint Authority, which consists of the Commonwealth Minister for Resources and Energy and the State Minister for Mines and Petroleum. The WA Minister for Mines and Petroleum acts as a Designated Authority and is advised by the DMP whilst the Commonwealth Minister for Energy and Resources is advised by the Commonwealth Department of Resources, Energy and Tourism (DRET).

Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations)

Under the OPGGS (E) Regulations an EP is required for proposals under Commonwealth jurisdiction, comprising a description of the environmental effects and risks of the project, and proposed mitigation measures to reduce these risks.

The EP must be submitted to, and accepted by the Designated Authority (DA). The DA for Commonwealth waters adjacent to Western Australian state waters and out to the Australian Exclusive Economic Zone (EEZ) at 200 nm is NOPSEMA, who administers the regulations.

Environment Protection and Biodiversity Conservation Act 1999

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;

Nuclear Actions;

Commonwealth Marine Areas; and

Great Barrier Reef Marine Park.

Historic Shipwrecks Act 1976

This Act protects shipwrecks, which have lain in Territorial waters for 75 years or more. It is an offence to interfere with any shipwreck covered by the Act.

Navigation Act 2012

This Act requires that ships carrying oil and chemical tankers conform to relevant Regulations in Annex I of the MARPOL convention for the Prevention of Pollution from Ships. Marine Orders are a body of delegated legislation made pursuant to the Navigation Act 2012 and the Protection of the Sea (Prevention of Pollution from Ships) Act 1983.

Protection of the Sea (Prevention of Pollution from Ships) Act 1983

This Act gives effect to the International Convention for the Prevention of Pollution from Ships 1973/78 (MARPOL 73/78/97 and Annexes). It provides for penalties of up to AUD 10 million for not complying with the MARPOL. Marine Orders are a body of delegated legislation made pursuant to the Navigation Act 2012 and the Protection of the Sea (Prevention of Pollution from Ships) Act 1983.

Biosecurity Act 2015

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.

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.

Marine Orders

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.

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,

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.

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.

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).

Sea Eagle-1 and Tahbilk-1 Vessel Based Activity Environment Plan

TM-50-PLN-I-00004

Rev 2

APPENDIX B - OIL SPILL RISK EMBA

FIGURES

1. EXISTING ENVIRONMENT FOR THE RISK EMBA

The Environment that May Be Affected (RISK EMBA) is the geographical area encompassing the environment that has the potential to be affected by the unplanned events associated with the described activities (Section 2 of the EP). The maximum extent of an oil spill due to a loss of well control (LOWC) resulting in a major blowout has been used to inform the oil spill response planning and oil spill risk assessment (as per NOPSEMA Guidance Environment Bulletin A652993 Oil Spill Modelling April 2019) (refer Figure 1-1).

See Section 3 of the EP for the detailed description of the Operational Area, including details of Threatened and Migratory animal's distribution, migratory movements, preferred habitat and likely presence within the Operational Area. For other receptors potentially exposed to an unplanned event such as LOWC and not previously described; further detail is provided in this Appendix.

It should be noted that several species identified in the PMST search of the RISK EMBA (Appendix E) as listed threatened species have not been presented as they are either terrestrial fauna or bird species that are typically found in habitats distributed on the coastal fringes of Australia but are unlikely to be present on shorelines. Therefore, these species are not considered relevant to this EP and not discussed further.

1.1 Defining the Area

The RISK EMBA presented is based on the low level exposure of hydrocarbons on the water surface and represents the largest extent of an oil spill due to a loss of well control.

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

This description of the environment within the RISK EMBA addresses OPGGS(E) Regulation 13(2), which requires an Environment Plan to include a description of the environment that may be affected by the petroleum activity (EMBA) and to detail particular relevant values and sensitivities of that EMBA.

Within the RISK EMBA lies the Operational Area containing the Montara wellhead platform, Tahbilk and Sea Eagle. Distances referenced throughout this report have been measured from the Montara Field, which lies approximately 4.4 km from Tahbilk and 18 km from Sea Eagle.

1.2 Marine Regional setting

Australia's offshore waters have been divided into six marine regions to facilitate their management by the Australian Government under the EPBC Act. The RISK EMBA is located within the North West Marine Region (NWMR) and the North Marine Region (SEWPaC 2012a and 2012b). The objectives of the North and North-west Marine Parks Management Plan 2018 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 of the marine regions 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 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.

A summary of each region is provided below.

1.2.1 North West Marine Region

The North West Marine Region (NWMR) encompasses Commonwealth waters from the Western Australian/ Northern Territory border in the north, to Kalbarri in the south. A number of regionally important marine communities and habitats have been identified as part of the NWMR bioregional plan and WA State planning processes. These include Ashmore Reef, Cartier Island, Seringapatam Reef, Scott Reef, 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 wellhead platforms (WHP). A number of key ecological features (KEFs) have been identified in the RISK EMBA (Section 1.3.5.2). The Continental Slope Demersal Fish Community 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. Other priority areas in the NWMR include Rowley Shoals and Ningaloo Reef, approximately 700 km from the operational area.

1.2.2 North Marine Region

The North Marine Region (NMR) comprises Commonwealth waters from the west Cape York Peninsula to the Northern Territory–Western Australia border, covering approximately 625,689 km^2 of tropical waters in the Gulf of Carpentaria and Arafura and Timor seas. This region is highly influenced by tidal flows and less by ocean currents. The marine environment of the NMR is known for its high diversity of tropical species but relatively low endemism, in contrast to other bioregions. Additional to these, Key Ecological Features (KEFs) in the region within the RISK EMBA include the Pinnacles of the Bonaparte Basin, the Carbonate Bank and Terrace System of the Van Diemen Rise, the Shelf Break and Slope of the Arafura Shelf and the Tributary Canyons of the Arafura Depression.

1.2.3 Provinces of the NWMR and NMR

The NWMR and NMR are further divided into Integrated Marine and Coastal Regionalisation of Australia (IMCRA) provincial bioregions, with those occurring within the RISK EMBA summarised in Table 1-1.

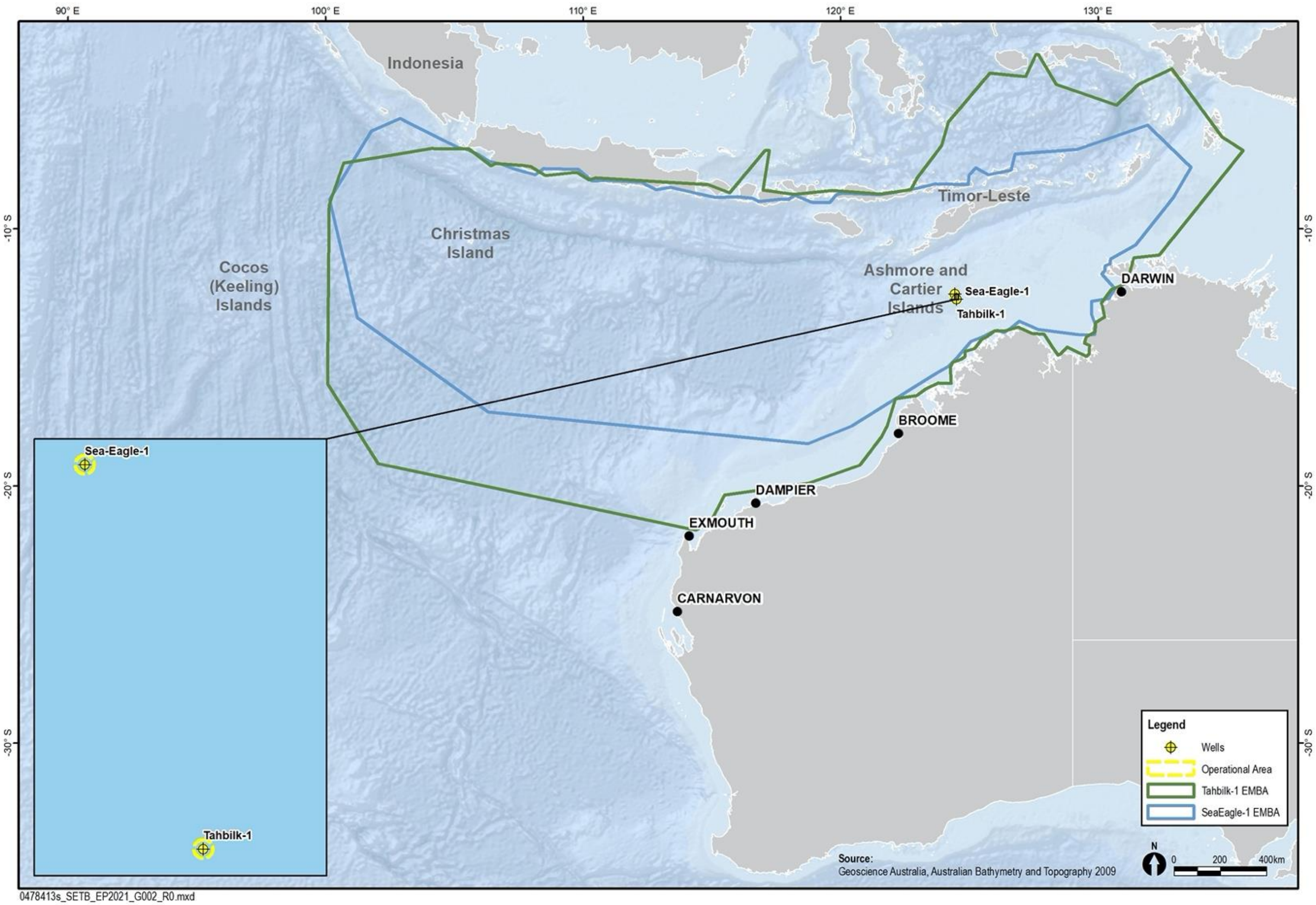


Figure 1-1: Spatial extent of the RISK EMBA

Table 1-1: Description of the IMCRA Provincial Bioregions within the RISK EMBA

Provincial Bioregion	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 (ITF). These open waters support pelagic species, including whale sharks, an unusual array of threadfin fish species and distinct genetic stocks of red snapper.
Timor transition	This bioregion is the shallowest on average of all the NBMB bioregions due to its location on the upper slope of the north margin. This bioregion contains the second smallest area of slope. The demersal fish data indicate that this bioregion has a strong boundary with Indonesian and Papua New Guinea fauna, although the similarity of the demersal fishes in this bioregion to Timor and Indonesian fauna has not been fully established
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.
Northwest Shelf Province	The Northwest Shelf Province is located primarily on the continental shelf between North West Cape and Cape Bougainville, varying in width from 50 m at Exmouth Gulf to more than 250 km off Cape Leveque. Around half of the bioregion has water depths of only 50 – 100 m. It is characterised by a dynamic oceanographic environment, influenced by strong tides, cyclonic storms, long-period swells and internal tides.
Northwest Transition	The Northwest Transition includes the shelf break, continental slope and the majority of the Argo Abyssal Plain of the NMWR. Mermaid Reef is a key topographical feature of the bioregion; a biodiversity hotspot where the steep change in slope around the reef attracts a range of pelagic migratory species including billfish, sharks, tuna and cetaceans.
Northwest Province	This bioregion is the third largest of all the IMCRA shelf bioregions. It includes unit clusters of geomorphic features defined by the distribution and abundance of pinnacles, banks, and sand banks. This bioregion contains the 2nd largest area of Class 1 units of all the IMCRA shelf bioregions.
Northern Shelf Province	This bioregion is the largest of all the IMCRA shelf bioregions. It includes units defined by the distribution and abundance of pinnacles, banks, and sand banks. This bioregion contains the largest area of Class 1 and Class 7 units of all IMCRA shelf bioregions, dominated by the low-gradient basin located in the Gulf of Carpentaria.
Christmas Island Province	The Christmas Island bioregion covers 277,180 km^2 of the marine area surrounding Christmas Island, specifically capturing the endemic fish species and other fauna associated with Christmas Island.
Central Western Shelf transition	Covering a total area of 3080km^2, this bioregion is the smallest of the IMCRA shelf bioregions. Class 1 units are overwhelmingly the dominant geomorphic class in this bioregion.
Central Western Transition	Covering a total of 173,660 km^2, this bioregion's biomes are defined by the demersal fish depth structure and are the 7th largest in terms of their total area.
Cocos (Keeling) Island Province	Covering a total area of 467,260km^2, this bioregion contains the largest abyssal plain/deep ocean floor area of all the NBMB bioregions. This bioregion does not correspond to any demersal fish province, but specifically captures endemic fish species and other fauna associated with the Cocos

Provincial Bioregion	Description
	(Keeling) Islands. This bioregion is the deepest NBMB bioregion on average due to the relatively large areas of abyssal plain/deep ocean floor. Due to the similar geomorphology and location adjacent to Indonesia in the tropical Indian Ocean, the fauna contained in this bioregion is probably similar or related to the fauna associated with the Christmas Island bioregion (PB23).

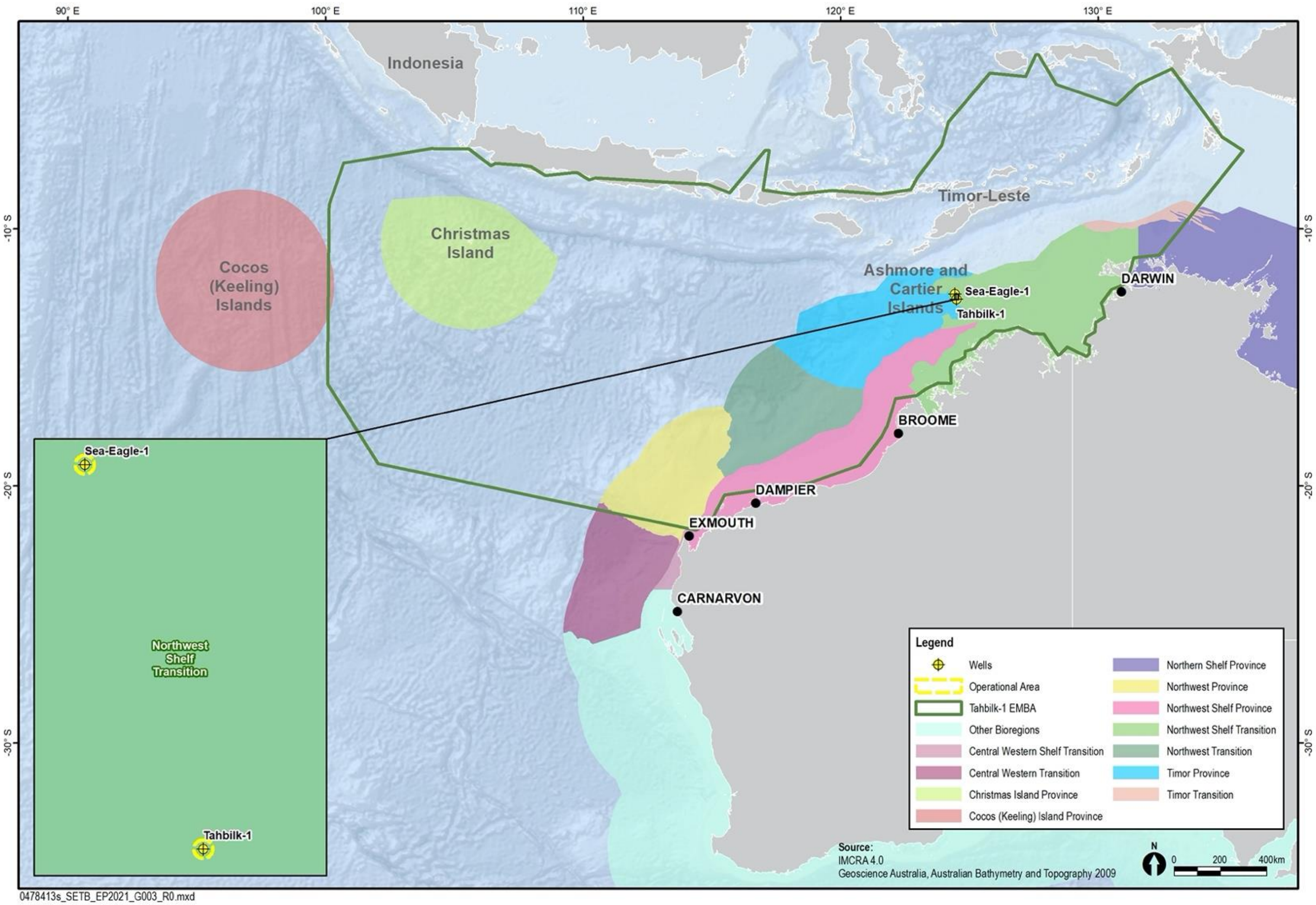


Figure 1-2: Provincial Bioregions relevant to the RISK EMBA

1.3 Conservation values and sensitivities

1.3.1 Matters of National Environmental Significance (MNES)

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 RISK EMBA are summarised in Table 1-2. The full EPBC Act Protected Matters report for the RISK EMBA is provided in Appendix G.

Table 1-2: Summary of conservation values and sensitivities in the RISK EMBA

MNES Protected under EPBC Act	RISK EMBA Presence	Appendix Section
World Heritage	✔ (1)	1.3.1.1
National Heritage Places	✔ (2)	1.3.1.2
Wetlands of International Importance (Ramsar)	✔ (4)	1.3.1.3
Great Barrier Reef Marine Park	✗	
Commonwealth Marine Areas	✔ (2)	1.3.1.4
Threatened Ecological Communities	✔ (1)	1.3.1.5
Listed Threatened Species	✔ (83)	1.3.2
Listed Migratory Species	✔ (77)	1.3.2
Nuclear actions and water resources, in relation to coal seam gas or coal mining	✗	
Other Matters Protected under EPBC Act	**RISK EMBA Presence**	
Commonwealth Land	✔	1.3.3
Commonwealth Heritage Places	✔ (16)	1.5.7
Listed Marine Species	✔ (145)	1.4
Whales and other cetaceans	✔ (32)	1.4.6
Critical habitats	✗	
Commonwealth reserves terrestrial	✔ (1)	
Australian Marine Parks	✔ (12)	0
Other Areas of high conservation significance	**RISK EMBA Presence**	
State and Territory Marine Parks (MP) and Marine Management Areas (MMA)	✔	1.3.5.1
Key Ecological Features (KEFs) (Marine)	✔ (16)	1.3.5.2

1.3.1.1 World Heritage Places

Although it will not receive floating/entrained/dissolved oil above threshold, The Ningaloo Coast has been described as the EMBA overlaps the outer edge of this marine park receptor that has been drawn, making this within the RISK EMBA (Table 1-3).

Table 1-3: World Heritage place distance to the Montara Field

World Heritage Place	Straight-line distance from Montara Field
The Ningaloo Coast	1,457 km

1.3.1.1.1 The Ningaloo Coast

The Ningaloo Coast was included on the World Heritage List in 2011 and was inscribed for outstanding natural universal values as follows:

- An example of superlative natural phenomena and areas of exceptional natural beauty and aesthetic importance;
- outstanding examples representing major stages of Earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features; and
- the most important and significant natural habitats for in situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

The Ningaloo Coast WHA includes (DEWHA 2010b):

- Ningaloo Marine Park (Commonwealth waters);
- Ningaloo Marine Park (Western Australia state waters);
- Muiron Island Marine Management Area (including the Muiron Islands);
- Jurabi Coastal Park;
- Bundegi Coastal Park;
- Cape Range National Park; and
- Learmonth Air Weapons Range.

The Ningaloo Coast World Heritage Area (including the Muiron Islands) is managed under a plan that is consistent with the World Heritage Convention and Australia's World Heritage management principles. World Heritage Management principles are set out in regulations and cover matters relevant to the preparation of management plans, the environmental assessment of actions that may affect the property and community consultation processes.

The Australian World Heritage management principles are outlined under Schedule 5 of the EPBC regulations (2000). The objective is to ensure that any likely impact of an action on the World Heritage values of the property should be considered. Any action should be consistent with the protection, conservation, presentation or transmission to future generations of the World Heritage values of the property.

The marine environment of the Ningaloo Coast World Heritage Area is protected as a National Heritage Place, a Commonwealth Heritage Place and an Australian Marine Park, and is discussed further in Section 1.3.1.2, Section 1.3.3 and Section 1.3.4, respectively.

1.3.1.2 National Heritage Places

The West Kimberley is described below. The Ningaloo Coast has been described in Section **Error! Reference source not found.** as it is also a World Heritage Place.

Table 1-4: National Heritage Place distances

National Heritage Place	Straight-line distance from Montara Field
The Ningaloo Coast	1,457 km

The West Kimberley	173 km

1.3.1.2.1 The West Kimberley

The West Kimberley was included on the National Heritage List in 2011 and has numerous values which contribute to the significance of the property, including indigenous, historic, aesthetic, cultural and natural heritage values (DSEWPaC 2012b). Of these values, the most relevant to the marine environment is Roebuck Bay as a migratory hub for shorebirds. The area is characterised by a diversity of landscapes and biological richness found in its cliffs, headlands, sandy beaches, rivers, waterfalls and islands.

1.3.1.3 Wetlands of International Importance (Ramsar)

There are four "wetlands of international importance" under the Convention on Wetlands of International Importance (Ramsar Convention), referred to henceforth as Ramsar wetlands, within the RISK EMBA**.** The values for those sites that could be affected by marine impacts are outlined in Table 1-6.

Table 1-5: Wetlands of International Importance (Ramsar) distances

Wetland of International Importance (Ramsar)	Straight-line distance from Montara Field
Ashmore Reef National Nature Reserve	125 km
The Dales	2,093 km
Ord River Floodplain	500 km
Hosnies Spring	2,093 km

There are a number of key management principles applicable to Ramsar wetlands. Contracting parties of the Ramsar Convention are expected to manage their Ramsar Sites as to maintain their ecological character and retain their essential functions and values for future generations. Preventing, stopping and reversing the loss and degradation is one of the priority areas of focus for the Ramsar Convention over 2016-2025.

The most significant threats to the ecological character of these sites are identified to be from seismic surveys, drilling activities, oil spills, mineral resource recovery and exploration. However, the majority of these impacts are recognised to be localised and short-term and would therefore only be relevant if development occurs in close proximity to the reserve.

Management goals include protecting the reserves from extractive commercial activity and minimising potential impact on the natural features of the reserve from exploration and extraction activities in the region. Relevant management strategies include prohibition of mining operations (including mineral and petroleum exploration and development) within the reserve and continuing to liaise with relevant departments and agencies in relation to proposals for exploration and extraction in the vicinity of the reserve.

Table 1-6: Description of Ramsar Wetlands of International Importance within the RISK EMBA

Ramsar Wetland	Ecological Characteristics	Relevant Management Documents
Ashmore Reef Marine Park Ramsar site	- All wetland types present are in near natural condition - Supports 64 internationally and nationally threatened species - Supports 47 waterbird species listed as migratory under international treaties, plus breeding of 20 waterbird species - Important feeding site for three turtle species and critical nesting and inter-nesting habitats for two turtle species - Regularly supports more than 20,000 waterbirds and has been known to support more than 65,000 waterbirds - Regularly supports > 1% of at least six species of waterbirds	Environment Australia (2002) DoNP (2018a) Ashmore Reef Commonwealth Marine Reserve Ramsar site Ecological Character Description (Hale and Butcher, 2013)
The Dales	- Located on Christmas Island, the Dales Ramsar site is located within the Christmas Island National Park, with the western boundary of the site extending to 50 m seaward from the low water mark (including a narrow, shallow reef) - System of seven watercourses that contain a number of wetland types - Exhibits unusual water-related limestone deposition features, including a 'flowstone' formation that is usually found underground - supports a wide diversity of endemic and threatened species (Director of National Parks 2014) - Migrating red crabs pass through the area on their annual breeding - Provides critical habitat for blue crabs that are dependent upon the freshwater streams for their reproductive cycle - Supports endemic fauna species including the Abbott's booby, blue crabs and forest birds (Director of National Parks 2014)	The Dales Ramsar site Ecological Character Description (2010) Christmas Island NP Management Plan 2014-2024
Hosnies Spring	Located on Christmas Island, Hosnies Spring is a small area of shallow freshwater streams and seepages 20-45 metres above sea-level on the shore terrace of the east coast of the island. The Ramsar site consists of a stand of two species of mangroves of the usually tidal genus Bruguiera. The Ramsar site includes surrounding terrestrial areas with rainforest grading to coastal scrub, and includes an area of shoreline and coral reef. Species and height of individual trees present rare and height above sea level unusual. Provides habitat for the protected blue crab	Hosnies Spring Ecological Character Description (2010) Christmas Island NP Management Plan 2014-2024
Ord River Floodplain	- Floodplain and estuarine wetland system - The site includes the Ord River Estuary leading into the Cambridge Gulf	Ecological Character description of the Ord River Floodplain Ramsar Site (2008)

Ramsar Wetland	Ecological Characteristics	Relevant Management Documents
	- The north-east end of the site heads around the coast to include a series of extensive intertidal creeks and flats known as the False Mouths of the Ord - The upstream portion of the floodplain and river tends to be freshwater, and becomes more saline as the river approaches the Cambridge Gulf and falls under tidal influence - Mangroves are the most common vegetation in the site, extending from the False Mouths of the Ord to the upstream sections of the estuary The mangroves form narrow fringes along the intertidal areas, with saltmarsh on higher ground. The intertidal mangroves support many species of birds and bats, and are a breeding area for banana prawns - Over 200 species of birds have been recorded within the site including waterfowl, migratory shorebirds, mangrove birds and terrestrial species - The wetlands are habitat for many diadromous fish species (that require migration between marine and more freshwater environments some time during their life), including the nationally threatened species freshwater sawfish, green sawfish and northern river shark	

1.3.1.4 Commonwealth Marine Areas

The RISK EMBA are within the Australian EEZ and Territorial Sea and the Extended Continental Shelf Commonwealth Marine Areas. 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" (EPBC Act 1999). 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 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.

1.3.1.5 Threatened Ecological Communities

One Threatened Ecological Community (TEC), the Monsoon Vine Thicket on the Coastal Sand Dunes of Dampier Peninsula (Table 1-7), was identified by the PMST search of the RISK EMBA (Appendix G).

Table 1-7: TEC distances

TEC	Straight-line distance from Montara Field
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	432 km

1.3.1.5.1 Monsoon Vine Thicket on the Coastal Sand Dunes of Dampier Peninsula

Monsoon vine thicket occurs as semi - deciduous and evergreen vine thicket communities of coastal Holocene sand dunes on the Dampier Peninsula in the Kimberley Region, covering an area of ~2,500 ha from Broome in the south to One Arm Point in the north, and on the north-eastern coast of the Peninsula from One Arm Point to Goodenough Bay (DSEWPaC 2013a). The community is predominantly restricted to the leeward slopes and swales of coastal sand dunes but occasionally found on dune crests and other coastal landforms such as beaches, sand-spit headlands and storm ridges with intertidal flats (Black et al. 2010).

It represents the most southern occurrences of rainforest type vegetation in WA. The most common canopy forming species are *Bauhinia cunninghammi* (jigal, joomoo), *Celtis philippensis* (goolnji), *Diospyros humilis* (ebony wood), *Exocarpos latifolius* (jarnba, mistletoe tree), *Grewia breviflora* (goolmi, currant/coffee fruit), *Mallotus nesophilus* (yellow ball flower), *Mimusops elengi* (joongoon, mamajen), *Sersalisia sericea* (mangarr), *Terminalia ferdinandiana* (gabiny, gubinge, kabiny) and *Terminalia petiolaris* (blackberry tree, marool, narwulu) (DSEWPaC 2013a).

The extent of the ecological community corresponds to the traditional lands of the Bardi Jawi, Djabera Djabera, Goolarabaloo, Jabirr Jabirr, Nyul Nyul and Yawuru Indigenous people and is of cultural significance. It is listed as Endangered under the EPBC Act (Government of Western Australia 2010; DoEE 2016b) and described in the Approved Conservation Advice for the monsoon vine thickets on the coastal sand dunes of

Dampier Peninsula (DSEWPaC 2013a); and, as Vulnerable in the Interim Recovery Plan 2018-2023 for the Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula (DBCA, 2018). This community is also subject to the Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoE 2014c).

1.3.2 Listed Threatened and Migratory Species

The PMST search of the RISK EMBA (Appendix G) identified 83 Listed Threatened Species (LTS) and 77 Listed Migratory Species (LMS).

The Listed Threatened Species included:

- 21 species of mammals (five marine species relevant to impact assessment);
- 13 species of reptiles (eight marine species relevant to impact assessment);
- Eight shark species; and,
- 32 avifauna species (17 marine or inter-tidal species relevant to impact assessment).

The Listed Migratory species (LMS) included:

- 18 Migratory Marine avifauna;
- 22 Migratory Wetland avifauna; and,
- 31 Migratory Marine species.

The relevant sections of this Appendix discuss the likelihood of these species and their biologically important areas occurring within the RISK EMBA. Those species that have been identified as likely to be present in the RISK EMBA are detailed in the sections 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). Relevant management for the species are described below and in Section 3 of the EP such as:

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

The requirements of the species recovery plans and conservation advices are considered to identify any requirements that may be applicable to the risk assessment in the event of an unplanned hydrocarbon spill.

1.3.3 Others Matters Protected by the EPBC

Listed Marine Species

A total of 145 Listed Marine Species are either likely to, or may, occur within the RISK EMBA, including:

- 58 avifauna species;
- 32 cetacean species;
- 1 mammal species;
- 52 fish species; and
- 34 reptile species.

Note that these also include all listed threatened and migratory species, as described in Section 1.3.2.

Whales and Other Cetaceans

The Protected Matters search determined that 32 cetacean species or their habitat, may occur within the RISK EMBA. Threatened species of whales and cetaceans occurring in the RISK EMBA are discussed in Section 1.4.6.

Commonwealth Land

The RISK EMBA intersects with four Commonwealth land sites, including two Defence sites.

Commonwealth Heritage Places

Six natural Commonwealth Heritage Places are found in the RISK EMBA (Table 1-8). These locations are Marine Parks and are discussed in the following MNES sections.

Table 1-8: Commonwealth Heritage Place distances

Commonwealth Heritage Place	Straight-line distance from Montara Field
Ashmore Reef National Nature Reserve	125 km
Christmas Island Natural Areas	2,077 km
Mermaid Reef – Rowley Shoals	712 km
Ningaloo Marine Area	1,457 km
Scott Reef and Surrounds – Commonwealth Area	321 km

1.3.4 Australian Marine Parks (AMPs)

12 Australian Marine Parks (AMPs) exist within the RISK EMBA (Table 1-9).

Marine parks are managed under management plans which provide the rules about what activities can and cannot occur within marine park zones. Petroleum titleholders must ensure that their offshore environment plans are consistent with the zoning and rules that apply to mining operations in marine parks, as described in the management plans. They must also ensure that impacts on the representative values of the parks will be of an acceptable level and managed to as low as reasonably practicable (ALARP) (NOPSEMA 2018). A summary of conservation values and management principles for marine parks found within the RISK EMBA is provided in Table 1-9 and Figure 1-3.

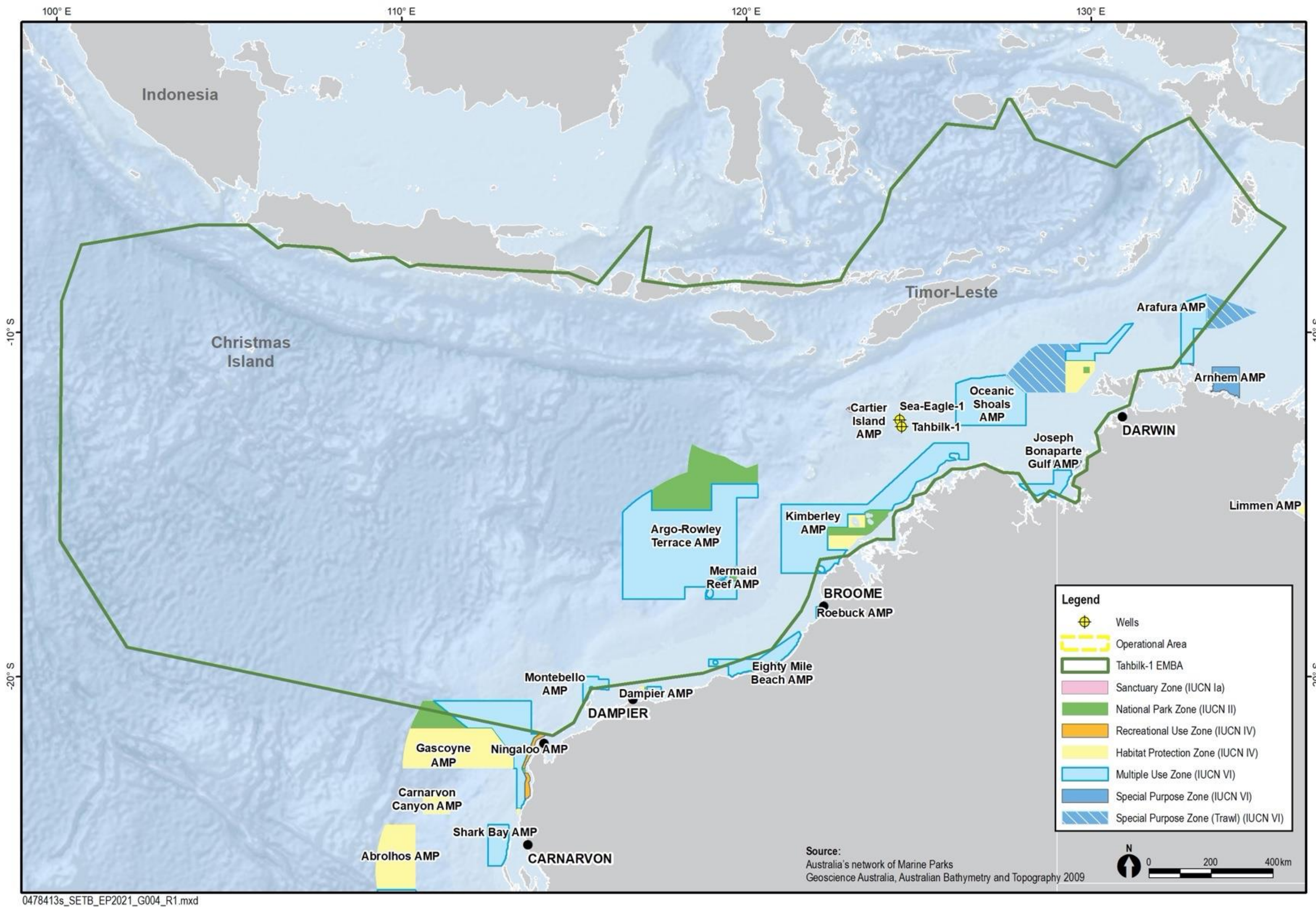


Figure 1-3: Australian Marine Parks within the RISK EMBA

Table 1-9: Description of Australian Marine Parks within the RISK EMBA

Australian Marine Park	Distance from Montara Field	Description and Key Features of Conservation Significance	IUCN Zone within EMBA	Rules/Requirements
Ashmore Reef	125 km	- Atoll-like structure with three low vegetated islands, sandbanks, lagoon areas, and surrounding reef - largest of only three emergent oceanic reefs present in the north-eastern Indian Ocean - Only oceanic reef in the region with vegetated islands - The Ashmore Reef Ramsar site is located within the boundary of the Marine Park. The site was listed under the Ramsar Convention in 2002 (site 1220) and is a wetland of international importance under the EPBC Act - Reef covers an area of 227 km2 - Encompasses ecosystems, habitats and communities associated with the North-West Shelf, Timor Province, and emergent oceanic reefs - World's highest recorded abundance and diversity of sea snakes (DSEWPaC 2012c) - Important biological stepping-stone facilitating transport of biological material to the reef systems along the WA coast - Critical nesting and inter-nesting habitat for green turtles on all three islands (DoE 2015a) - Moderate nesting habitat for hawksbill turtles (Whiting and Guinea 2005; Guinea 2013) - Low nesting activity by loggerhead turtles (single report of nesting on West Island; Whiting and Guinea 2005) - Large and significant feeding populations of green, hawksbill and loggerhead turtles occur around the reefs - Supports a range of pelagic and benthic marine species - Seagrass supports a small dugong population of less than 50 individuals that breeds and feeds around the reef (Whiting and Guinea 2005)	Sanctuary (1a) Recreational (IV)	North-west Marine Parks Network Management Plan (DoNP 2018a) Sanctuary Zone (IUCN category Ia)—managed to conserve ecosystems, habitats and native species in as natural and undisturbed a state as possible The zone allows only authorised scientific research and monitoring Emergency response permitted

Australian Marine Park	Distance from Montara Field	Description and Key Features of Conservation Significance	IUCN Zone within EMBA	Rules/Requirements
		- Reef is highly diverse, particularly for corals and molluscs, supporting the highest number of coral species of any reef off the west Australian coast (DSEWPaC 2012b) - Migratory pathway for pygmy blue whales - Islands support some of the most important seabird rookeries on the North West Shelf, including colonies of bridled terns, common noddies, brown boobies, eastern reef egrets, frigatebirds, tropicbirds, red-footed boobies, roseate terns, crested terns and lesser crested terns (DoEE 2018c) - Important seabird rookery and staging/feeding areas for many migratory seabirds, including 43 species listed on one or both of the China– Australia Migratory Bird Agreement (CAMBA) and the Japan– Australia Migratory Bird Agreement (JAMBA) - Cultural and heritage sites including Indonesian artefacts and grave sites - Two KEFs: Ashmore Reef and Cartier Island and surrounding Commonwealth waters and Continental Slope Demersal Fish Communities - Subject to the Memorandum of Understanding between Australia and Indonesia (MoU Box) - Indigenous Australians Sea country is valued for Indigenous cultural identity, health and wellbeing. Across Australia, Indigenous people have been sustainably using and managing their sea country for tens of thousands of years. At the commencement of this plan there is limited information about the cultural significance of this Marine Park - Indonesian The Marine Park contains Indonesian artefacts and grave sites and Ashmore lagoon is still accessed as a rest or staging area for traditional Indonesian fishers travelling to and from fishing grounds within the MoU Box No international or national heritage listings apply to the Marine Park at commencement of the management plan (DoNP 2018a)		

Australian Marine Park	Distance from Montara Field	Description and Key Features of Conservation Significance	IUCN Zone within EMBA	Rules/Requirements
		- Commonwealth heritage Ashmore Reef was listed on the Commonwealth Heritage List in 2004, meeting Commonwealth heritage listing criteria A, B and C Tourism, recreation and scientific research are important activities in the Marine Park. These activities contribute to the wellbeing of regional communities and the prosperity of the nation		
Cartier Island	84 km	- The Marine Park includes an unvegetated sand island (Cartier Island), mature reef flat, a small, submerged pinnacle (Wave Governor Bank), and two shallow pools to the north-east of the island - Covers an area of 172 km2 - Encompasses ecosystems, habitats and communities associated with the Timor Province (Director of National Parks 2018a) - Internationally significant for its abundance and diversity of sea snakes (DSEWPaC 2012b) - Important biological stepping stone facilitating the transport of biological material to the reef systems along the WA coast - Large and significant populations of green, hawksbill and loggerhead turtles occur around the reefs (interesting and feeding habitat), with a significant population of nesting green turtles (DSEWPaC 2012b) - Important seabird rookery and staging/feeding areas for many migratory seabirds - Supports colonies of bridled terns, common noddies, brown boobies, eastern reef egrets, frigatebirds, tropicbirds, red-footed boobies, roseate terns, crested terns and lesser crested terns (DoE 2015b) - Supports a range of pelagic and benthic marine species - High diversity and abundance of hard and soft corals, gorgonians (sea fans), sponges and a range of encrusting organisms - Reef crests are generally algal dominated	Sanctuary Zone (1a)	Sanctuary Zone (IUCN category Ia)—managed to conserve ecosystems, habitats and native species in as natural and undisturbed a state as possible. The zone allows only authorised scientific research and monitoring. DoNP (2018a)

Australian Marine Park	Distance from Montara Field	Description and Key Features of Conservation Significance	IUCN Zone within EMBA	Rules/Requirements
		- Reef flats feature ridges of coral rubble and large areas of seagrass (Director of National Parks 2018a) - Foraging habitat for whale sharks (DoEE 2018b) - Two KEFs: Ashmore Reef and Cartier Island and surrounding Commonwealth waters and Continental Slope Demersal Fish Communities - Cultural and heritage site of the Ann Millicent historic shipwreck - Subject to the Memorandum of Understanding between Australia and Indonesia (MoU Box) - Sea country is valued for Indigenous cultural identity, health and wellbeing. Across Australia, Indigenous people have been sustainably using and managing their sea country for tens of thousands of years. At the commencement of the management plan (DoNP 2018a), there is limited information about the cultural significance of this Marine Park. - Scientific research is an important activity in the Marine Park		
Eighty Mile Beach	741 km	Covers an area of approximately 10,785 km^2 and protects the following conservation values: - Breeding, foraging and resting habitat for seabirds (one of the world's most important feeding grounds for migratory shorebirds and waders and is listed under the Ramsar Convention); - Internesting and nesting habitat for marine turtles (it supports a significant nesting population of flatback turtles, which are endemic to northern Australia); - Foraging, nursing and pupping habitat for sawfish; - Migratory pathway for humpback whales; - Coastal waters provide critical habitat for several shark and ray species at varying life stages; - The Nyangumarta, Karajarri and Ngarla people's sea country extends into Eighty Mile Beach Marine Park. Access to sea country by families is important for cultural	Multiple Use (VI)	The objective of the Multiple Use Zone (VI) is to provide for ecologically sustainable use and the conservation of ecosystems, habitats and native species DoNP (2018a)

Australian Marine Park	Distance from Montara Field	Description and Key Features of Conservation Significance	IUCN Zone within EMBA	Rules/Requirements
		traditions, livelihoods and future socio-economic development opportunities; and - Three known shipwrecks listed under the *Underwater Cultural Heritage Act 2018*: Lorna Doone (wrecked in 1923), Nellie (wrecked in 1908), and Tifera (wrecked in 1923).		
Gascoyne	1,458 km	Covers an area of approximately 81,766 km^2 and protects the following conservation values: - Important foraging areas for: migratory seabirds threatened and migratory hawksbills and flatback turtles; and vulnerable and migratory whale shark; - A continuous connectivity corridor from shallow depths around 15 m out to deep offshore waters on the abyssal plain at over 5,000 m in depth; - Seafloor features including canyon, terrace, ridge, knolls, deep hole/valley and continental rise. It also provides protection for sponge gardens in the south of the reserve adjacent to Western Australian coastal waters; - Ecosystems examples from the Central Western Shelf Transition, the Central Western Transition and the Northwest province provincial bioregions as well as the Ningaloo meso-scale bioregion; - Four KEFs: Canyons on the slope between the Cuvier Abyssal Plain and the Cape Range Peninsula, Exmouth Plateau, Continental slope demersal fish communities and Commonwealth waters adjacent to Ningaloo Reef. - The canyons in this reserve are believed to be associated with the movement of nutrients from deep water over the Cuvier Abyssal Plain onto the slope where mixing with overlying water layers occurs at the canyon heads. These canyon heads, including that of Cloates Canyon, are sites of species aggregation and are thought to play a significant role in maintaining the ecosystems and biodiversity associated with the adjacent Ningaloo Reef; and - The reserve therefore provides connectivity between the inshore waters of the existing Ningaloo Commonwealth marine park and the deeper waters of the area.	Multiple Use (VI) National Park (II)	Multiple Use Zone (IUCN category VI)—managed to allow ecologically sustainable use while conserving ecosystems, habitats and native species. The objective of the National Park Zone (II) is to provide for the protection and conservation of ecosystems, habitats and native species in as natural a state as possible. DoNP (2018a)

Australian Marine Park	Distance from Montara Field	Description and Key Features of Conservation Significance	IUCN Zone within EMBA	Rules/Requirements
Oceanic Shoals	162 km	- Covers an area of 72,000 km2 - Examples of the ecosystems of the Northwest Shelf Transition Province and the Timor Transition Province - Important internesting area for flatback and olive ridley turtles - Important foraging area for loggerhead and olive ridley turtles (DoEE 2018b) - BIAs include foraging and internesting habitat for marine turtles, particularly the threatened flatback turtle and olive ridley turtle - Four KEFs: carbonate bank and terrace system of the Van Diemen Rise; carbonate banks of the Joseph Bonaparte Gulf; pinnacles of the Bonaparte Basin; and shelf break and slope of the Arafura Shelf	National Park (II) Multiple Use (VI) Habitat Protection (IV) Special Purpose [Trawl] (VI)	The objective of the National Park Zone (II) is to provide for the protection and conservation of ecosystems, habitats and native species in as natural a state as possible The objective of the Multiple Use Zone (VI) is to provide for ecologically sustainable use and the conservation of ecosystems, habitats and native species DoNP (2018a)
Argo-Rowley Shoals	464 km	- Covers an area of 146,099 km2 - Important foraging areas for migratory seabirds and the endangered loggerhead turtle (DoE 2016a) - Important area for sharks, which are found in abundance around the Rowley Shoals relative to other areas in the region (DoE 2016a) - Provides protection for the communities and habitats of the deeper offshore waters of the region in depth ranges from 220 m to over 5,000 m - Provides connectivity between the existing Mermaid Reef Marine National Nature Reserve and reefs of the WA Rowley Shoals Marine Park and the deeper waters of the region - 2 KEFs: The canyons linking the Argo Abyssal Plain with the Scott Plateau and Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals - Sea country is valued for Indigenous cultural identity, health and wellbeing. Across Australia, Indigenous people have been sustainably using and managing their sea country for tens of thousands of years. At the commencement of the	Multiple Use (VI) National Park (II) Special Purpose [Trawl] (VI)	Multiple Use Zone (IUCN category VI)—managed to allow ecologically sustainable use while conserving ecosystems, habitats and native species. The zone allows for a range of sustainable uses, including commercial fishing and mining where they are consistent with park value. The objective of the Special Purpose Zone (Trawl) (VI) is to provide for ecologically sustainable use and the conservation of ecosystems, habitats and native species, while applying special purpose

Australian Marine Park	Distance from Montara Field	Description and Key Features of Conservation Significance	IUCN Zone within EMBA	Rules/Requirements
		management plan (DoNP 2018a) there is limited information about the cultural significance of this Marine Park - Commercial fishing and mining are important activities in the Marine Park. These activities contribute to the wellbeing of regional communities and the prosperity of the nation - No international, Commonwealth or national listings apply to the Marine Park - Historic shipwrecks: The Marine Park contains two known shipwrecks listed under the Historic Shipwrecks Act 1976: Alfred (wrecked in 1908) and Pelsart (wrecked in 1908)		management arrangements for specific activities. The objective of the National Park Zone (II) is to provide for the protection and conservation of ecosystems, habitats and native species in as natural a state as possible. DoNP (2018a)
Kimberley	108 km	- Covers an area of 74,500 km2 - The Wunambal Gaambera, Dambimangari, Bardi Jawi and the Nyul Nyul people's sea country extends into the Kimberley Marine Park and supports key cultural values and future socio-economic opportunities - Provides connectivity between deeper offshore waters, and the inshore waters of the adjacent WA North Kimberley Marine Park and Lalang-garram/Camden Sound Marine Park - Breeding and foraging habitat for seabirds - Internesting and nesting habitat for marine turtles - Breeding, calving and foraging habitat for inshore dolphins - Calving, migratory pathway and nursing habitat for humpback whales - Migratory pathway for pygmy blue whales - Foraging habitat for dugong - Foraging habitat for whale sharks - Adjacent to important foraging and pupping areas for sawfish and important nesting sites for green turtles (DoE 2016a) - 2 KEFs: the ancient coastline at the 125-m depth contour and continental slope demersal fish communities	Multiple Use (VI) Habitat Protection (IV) National Park (II)	Multiple Use Zone (IUCN category VI)—managed to allow ecologically sustainable use while conserving ecosystems, habitats and native species. The zone allows for a range of sustainable uses, including commercial fishing and mining where they are consistent with park value The objective of the Habitat Protection Zone (IV) is to provide for the conservation of ecosystems, habitats and native species in as natural a state as possible, while allowing activities that do not harm or cause destruction to seafloor habitats. The objective of the National Park Zone (II) is to provide for

Australian Marine Park	Distance from Montara Field	Description and Key Features of Conservation Significance	IUCN Zone within EMBA	Rules/Requirements
		- No international, Commonwealth or national heritage listings apply to the Marine Park at commencement of the management plan (DoNP 2018a), however the Marine Park is adjacent to the national heritage place of The West Kimberley - Historic shipwrecks The Marine Park contains more than 40 known shipwrecks listed under the Historic Shipwrecks Act 1976 - Tourism, commercial fishing, mining, recreation, including fishing, and traditional use are important activities in the Marine Park. These activities contribute to the wellbeing of regional communities and the prosperity of the nation		the protection and conservation of ecosystems, habitats and native species in as natural a state as possible DoNP (2018a)
Arafura	900 km	- Covers an area of 22,924 km2 - Examples of the ecosystems of the Northern Shelf Province and the Timor Transition Province - Important internesting area for flatback, green, hawksbill and olive ridley turtles - Important foraging habitat for breeding aggregations of the migratory roseate tern (DoNP 2018b) - One KEF: Tributary Canyons of the Arafura Depression	Multiple Use (IV) Special Purpose [Trawl] (VI)	Multiple Use Zone (IUCN category VI)—managed to allow ecologically sustainable use while conserving ecosystems, habitats and native species. The zone allows for a range of sustainable uses, including commercial fishing and mining where they are consistent with park value The objective of the Special Purpose Zone (Trawl) (VI) is to provide for ecologically sustainable use and the conservation of ecosystems, habitats and native species, while applying special purpose management arrangements for specific activities Environment Australia (2002)

Australian Marine Park	Distance from Montara Field	Description and Key Features of Conservation Significance	IUCN Zone within EMBA	Rules/Requirements
				DoNP (2018b)
Mermaid Reef	700 km	- Covers an area of 540 km2 - National and international significance due to its pristine character, coral formations, geomorphic features and diverse marine life - Key area for over 200 species of hard corals and 12 classes of soft corals with coral formations in pristine condition - Important areas for sharks including the grey reef shark, the whitetip reef shark and the silvertip whaler - Important foraging area for marine turtles - Important area for toothed whales, dolphins, tuna and billfish - Important resting and feeding sites for migratory seabirds	National Park (II)	The objective of the National Park Zone (II) is to provide for the protection and conservation of ecosystems, habitats and native species in as natural a state as possible Environment Australia (2002) DoNP (2018a)
Joseph Bonaparte Gulf	409 km	- Covers an area of 8,600 km2 - Examples of the shallow water ecosystems and communities of the Northwest Shelf Transition Province - Contains a number of prominent shallow seafloor features, including an emergent reef system, shoals and sand banks - Provides connectivity between the sea and nearshore environments, such as the Ord River floodplain, as well as the adjacent North Kimberley Marine Park - Important foraging area for threatened and migratory marine turtles (green and olive ridley) (DoNP 2018b) - Significant year-round flatback turtle nesting at Turtle Point (Chatto and Baker 2008) - Important foraging area for Australian snubfin dolphin - One KEF: Carbonate banks of the Sahul Shelf	Multiple Use (IV) Special Purpose (VI)	Multiple Use Zone (IUCN category VI)—managed to allow ecologically sustainable use while conserving ecosystems, habitats and native species. The zone allows for a range of sustainable uses, including commercial fishing and mining where they are consistent with park value The objective of the Special Purpose Zone (IUCN VI) is to protect the area with sustainable use of its natural resources and managed mainly for the sustainable use of natural ecosystems Environment Australia (2002)

Australian Marine Park	Distance from Montara Field	Description and Key Features of Conservation Significance	IUCN Zone within EMBA	Rules/Requirements
				DoNP (2018)
Montebello	1,224 km	Covers an area of approximately 3,413 km^2 and protects the following conservation values: - Foraging areas for migratory seabirds that are adjacent to important breeding areas; - Areas used by vulnerable and migratory whale sharks for foraging; - Foraging areas marine turtles which are adjacent to important nesting sites; - Section of the north and south bound migratory pathway of the humpback whale; - Shallow shelf environments with depths ranging from 15–150 m which provides protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features; - Seafloor habitats and communities of the Northwest Shelf Province provincial bioregions as well as the Pilbara (offshore) meso-scale bioregion; and - One KEF for the region is the ancient Coastline	Multiple Use (IV)	Multiple Use Zone (IUCN category VI)—managed to allow ecologically sustainable use while conserving ecosystems, habitats and native species. The zone allows for a range of sustainable uses, including commercial fishing and mining where they are consistent with park value DoNP (2018)
Ningaloo	1,473 km	Covers an area of approximately 2,435 km^2 and protects the following conservation values: - Important habitat (foraging areas) for vulnerable and migratory whale sharks; - Areas used for foraging by marine turtles adjacent to important internesting sites; - Part of the migratory pathway of the protected humpback whale; - Foraging and migratory pathway for pygmy blue whales; - Breeding, calving, foraging and nursing habitat for dugong; - Shallow shelf environments which provides protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features; - Seafloor habitats and communities of the Central Western Shelf Transition; - Three KEFs; and	Recreational Use (IV)	The Recreational Use zone (IV) is managed to ensure the maintenance of the habitat conditions necessary to protect significant species, groups of species, biotic communities or physical features of the environment. Recreational fishing, other recreational uses and tourism may be carried out within the zone. DoNP (2018)

Australian Marine Park	Distance from Montara Field	Description and Key Features of Conservation Significance	IUCN Zone within EMBA	Rules/Requirements
		- The Ningaloo Coast World Heritage Property, the Ningaloo Coast National Heritage listing and Ningaloo Marine Area Commonwealth Heritage Listing		

1.3.5 Other Areas of High Conservation Significance within the RISK EMBA

1.3.5.1 State and External Territory Reserves

23 State and Territory reserves are located within the RISK EMBA, nine of which are marine or coastal and relevant to potential impact assessment (Table 1-10 and Figure 1-4).

Table 1-10: Description of State and Territory Marine Parks within the RISK EMBA

State or External Territory Marine Parks	Straight-line distance from Montara Field	Key Features of Conservation Significance	Rules/ Requirements
North Kimberley Marine Park (WA)	555 km	- Covers an area of ~1,845,000 ha - Comprises four separate management areas including, Uunguu, Balanggarra, Miriuwung Gajerrong and Wilinggin - Recognised for its Aboriginal cultural and heritage values - Natural values include coral reefs, marine turtle species, dugongs, seagrass and macroalgal communities, mangroves and saltmarshes, finfish, and water and sediment quality - Social values include recreation, tourism and community values) and commercial values and resource use (e.g. commercial fishing) (DPaW 2016a)	North Kimberley Marine Park Joint Management Plan 2016 Uunguu, Balanggarra, Miriuwung Gajerrong, and Wilinggin management areas (Department of Parks and Wildlife 2016)
Browse Island Nature Reserve (WA)	193km	- Small, approx. 14 ha uninhabited island - Coral assemblages characteristic of coral platform reefs throughout the Indo-West Pacific region, particularly Cartier Island - Coral diversity greatest on the reef faces and shallow lagoons but these areas were of very limited extent (URS 2010a) - Nesting site for green turtles - Seabird nesting site - Fringing coral reefs with the waters around the island a site of upwelling associated with concentrations of tropical krill - Nine historic shipwrecks (one on register of National Estate) - Historical human impact from guano mining, lighthouse construction and introduction of house mice - Surrounding waters visited by Indonesian fisherman	No MP in place
Christmas Island	~2500 km	- An isolated oceanic island, approximately 135 km^2 in area - Rises steeply from the sea floor from depths of 5,000 m - National Park covers approximately 85 km^2 (63%) of the island's land area (Director of National Parks 2014).	Christmas Island National Park Management Plan (2014-2024)

State or External Territory Marine Parks	Straight-line distance from Montara Field	Key Features of Conservation Significance	Rules/ Requirements
		- High level of endemism - 254 endemic species and 165 species occurring nowhere else in Australia (including 50 fish species) - Whale sharks generally migrate through the island's waters between November and April - Waters surrounding the island are critical for the survival of the island's land crabs, including tens of millions of red crabs, as they release their eggs into the sea as part of their breeding life cycle - Two marine turtles listed as vulnerable under the EPBC Act, the green and hawksbill turtles, are found in the park's waters and green turtles occasionally nest on Dolly Beach - One of the world's significant seabird islands - More than 100 migrant and vagrant species have been recorded, including nine resident breeding seabird species (with three of these being endemic or endemic subspecies) and 23 vagrant/non-breeding seabirds - Abbott's booby and the Christmas Island frigatebird have their only extant nesting habitat in the world on Christmas Island - Fringing coral reefs and significant geomorphological features such as the island's terraces and cave systems, including anchialine cave systems (caves containing a subterranean water body with connections to the ocean) which provide animal habitat - The Dales and Hosnies Spring Ramsar wetlands - High recreational value	
Lalang-garram/ Horizontal Falls and North Lalang-garram Marine Parks	226 km	Jointly managed by Dambimangari Traditional Owners and the Department of Parks and Wildlife (DPaW 2016) - Included in the Australian National Heritage List for its nationally significant natural, indigenous and historic values (DoEE 2017c) - The Lalang-garram/ Horizontal Falls Marine Park covers approximately 353,000 ha (DPaW 2016). The North Lalang-garram Marine Park covers approximately 110,000 ha (DPaW 2016) - protects the internationally recognised Horizontal Falls and is important for the region's tourism - large tidal range results in extensive intertidal areas with diverse ecosystems such as fringing coral reefs, mangroves and mudflat communities - critical foraging and nursery areas for dugong, marine turtles, estuarine crocodiles, snubfin and Indo-Pacific humpback dolphins, several species of sawfish and migratory seabirds	DPaW 2016, Lalang-garram/ Horizontal Falls and North Lalang-garram marine parks joint management plan 2016. Management Plan 88. Department of Parks and Wildlife, Perth.

State or External Territory Marine Parks	Straight-line distance from Montara Field	Key Features of Conservation Significance	Rules/ Requirements
		- a principal calving habitat for humpback whales (DPaW 2016)	
Lalang-garram/Camden Sound	276 km	- Located ~300 km north of Broome and lies within the traditional country of three Aboriginal native title groups; The Dambimangari people (majority of the marine park), Wunambal Gaambera people (includes a small portion of St George Basin) and Mayala people (southwest corner of the marine park) (DPaW 2013) - Covers an area of approximately 705,000 ha - Principal calving habitat of the humpback whale - Important habitat for marine turtles, snubfin and Indo-Pacific humpback dolphins, dugong, saltwater crocodiles, and several species of sawfish - Wide range of marine habitats and associated marine life, such as coral reef communities, rocky shoals, and the extensive mangrove forests and marine life of the St George Basin and Prince Regent River (DPaW 2013)	Lalang-garram / Camden Sound Marine Park Management Plan 2013–2023 (Department of Parks and Wildlife 2013)
Rowley Shoals	744 km	- ~300 km north-north-west of Broome - Comprise three oceanic reef systems approximately 30–40 km apart (Mermaid Reef, Clerke Reef and Imperieuse Reef - Intertidal and subtidal coral reefs, exceptionally rich and diverse marine fauna and high water quality - Lying in the headwaters of the Leeuwin Current, the Shoals are thought to provide a source of invertebrate and fish recruits for reefs further south and as such are regionally significant	Rowley Shoals Management Plan (DEC 2007b)
Scott Reef Nature Reserve	314 km	Scott Reef is a large, emergent shelf atoll located on the edge of the broad continental shelf, about 300 km from mainland north-western Australia. The listing comprises the areas of Scott Reef that are within Commonwealth waters to the 50 m BSL bathymetric contour. This includes North Reef, an annular reef, 16.3 km long and 14.4 km wide; and parts of the lagoon of South Reef, a crescent shaped reef 17 km across (DSEWPaC 2012b). The place is regionally significant both because of its high representation of species not found in coastal waters off Western Australia and for the unusual nature of its fauna which has affinities with the oceanic reef habitats of the Indo-West Pacific as well as the reefs of the Indonesian region (DSEWPaC 2012b).	KEF and Commonwealth Marine
Muiron Islands Marine	1,464 km	The Muiron Islands Marine Management Area (MMA) was WA's first MMA, gazetted in November 2004. It covers an area of 28,616 ha and occurs entirely within state waters (CALM 2005).	Management Plan for the Ningaloo Marine Park and Muiron Islands Marine

State or External Territory Marine Parks	Straight-line distance from Montara Field	Key Features of Conservation Significance	Rules/ Requirements
Management Area		The Muiron Islands, located 15 km northeast of the North West Cape, comprise the North and South Muiron Islands and cover an area of 1,400 ha (AHC 2006). They are low limestone islands (maximum height of 18 m above sea level (ASL)) with some areas of sandy beaches, macroalgae and seagrass beds in the shallow waters (particularly on the eastern sides) and coral reef up to depths of 5m, which surrounds both sides of South Muiron Island and the eastern side of North Muiron Island. The Muiron Islands MMA is managed as an integrated area together with the Ningaloo Marine Park, but its status as a MMA means that some activities, including oil and gas exploration, are still permitted under a strict environmental assessment process involving DMIRS.	Management Area (DPAW, 2005)
Montebello Islands Marine Park	1,228 km	The Montebello Islands Marine Park (58,331 ha) consists of two sanctuary zones, two recreation zones, one special purpose zone for benthic protection, eleven special purpose zones for pearling and general use zones. The Montebello Islands comprise over 100 islands, the majority of which are rocky outcrops; rocky shore accounts for 81% of shoreline habitat (DEC 2007a). The ecological and conservation values of the Montebello and Barrow Islands Marine Conservation Reserve (MCR) include important habitats including corals reefs and bommies, mangroves, seagrass and macroalgae meadows, rocky shorelines and hard substrate, intertidal sand and mudflat communities. These habitats provide protection, food and habitat for a large diversity of species, including dugongs, turtles, whales, other protected cetaceans and birds as well as sea snakes and fish. The area is considered to have a high biodiversity. The islands also provide feeding and resting areas for migrating shorebirds and seabird nesting areas.	Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007-2017 (DEC, 2007)

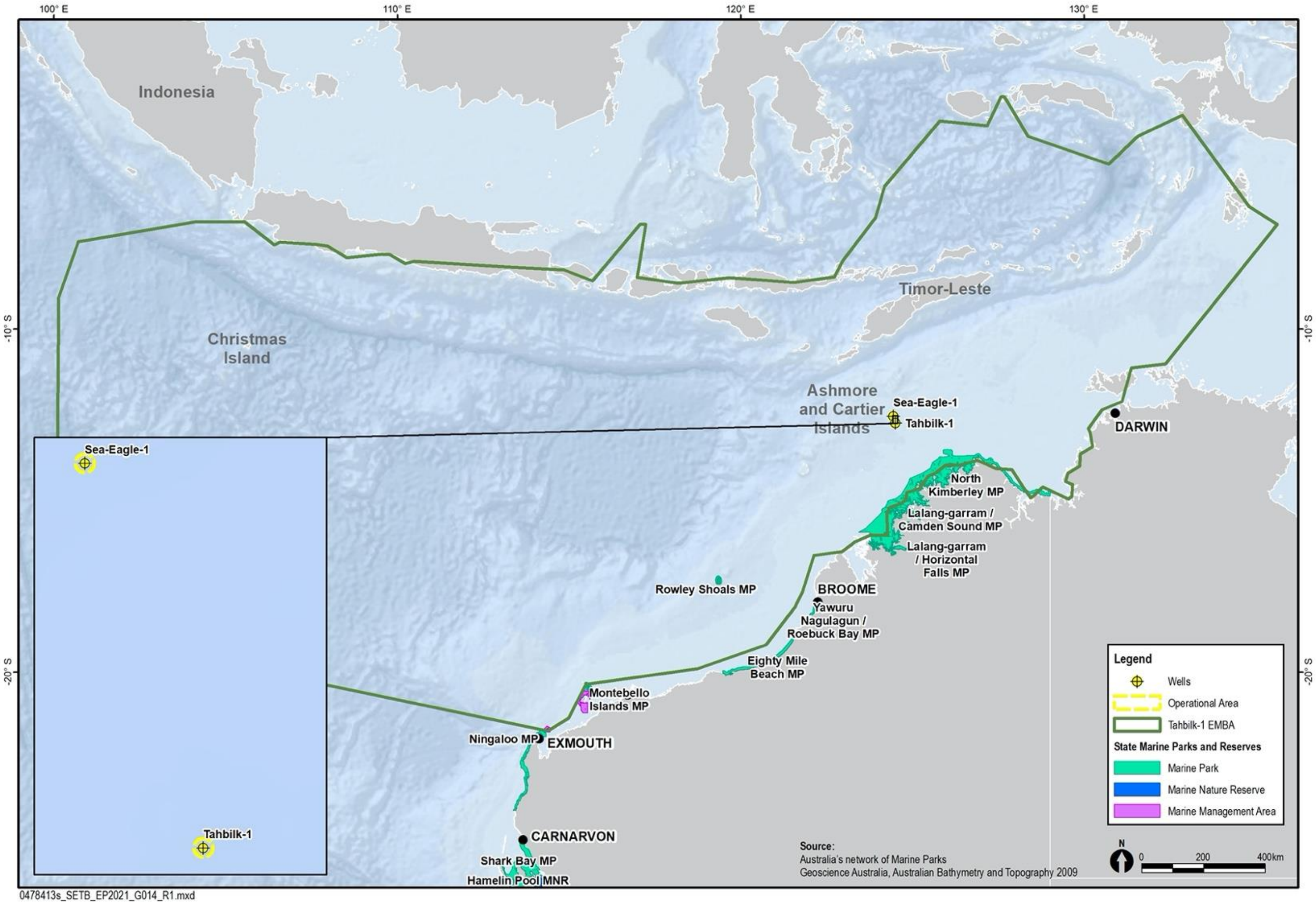


Figure 1-4: State and Territory Marine Parks and Marine Management Areas within the RISK EMBA

1.3.5.2 Key Ecological Features

The KEFs that intersect the RISK EMBA are described in Table 1-11 and their location is shown in Figure 1-5.

Table 1-11: Description of Key Ecological Features within the RISK EMBA

Key Ecological Feature	Straight-line distance from Montara Field	Description and Values
Continental Slope Demersal Fish Communities	82 km	- Valued for its high degree of endemism as the diversity of demersal fish assemblages is high compared to elsewhere along the continental slope
Ashmore Reef and Cartier Island and Surrounding Commonwealth Waters	84 km	- Regionally important for feeding and breeding aggregations of birds and other marine life - Areas of enhanced primary productivity in an otherwise low-nutrient environment - Ashmore Reef supports the highest number of coral species of any reef off the WA coast
Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex	279 km	- Coral communities occur across shallow (<30 m) and deep (>30 m) habitats - 306 hard coral species from 60 genera and 14 families having been identified; all were predominantly widespread Indo–Pacific species (Gilmour et al. 2009) - Coral species diversity comparable to other reefs in the region, such as Ashmore, Seringapatam and Mermaid Reef/Rowley Shoals - Green turtle nesting at Sandy Islet (Guinea 2006) - Shallow atoll reef forms an intertidal platform at low tide High primary productivity relative to other parts of the region and coral communities are largely self-seeded and rely on the reproductive output of resident corals - Relatively pristine and has a high species richness, which apply to both the benthic and pelagic habitats, attracting aggregations of marine life including whale and dolphin species
Canyons Linking the Argo Abyssal Plain with the Scott Plateau	540 km	- Scott Plateau connects with the Argo Abyssal Plain via a series of canyons, the largest of which are the Bowers and Oates canyons (DSEWPaC 2012a) - High productivity of the region is believed to be led by topographically induced water movements through the canyons and the action of internal waves in these canyons as well as around islands and reefs

Key Ecological Feature	Straight-line distance from Montara Field	Description and Values
		- The canyons are thought to be linked to small and periodic upwellings that enhance this biological productivity (DEWHA 2008c) - The canyons are likely to be important features due to their historical association with sperm whale aggregations (DSEWPaC 2012a). Historical records indicate that the number of sperm whales was high. Although current numbers are unknown, it is possible that they congregate around the canyon heads, encouraged by the high biological productivity, supporting stocks of their prey (DEWHA 2008c) - Anecdotal evidence that the Scott Plateau may be a breeding ground for sperm and beaked whales - Likely that important demersal communities occur in the canyons, as they do in the Scott Plateau supported by the localised upwelling (DEWHA 2008c)
Canyons Linking the Cuvier Abyssal Plain and the Cape Range Peninsula	1,434 km	- Cape Range Peninsula and the Cuvier Abyssal Plain are linked by canyons, the largest of which are the Cape Range Canyon and Cloates Canyon which are unique due to their close proximity to the North West Cape (DSEWPaC 2012a) - Defined as a KEF due to their unique seafloor features with ecological properties of regional significance - The canyons are thought to be significant contributors to the biodiversity of the adjacent Ningaloo Reef, as they channel deep water nutrients up to the reef, stimulating primary productivity (DEWHA, 2008c)
Commonwealth waters adjacent to Ningaloo Reef	1,473 km	- Defined for high productivity and aggregations of marine life - The Ningaloo Reef extends almost 300 km along the Cape Range Peninsula to the Red Bluff and is globally significant as the only extensive coral reef in the world that fringes the west coast of a continent - The narrow continental shelf (10 km at its narrowest) means that the nutrients channelled to the surface via canyons are immediately available to reef species (DSEWPaC, 2012a) - The reef is known to support an extremely abundant array of marine species including over 200 species of coral and more than 460 species of reef fish, as well as molluscs, crustaceans and other reef plants and animals (DEWHA 2008c) - Marine turtles, dugongs and dolphins frequently visit the reef lagoon, while Humpback whales are seasonal visitors to the outer reef edge and seasnakes, sharks, large predatory fish and seabirds also utilise the reef and surrounding waters

Key Ecological Feature	Straight-line distance from Montara Field	Description and Values
Mermaid Reef and Commonwealth Waters Surrounding Rowley Shoals	700 km	- The Rowley Shoals are a group of three atoll reefs—Clerke, Imperieuse and Mermaid reefs—located ~300 km north-west of Broome - Mermaid Reef lies 29 km north of Clerke and Imperieuse reefs and is totally submerged at high tide - Regionally important in supporting high species richness, higher productivity and aggregations of marine life associated with the adjoining reefs themselves (Done et al. 1994) - Contains 214 coral species and approximately 530 species of fishes (Gilmour et al. 2007), 264 species of molluscs and 82 species of echinoderms (Done et al. 1994; Gilmour et al. 2007) - Both coral communities and fish assemblages differ from similar habitats in eastern Australia (Done et al. 1994)
Pinnacles of the Bonaparte Basin	284 km	- The Pinnacles rise steeply from depths of ~80 m to within 30 m of the water surface. Supported communities include sessile benthic invertebrates, including hard and soft corals, sponges, whips, fans, bryozoans and aggregations of demersal fish species such as snappers, emperors and groupers - Recognised as a unique seafloor feature and a biodiversity hotspot for sponges
Ancient Coastline at 125 m Depth Contour	57 km	- A unique seafloor feature with ecological properties of regional significance - Migratory pelagic species (e.g. humpback whales and whale sharks) may use this escarpment as a guide - The topographic complexity of escarpments associated with this feature may facilitate vertical mixing of the water column, providing nutrient-rich localised environments
Carbonate Bank and Terrace System of the Sahul Shelf	46 km	- Regionally important because of its likely ecological role in enhancing biodiversity and local productivity relative to its surrounds - Forms a unique seafloor feature, with banks that rise to at least 45 m, and to within 30 m water depth, allow light dependent organisms to thrive and support more biodiversity (Nichol et al. 2013; NERP 2014) - Supports a high diversity of organisms including reef fish, sponges, soft and hard corals, gorgonians, bryozoans, ascidians and other sessile filter feeders - The banks are known to be foraging areas for loggerhead, olive ridley and flatback turtles - Cetaceans and green and largetooth sawfish are likely to occur in the area
Shelf Break and Slope of the Arafura Shelf	578 km	- Situated in a major biogeographic crossroad where biota is largely affiliated with the Timor–Indonesian–Malay region

Key Ecological Feature	Straight-line distance from Montara Field	Description and Values
		- Area is characterised by continental slope, patch reefs and hard substrate pinnacles
Carbonate Bank and Terrace System of the Van Diemen Rise	408 km	- Unique seafloor feature with ecological properties of regional significance - While reef-forming corals are sparse throughout the region, some locally dense hard corals can be found on the banks of the Van Diemen Rise. These include near threatened, vulnerable and endangered species on the IUCN Red List. Coral communities on the Van Diemen rise are believed to be genetically distinct from those elsewhere in northern Australia. - Pelagic fish such as mackerel, red snapper and a distinct gene pool of gold band snapper are also found on the Van Diemen rise
Exmouth Plateau	1,302 km	- Unique seafloor feature with ecological properties of regional significance, covering an area of 49,310 km^2, located approximately 150 km northwest of Exmouth - The plateau ranges in water depths from 800 to 4,000 m (Heap & Harris 2008 in DSEWPaC 2012) - Serves an important ecological role by acting as a topographic obstacle that modifies the flow of deep waters that generate internal tides, causing upwelling of deeper water nutrients closer to the surface (Brewer et al. 2007) - Sediments on the plateau suggest that biological communities include scavengers, benthic filter feeders and epifauna - Whaling records suggest that the Exmouth Plateau may have supported large populations of sperm whales (Bannister et al. 2007) - Fauna in the pelagic waters above the plateau are likely to include small pelagic species and nekton (Brewer et al. 2007)
Tributary Canyons of the Arafura Depression	964 km	- Valued for its high productivity, levels of endemism and biodiversity, and is located in the Timor Transition provincial bioregion - The canyons are approximately 80–100 m deep and 20 km wide. The largest of the canyons extend some 400 km from Cape Wessel into the Arafura Depression (Heap et al. 2004) - Almost all canyons in the NMR are located within this KEF and endemic benthic species are believed to occur there (Wilson 2005) - Primary productivity likely to be associated with movements of water through the canyons and surface water circulation driven by seasonal north-west monsoon winds

Key Ecological Feature	Straight-line distance from Montara Field	Description and Values
		- The steep topography of the canyons, their diverse current regimes, nutrient enrichment and entrapment, detritus funnelling and diverse substrate types form widely divergent ecosystems (McClain & Barry 2010; Vetter 1994; Vinogradova 1958) which, in combination with the regional setting and geological origins of the area, strongly influence species biodiversity (Kloser et al. 2010) - Marine turtles (most likely olive ridleys) have been reported to feed in the vicinity of the canyons (Whiting et al. 2007)
Glomar Shoals	1,118 km	- Submerged feature situated at a depth of 33–77 m, approximately 150 km north of Dampier on the Rowley Shelf (Falkner et al. 2009 in DSEWPaC 2012a) - Consist of a high percentage of marine-derived sediments with high carbonate content and gravels of weathered coralline algae and shells (McLoughlin & Young 1985 in DSEWPaC 2012a) - The area's higher concentrations of coarse material compared to surrounding areas are indicative of a high energy environment subject to strong seafloor currents (Falkner et al. 2009 in DSEWPaC 2012a) - Biological communities found at the Glomar Shoals have not been comprehensively studied, however the shoals are known to be an important area for a number of commercial and recreational fish species such as rankin cod, brown striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish. Catch rates at the Glomar Shoals are high, indicating that the area is a region of high productivity (Falkner et al. 2009, Fletcher & Santoro 2009 in DSEWPaC 2012a). It is unclear if the removal of non-target species due to the commercial fishing over the shoals is having an impact on its value (DSEWPaC 2012a). - Regionally important for their potentially high biological diversity and localised productivity - Biological data specific to the Glomar Shoals is limited, however the fish of the shoals are probably a subset of reef-dependent species and anecdotal evidence suggests they are particularly abundant (DSEWPaC 2012a)

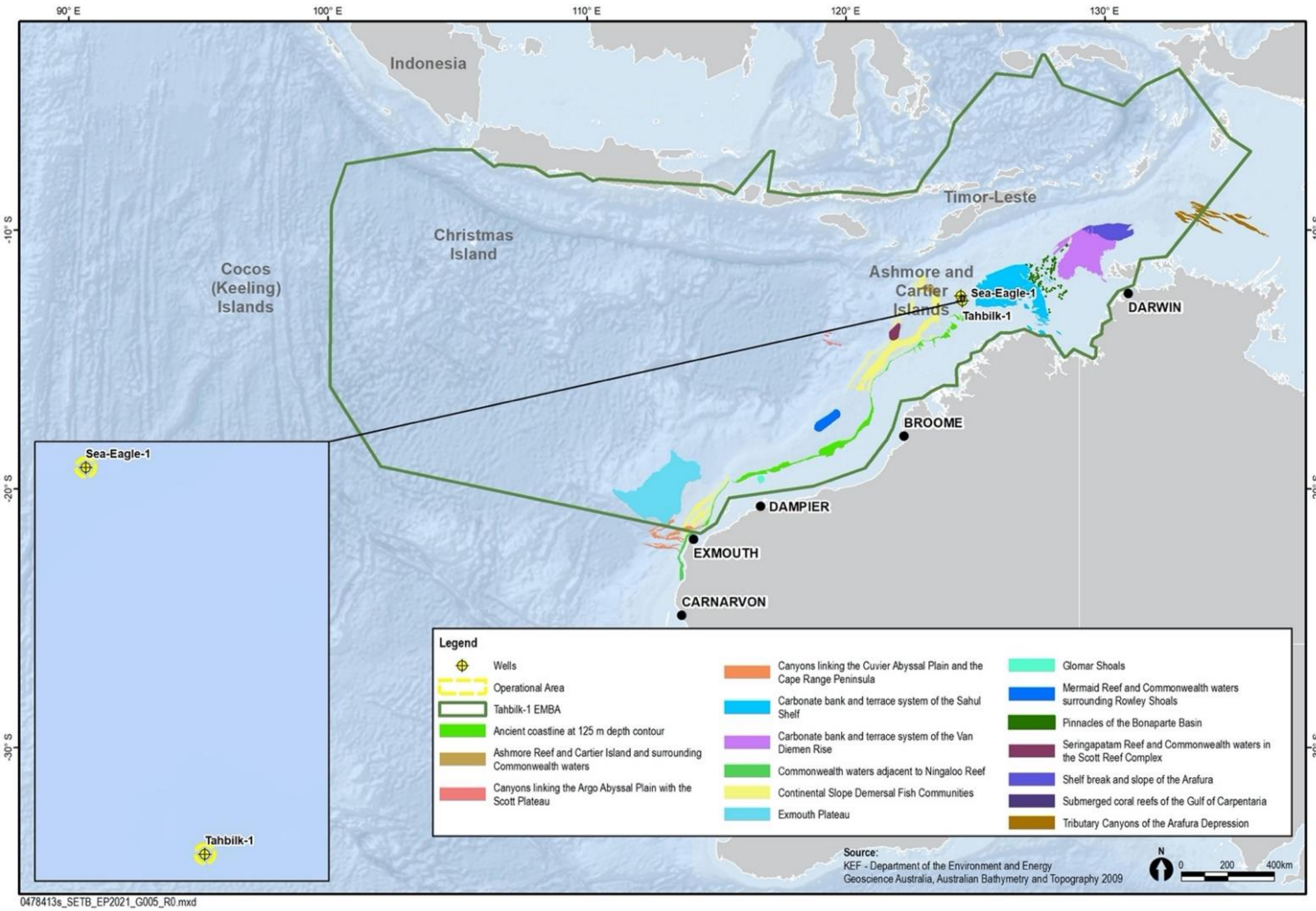


Figure 1-5: Key Ecological Features within the RISK EMBA

1.4 Biological environment – species and communities' descriptions

1.4.1 Benthic habitats and communities

Regionally, the seabed generally comprises a relatively flat and featureless habitat, although numerous seamounts or banks can be found along the perimeter of the Australian continental shelf. The shoals and banks in the NWMR share a tropical marine biota consistent with that found on emergent reef systems of the Indo West Pacific region, such as Ashmore Reef, Cartier Island, Seringapatam Reef and Scott Reef. These support a diverse range of benthic communities; algae, soft corals, hard corals and filter feeders. Bare sand and consolidated reef supporting turfing algae are features of all shoals and banks in the Timor Sea. Hard corals and macroalgae tend to be variable in abundance, while soft corals and sponges are often present. All banks and shoals in the region support comparable levels of biodiversity but vary in the abundance and diversity of dominant species (Heyward et al. 1997; Moore et al 2017).

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).

Deep water soft sediment habitats are expected to be broadly similar in the wider EMBA to the surveyed locations in the Montara field and surrounding areas. In a study of benthic habitats on the continental shelf near the Big Bank Shoals (approximately 200 km to the northeast of the Operational Area) by Heyward et al. (1997), the predominant benthic infaunal species were polychaetes (burrowing worms) and crustaceans (prawns, shrimp, crabs, etc.). These two groups made up 84% of the total species in sediment samples with a high diversity of species but a low abundance of each individual species. The remaining 16% of species included echinoderms, such as sea stars, sea urchins, feather stars, molluscs, both gastropods and bivalves, nemerteans (ribbon worms), sponges and fish. Epibenthic communities were sparse and species commonly associated with soft sediment habitats included sponges, gorgonians such as sea whips and sea fans, ascidians such as sea squirts, echinoderms, crustaceans, bryozoans such as lace corals, and soft corals (Heyward et al. 1997). The absence of light and hard substrate is considered a limiting factor for recruitment of epibenthic organisms.

Windows of sensitivity are shown in Table 1-12. Key locations for types of benthic communities are shown in Table 1-13.

Table 1-12: Benthic habitat windows of sensitivities

Key	Peak times											
	January	February	March	April	May	June	July	August	September	October	November	December
Key Ecosystems and Biological Resources												
Coral: Spawning												
Seagrass: Flowering and Fruiting												

1.4.2 Banks and Shoals

There are around 150 shoal/bank features across the Sahul Shelf and a high level of interconnectivity exists between them. They are often 5 – 20 km apart, creating an extensive series of 'stepping stone' habitats for larval recruitment. The larval development rates of the species present, current speeds (20-30 km/day in mild weather) and the relatively short distance between the shoals, banks and reefs maintains this connectivity. As such, neighbouring shoals and banks (i.e. within 100s of kms) share ~>80% benthic community composition (Moore et al. 2017). The associated fish fauna is highly diverse but variable between shoals and banks but sharing of many species, which is influenced by depth, substrate, exposure to prevailing weather. Fish species richness tends to increase with reef structure and size of shoal/bank (Moore et al. 2017).

By analysing local bathymetry, Heyward et al. (2010) identified more than 20 possible shoal features within a 100 km radius of the Operational Area and greater than 100 similar bathymetric features within 200 km. The nearest shoals to the Operational Area, which are likely to experience the highest concentrations of entrained and dissolved hydrocarbons in the event of a LOWC are Goeree and Vulcan Shoals, located approximately 30 km to the southwest. Other shoals in close proximity include Eugene McDermott Shoal (approximately 45 km south) and Barracouta Shoal (approximately 60 km northwest).

1.4.2.1 Barracouta and Vulcan Shoals

Extensive surveys to characterise the habitats and ecosystems of the Barracouta and Vulcan Shoals were undertaken between 2010 and 2013 (Heyward et al. 2010, 2011a, 2013). These shoals rise steeply from 100 to 200 m depths on the outer continental shelf and are elliptical in shape with the long axis running approximately east-west (Heyward et al. 2010). The shoals begin to plateau at approximately 40 to 50 m depth with the plateau area of each shoal covering several square kilometres (10 to 15 km^2) at depths of 20 to 30 m (Heyward et al. 2011a). Occasional higher ground rises to within approximately 10 m of the sea surface.

The surveys observed that Barracouta and Vulcan Shoals support diverse biological communities across their shallow plateau areas, with many organisms typical of shallow water coral reefs (Heyward et al. 2010, 2011a, 2013). Benthic environments were composed of ~25-42 % living macro-epibenthic organisms, including diverse algae, sponge, and hard and soft coral communities, interspersed with rubble, sand and consolidated reef (Heyward et al. 2013). Extensive rubble and rock fields were observed to support reef building corals, seagrass, algae and filter feeders, particularly the calcareous green algae Halimeda species.

Significant differences were observed between the Barracouta and Vulcan Shoals in the relative abundance of dominant groups, particularly the algae, seagrass, hard corals and soft corals. The western margin of the Barracouta Shoal supported abundant soft corals and calcareous red and green algae with only a limited area of seagrass. Vulcan Shoal supported extensive seagrass fields at the eastern end as well as hard corals, algae and some filter feeders. The surveys also indicated that Barracouta Shoal had more bare sand and consolidated low, reef-like substrate in comparison to Vulcan Shoal. These consolidated areas were dominated by light dependent organisms and supported a rich coral community and macroscopic invertebrates or encrusting red algae. Filter feeders such as sponges and soft corals generally had a lower representation although they were widely distributed (Heyward et al. 2010, 2011a, 2013).

Table 1-13: Key locations of benthic habitat

Aspect	Timor Province	Northwest Province	Northwest Transition	Northwest Shelf Province	Northwest Shelf Transition	Northern Shelf Province	Timor Transition	Central Western Shelf Transition	Central Western Transition	Christmas Island Province	Cocos (Keeling) Island Province	Other (Indonesia, Timor-Leste)
Coral	Ashmore Reef, Cartier Island, Hibernia, Scott and Seringapatam Reef, shoals and banks of the Sahul Shelf	Montebello Islands, Dampier Archipelago	Rowley Shoals	Browse Island	Big Bank Shoals	Not present	Not present	Ningaloo Reef	Not present	Christmas Island	Not present	Indonesia (west) Rote Island Timor-Leste (east - Coral Triangle)
Seagrasses	Ashmore Reef, Cartier Island, Scott Reef, Seringapatam reefs	Eighty Mile Beach, Montebello Islands	Rowley Shoals	Not present	Darwin Coast, Tiwi Islands	Arnhem Coast	Not present	Ningaloo Reef	Not present	Present but no significant areas	Not present	Indonesia (west) Kepulauan Seribu National Park Timor-Leste
Macroalgae	Ashmore Reef, Cartier Island, Scott Reef, Seringapat	Dampier Archipelago, Shallow coastal and offshore	Not present	Present but no significant areas	Big Bank Shoals	Not present	Not present	Ningaloo Reef, Muiron Islands	Not present	Present but no significant areas	Not present	Present but no significant areas

Aspect	Timor Province	Northwest Province	Northwest Transition	Northwest Shelf Province	Northwest Shelf Transition	Northern Shelf Province	Timor Transition	Central Western Shelf Transition	Central Western Transition	Christmas Island Province	Cocos (Keeling) Island Province	Other (Indonesia, Timor-Leste)
	am Reef, shoals and banks of the Sahul Shelf, Barracouta Shoal	waters of the Pilbara, Montebello Islands										
Non-coral benthic Invertebrates	Ashmore Reef, Cartier Island, Scott Reef, Seringapatam Reef, shoals and banks of the Sahul Shelf, Vulcan Shoal, Barracouta Shoal, Goeree Shoal	Present but no significant areas	Rowley Shoals	Dampier to Port Hedland	Big Bank Shoals, Van Diemen Rise	Present but no significant areas	Present but no significant areas	Ningaloo Reef	Present but no significant areas	Present but no significant areas	Present but no significant areas	Present but no significant areas

1.4.3 Shoreline Habitats

A wide variety of shoreline habitats are present within the RISK EMBA. Key locations for shoreline habitats are shown in Table 1-14.

Table 1-14: Location of key shoreline habitats

Aspect	Timor Province	Northwest Province	Northwest Transition	Northwest Shelf Province	Northwest Shelf Transition	Northern Shelf Province	Timor Transition	Central Western Shelf Transition	Central Western Transition	Christmas Island Province	Cocos (Keeling) Island Province	Other (Indonesia, Timor-Leste)
Mangroves	Not present	Not present	Not present	North Kimberley Marine Park, Port Hedland, Karratha	Darwin Coast, Tiwi Islands, Joseph Bonaparte Gulf, Kakadu	Cobourg Peninsula, Kakadu	Not present	Not present	Not present	Present but no significant areas	Not present	Indonesia (west)
Intertidal sand/mud flats	Ashmore Reef	Not present	Not present	Eighty Mile Beach, Roebuck Bay	Darwin Coast, Joseph Bonaparte Gulf, Kakadu	Cobourg Peninsula, Arnhem Coast, Kakadu	Not present	Not present	Not present	Present but no significant areas	Not present	
Intertidal platforms	Ashmore Reef, Scott Reef, Cartier Island	Not present	Not present	Eight Mile Beach	Darwin Coast, Joseph Bonaparte Gulf	Cobourg Peninsula, Arnhem Coast	Not present	Not present	Not present	Present but no significant areas	Not present	Present but no significant areas
Sandy beaches	Ashmore Reef, Sandy Islet (Scott Reef)	Not present	Not present	Eight Mile Beach	Darwin Coast	Arnhem Coast, Cobourg Peninsula	Not present	Not present	Not present	Present but no significant areas	Not present	

Aspect	Timor Province	Northwest Province	Northwest Transition	Northwest Shelf Province	Northwest Shelf Transition	Northern Shelf Province	Timor Transition	Central Western Shelf Transition	Central Western Transition	Christmas Island Province	Cocos (Keeling) Island Province	Other (Indonesia, Timor-Leste)
Rocky shorelines	Not present	Not present	Not present	North Kimberley Marine Park, Dampier to Point Samson	Present but no significant areas		Not present		Not present		Not present	Present but no significant areas

1.4.4 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). Zooplankton rely on phytoplankton as food and are subject to similar seasonality. Key windows of sensitivity for plankton is shown in Table 1-15.

Table 1-15: Plankton windows of sensitivity

Key	Peak times											
	January	February	March	April	May	June	July	August	September	October	November	December
Plankton: Concentrations												

1.4.5 Fish, Sharks and Rays

1.4.5.1 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 RISK EMBA. The whale shark foraging BIA intersects with the RISK EMBA (Figure 1-6).

1.4.5.2 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). No great white shark BIAs are intersected by the RISK EMBA (Figure 1-6) **.** Given a preference for cooler, southern waters inhabited by seals and sea lions, great white sharks are considered unlikely to be encountered in the RISK EMBA.

1.4.5.3 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 species' preference for turbid, inshore waters, it is likely that the species will not be encountered in the RISK EMBA.

1.4.5.4 Grey Nurse Shark (vulnerable)

The grey nurse shark (*Carcharias taurus*) is listed as vulnerable under the EPBC Act and the Biodiversity Conservation Act 2016 and is known to occur within the RISK EMBA. In Australia, the grey nurse shark is now restricted to two populations, one on the east coast from southern Queensland to southern NSW and the other predominantly around the southwest coast of WA, but has been recorded on the North West Shelf (DoE 2014d; Pogonoski et al. 2002). It is believed that the east and west coast populations do not interact and ongoing research is likely to confirm that the populations are genetically different (Last & Stevens 2009).

While it is thought that grey nurse sharks have a high degree of site fidelity, some studies (McCauley 2004) suggest that grey nurse sharks move between different habitats and localities, exhibiting some migratory characteristics. In certain areas grey nurse sharks are vulnerable to localised pressure due to high endemism. The status of the west coast population is poorly understood although they are reported to remain widely distributed along the WA coast and are still regularly encountered, albeit with low and indeterminate frequency (Chidlow et al. 2006).

Grey nurse sharks are often observed hovering motionless just above the seabed, in or near deep sandy-bottomed gutters or rocky caves, and in the vicinity of inshore rocky reefs and islands (Pollard et al. 1996). The species has been recorded at varying depths, but is generally found between 15–40 m (Otway & Parker 2000). Grey nurse sharks have also been recorded in the surf zone, around coral reefs, and to depths of around 200 m on the continental shelf (Pollard et al. 1996). Grey nurse sharks feed primarily on a variety of teleost and elasmobranch fishes and some cephalopods (Gelsleichter et al. 1999; Smale 2005) and may be found within the RISK EMBA.

1.4.5.5 Dwarf Sawfish (Vulnerable/Migratory)

The dwarf sawfish (*Pristis clavata*) is listed as vulnerable under the EPBC Act and thought to be restricted to Australia (DoE 2014b). It is also listed as a Priority 1 conservation species in WA. The Australian distribution of the dwarf sawfish is considered to extend across northern Australia and along the Kimberley and Pilbara coasts (Last and Stevens 2009, Stevens et al. 2005). However, the majority of records of dwarf sawfish in WA have come from shallow estuarine waters of the Kimberley region which are believed to be nursery (pupping) areas, with immature juveniles remaining in these areas up until three years of age (Thorburn et al. 2004). Adults are known to seasonally migrate back into inshore waters (Peverell 2007); although it is unclear how far offshore the adults travel as captures in offshore surveys are very uncommon. The species' range is restricted to brackish and salt water (Thorburn et al. 2007).

The recovery plan identifies pupping as known to occur in the King Sound, the Cambridge Gulf and 80 Mile Beach, with pupping likely to occur identified at a number of locations along the Pilbara and Kimberly coastline. Under the associated recovery plan all areas where aggregations of individuals have been recorded displaying biologically important behaviours such as breeding, foraging, resting or migrating are considered critical to the survival of the species unless population data suggests otherwise. Based on the known distribution of the species, individuals are known to exist within the RISK EMBA.

1.4.5.6 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). Given the species' known distribution, individuals are known to be found within the RISK EMBA.

1.4.5.7 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 known distribution of the species, individuals are known to exist within the RISK EMBA.

1.4.5.8 Speartooth shark (Critically endangered)

The Speartooth Shark (*Glyphis glyphis*) has only been captured in tidal rivers and estuaries indicating that large tropical river systems appear to be the primary habitat for this shark (Stevens et al. 2005). The Speartooth Shark is known to have feeding and ontogenetic (life cycle) migrations offshore, and to migrate inshore to breed, although data to support this is limited (Stevens et al. 2005). Given the species' known distribution, individuals are likely to be found within the RISK EMBA.

1.4.5.9 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 be found within the RISK EMBA.

1.4.5.10 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). Given the RISK EMBA overlap with a number of coral and rocky reefs in the region, it is possible the species may be encountered within the RISK EMBA.

1.4.5.11 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). Given the RISK EMBA overlap with a number of coral and rocky reefs in the region, it is possible that the species may be encountered within the RISK EMBA.

1.4.5.12 Narrow Sawfish (Migratory)

The narrow sawfish (*Anoxypristis cuspidate*) or knifetooth sawfish are distributed throughout the Gulf of Carpentaria, which has been identified as one of the only places worldwide where viable populations of sawfish remain (Peverell 2005). There are only sparse anecdotal records of the narrow sawfish occurring beyond the Gulf of Carpentaria to the west, but their habitat is accepted to be fresh and brackish waters of coastal and inshore areas in depths up to 100 m (Bray 2019). Based on the species' habitat preference it may be encountered within certain parts of the RISK EMBA.

1.4.5.13 Oceanic Whitetip Shark (Migratory)

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

1.4.5.14 Sygnathids

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 1-16: Fish, Shark and Ray windows of sensitivity

Key	Peak times											
	January	February	March	April	May	June	July	August	September	October	November	December
Fish Spawning												
Southern Bluefin Tuna: Spawning												
Goldband Snapper: Spawning												
Red Emperor: Spawning												
Elasmobranchs												
Whale Shark: Foraging												

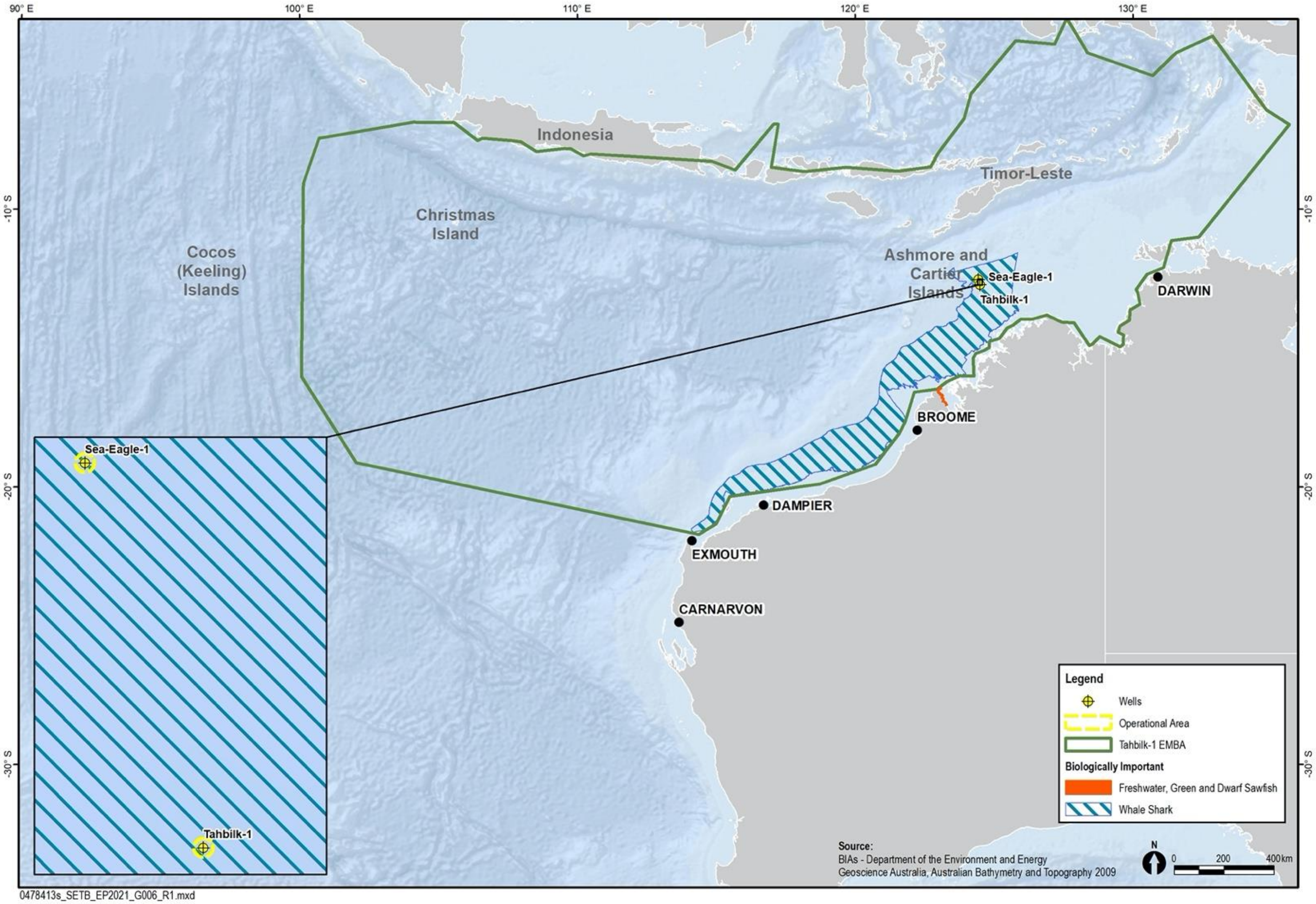


Figure 1-6: Fish, Sharks and Rays BIAs

1.4.6 Marine Mammals

The region is known 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 1-17: Marine Mammal windows of sensitivity

Key	**Peak times**											
	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Marine Mammals												
Dugong: Calving / breeding												
Pygmy Blue Whale: Northern migration												
Pygmy Blue Whale: Southern migration												
Humpback Whale: Calving / breeding												

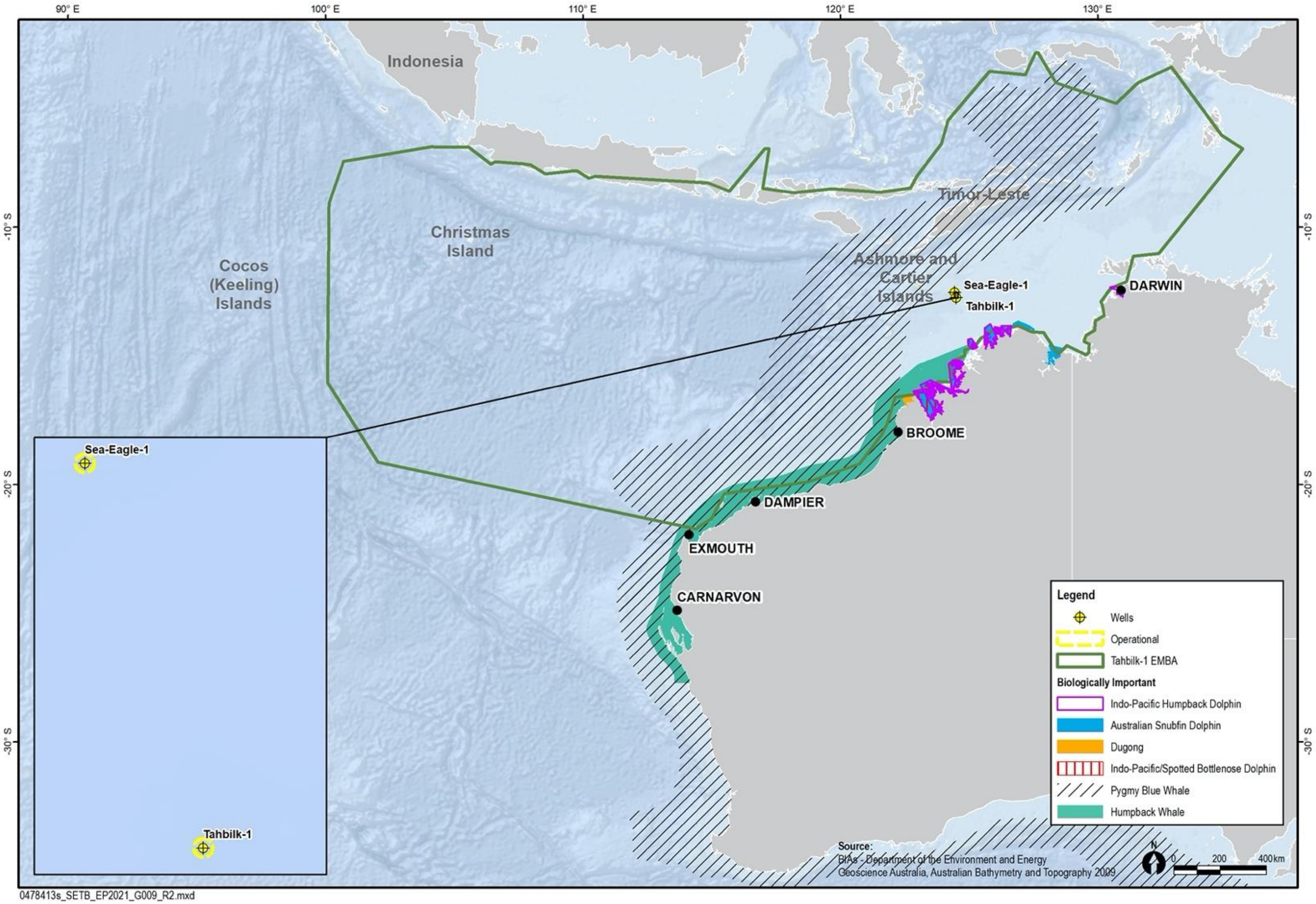


Figure 1-7: Marine Mammal BIAs

1.4.6.1 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 2008c). In general, the southern blue whale is found south of 60° S and pygmy blue whales are found north of 55° S (DEWHA 2008).

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 RISK EMBA overlap with the pygmy blue whale migratory route BIA off the Kimberley Coast (Figure 1-7). The pygmy blue whale migratory BIA extends from approximately the south-westernmost point of WA to the northernmost edge of Australian commonwealth waters, north of Scott Reef. Blue whale BIAs overlapping the RISK EMBA include migration, foraging, and 'distribution' areas. Possible foraging habitat has been identified in the area around Scott and Seringapatam Reefs.

1.4.6.2 Humpback Whale (Vulnerable/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 within 30 km of the coast, 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 are used as a calving area for this species (Jenner et al. 2001).

The RISK EMBA overlaps with the humpback whale BIA identified for breeding and calving at Camden Sound Marine Park, adjacent to the Kimberley coast (Figure 1-7). Individuals may be encountered within the RISK EMBA.

1.4.6.3 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). Individuals of the species may be encountered within the RISK EMBA, although large numbers are unlikely.

1.4.6.4 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).

Individual fin whales may be encountered within the RISK EMBA, although large numbers are unlikely.

1.4.6.5 Southern Right Whale (Endangered/Migratory)

The Southern Right Whale (*Eubalaena australis*) is present in the southern hemisphere between approximately 30° and 60°S. The species feeds in the Southern Ocean in summer, moving close to shore in winter. In Australian waters, southern right whales range from Perth, along the southern coastline, to Sydney. Sightings have been recorded as far north as Exmouth although these are rare (Bannister *et al*. 1996).

Given the rarity of sightings north of Perth, it is unlikely that the species will be encountered in the RISK EMBA.

1.4.6.6 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 have been recognised in the past, however recent DNA sequencing has revealed the known 'pygmy form' of Bryde's whale to be a separate species now known as the Omura's whale (*Balaenoptera omurai*) which has been recorded at the Coco-Keeling Islands offshore of northwest Australia (Cherchio et al. 2019).

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. This data demonstrates that individuals are likely to occur within the RISK EMBA.

1.4.6.7 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 the RISK EMBA in significant numbers.

1.4.6.8 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 breeding, calving and foraging of this species exist in state coastal waters of the RISK EMBA and are illustrated in **Figure 1-7**.

Given their cosmopolitan distribution, the species may be encountered within the RISK EMBA.

1.4.6.9 Indo-Pacific Humpback Dolphin (Migratory)

In Australia, humpback dolphins are thought to be widely distributed along the northern Australian coastline from approximately the Queensland–New South Wales border to western Shark Bay, Western Australia. Most studies to date indicate that Australian humpback dolphins occur mostly close to the coast (within 20 km from land) and in relatively sheltered offshore waters near reefs or islands. BIAs for breeding and foraging of this species exist in state coastal waters of the RISK EMBA and are illustrated in Figure 1-7.

1.4.6.10 Sperm Whale (Migratory)

The habitat of the Sperm Whale is difficult to categorise due to the cosmopolitan nature of this species and its ability to inhabit all oceans. Sperm Whales tend to inhabit offshore areas with a water depth of 600 m or more and are uncommon in waters less than 300 m deep.

1.4.6.11 Australian Snubfin Dolphin (Migratory)

Australian Snubfin Dolphins occur only in waters off the northern half of Australia, from approximately Broome on the west coast to the Brisbane River on the east coast. Most recorded sightings come from protected and shallow coastal waters, especially in close vicinity to river mouths. BIAs for foraging, breeding and calving of this species exist in state coastal waters of the RISK EMBA and are illustrated in Figure 1-7.

1.4.6.12 Dugong (Migratory)

Dugongs occur in coastal and island waters from Shark Bay in Western Australia across the northern coastline to Moreton Bay in Queensland (Marsh et al. 2002, 2011a). The winter range includes about 24 000 km of Australia’s coast, which represents about 19% of the global extent of occurrence along coastline habitats (Marsh et al. 2011a). A single individual has been recorded in the Cocos (Keeling) Islands (Hobbs et al. 2007). Dugongs are seagrass community specialists and the range of the dugong is broadly coincident with the distribution of seagrasses in the tropical and sub-tropical waters in their Australian range.

BIAs for foraging of the dugong exist along the Pilbara and Kimberley coast within the RISK EMBA, illustrated in Figure 1-7.

1.4.6.13 Antarctic Minke Whale/Dark-shoulder Minke Whale

Found throughout the Southern Hemisphere, the distribution up the west coast of Australia is currently unknown. Antarctic Minke Whales appear to occupy primarily offshore and pelagic habitats within cold temperate to Antarctic waters but this species does undergo extensive migration between the summer Antarctic feeding grounds and winter sub-tropical to tropical breeding grounds.

1.4.7 Marine reptiles

A search of the EPBC Act Protected Matters database identified nine species of marine reptiles (6 species of turtles) that may occur in, or have habitat within the RISK EMBA. The RISK EMBA intersect with a number of BIAs for marine reptiles in the region (Figure 1-8 to Figure 1-11). These are discussed in further detail below for each species. BIAs for turtle species in the RISK EMBA include the following locations: Browse Island, Ashmore Reef, Cartier Island, Cassini Island, Joseph Bonaparte Gulf, Joseph Bonaparte Depression, Sahul Shelf, and Sandy Islet (Scott Reef). These locations support marine turtle foraging, nesting and internesting areas with the windows of sensitivity shown in Table 1-18.

Table 1-18: Marine Reptile windows of sensitivity

Key	Peak times											
	January	February	March	April	May	June	July	August	September	October	November	December
Marine Reptiles												
Flatback Turtle: Nesting												
Green Turtle: Nesting (Ashmore and Cartier)												
Hawksbill Turtle: Nesting												
Leatherback Turtle: Nesting												
Loggerhead Turtle: Nesting												
Olive Ridley Turtle: Nesting												

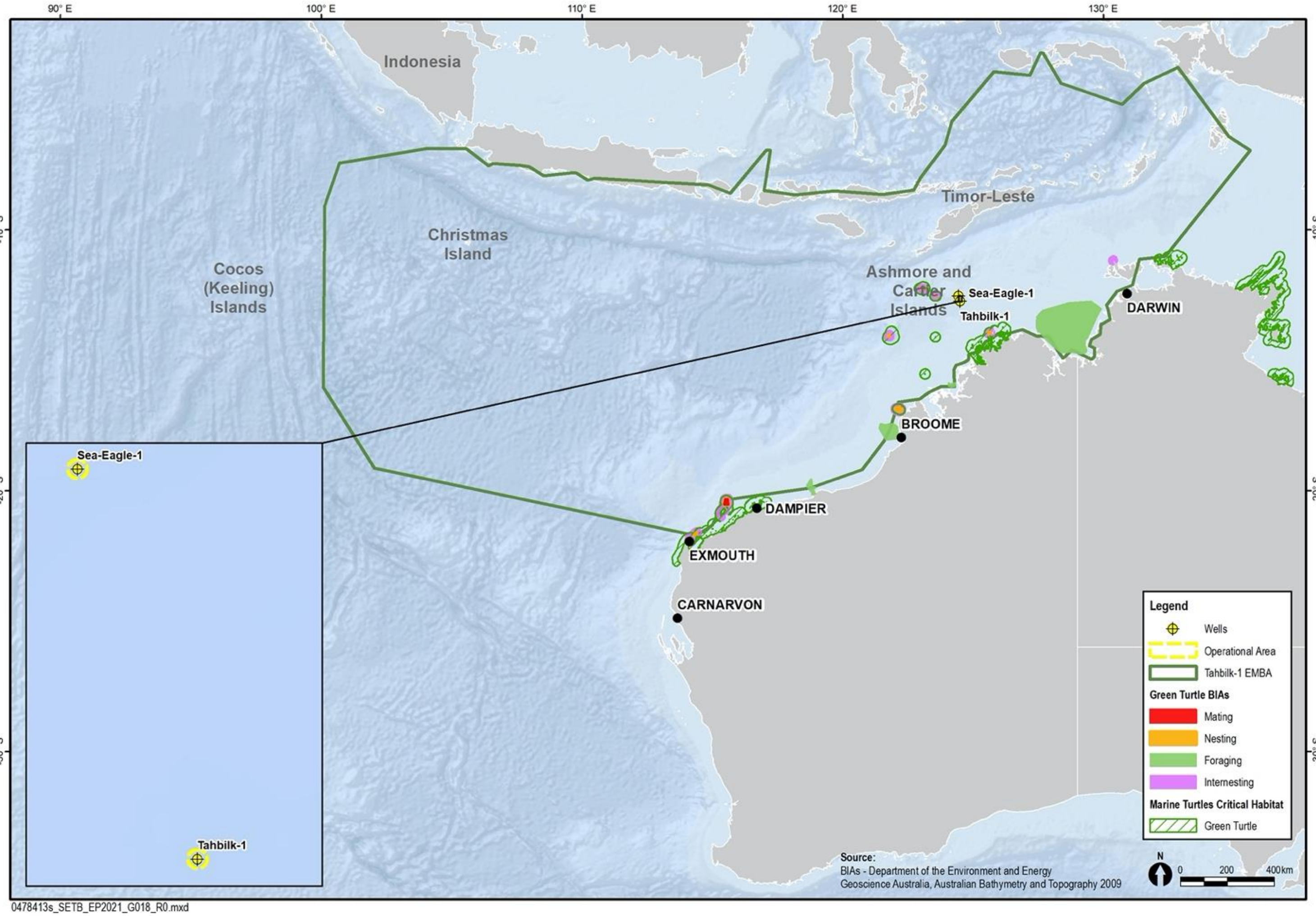


Figure 1-8: Green Turtle BIAs

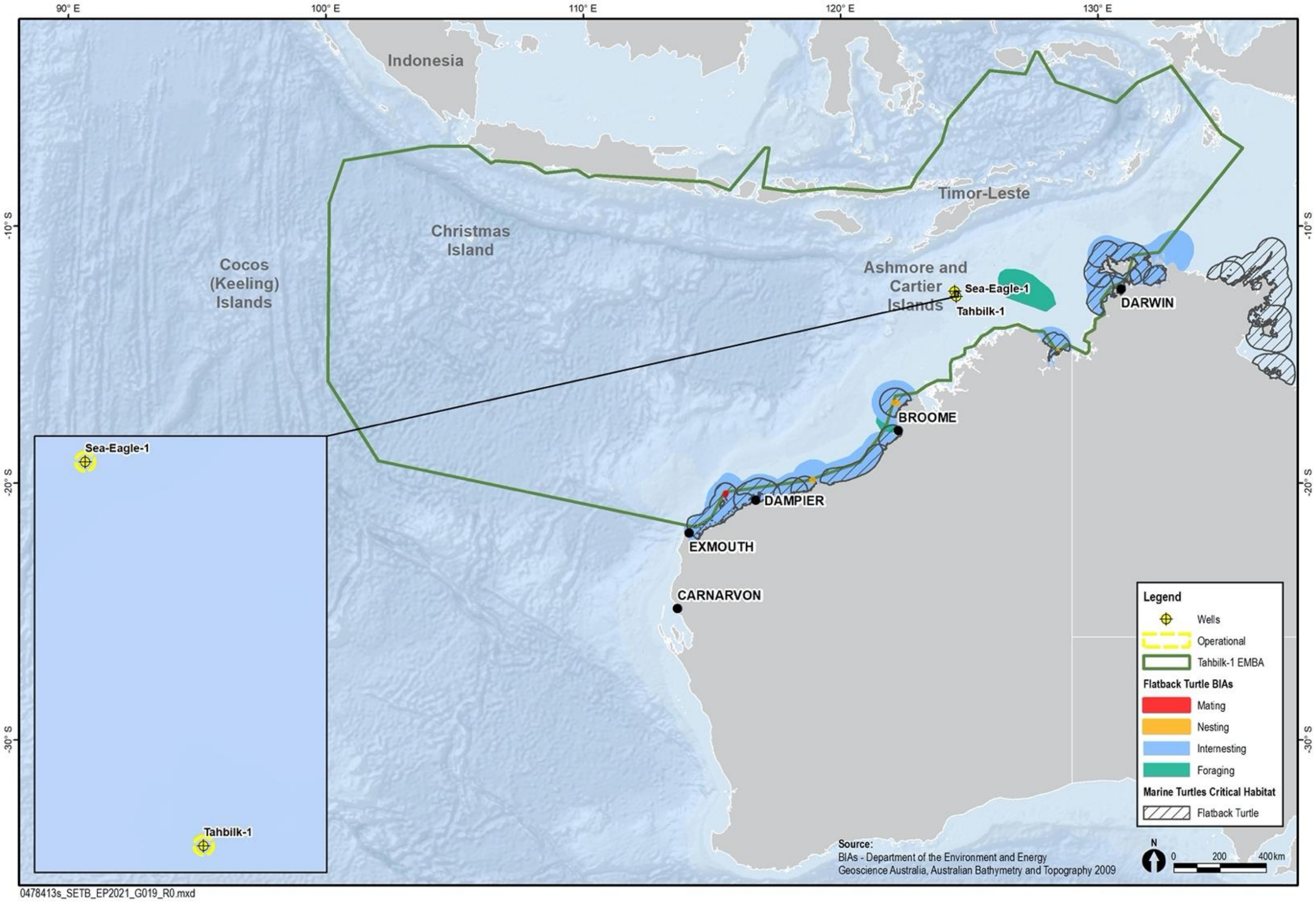


Figure 1-9: Flatback Turtle BIAs

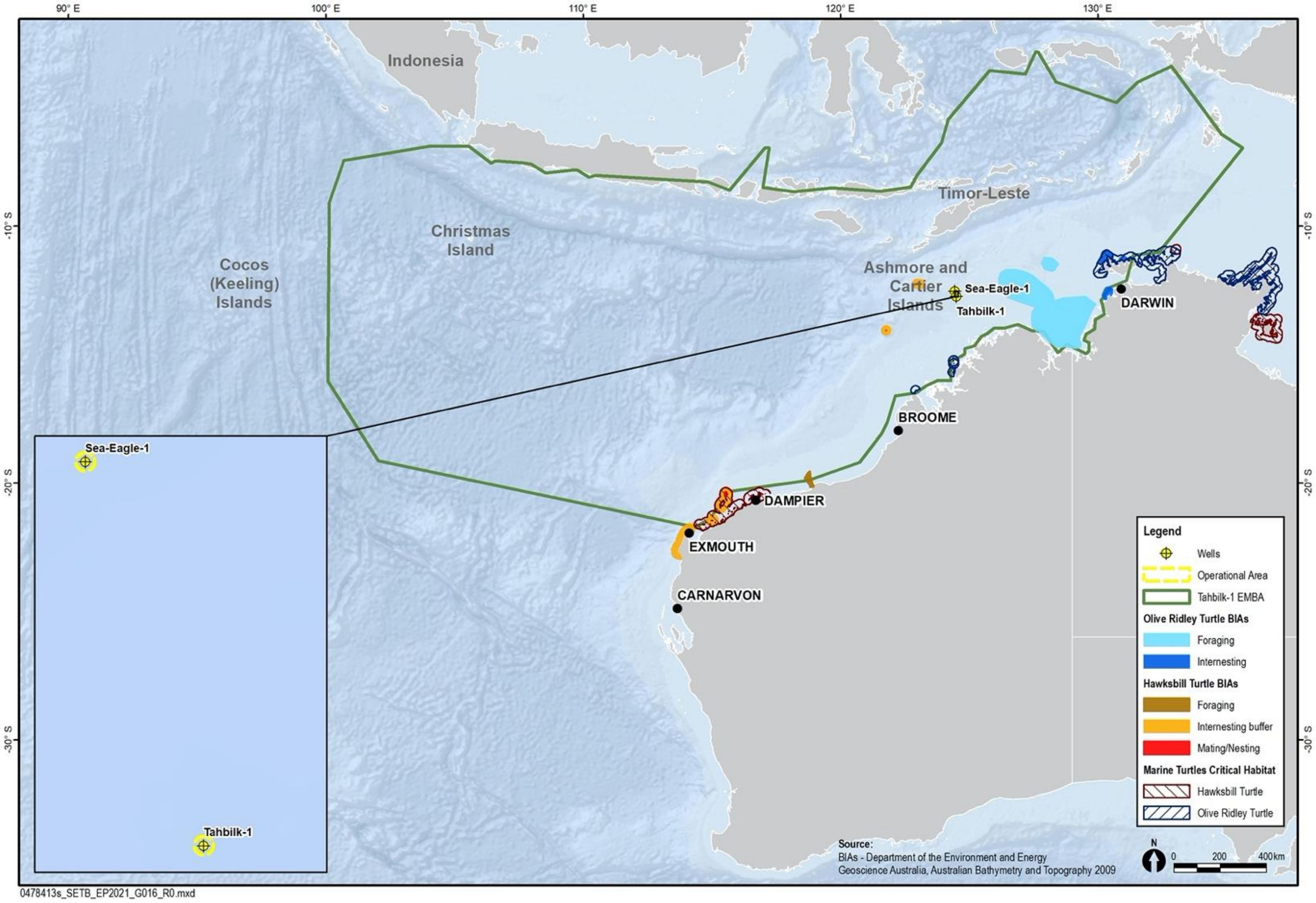


Figure 1-10: Hawksbill and Olive Ridley Turtle BIAs

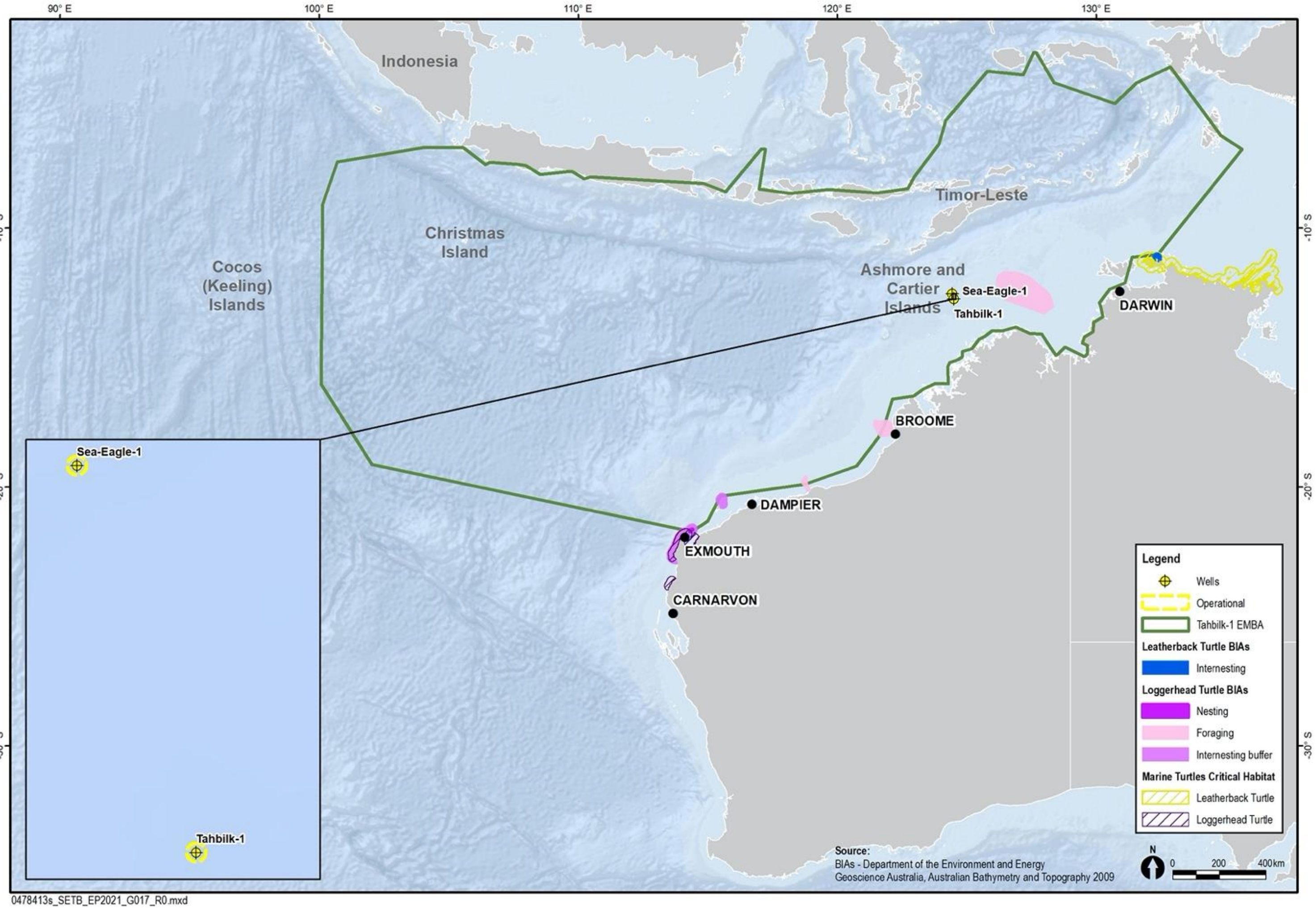


Figure 1-11: Leatherback and Loggerhead Turtle BIAs

1.4.7.1 Green Turtle (Vulnerable/Migratory)

The closest known significant breeding/nesting grounds for the green turtle (*Chelonia mydas*) to the Montara field are Ashmore Reef and Cartier Island, approximately 125 and 84 km to the northwest respectively (Figure 1-8). Green turtle nesting has also been observed at Cassini Island (RPS 2010a) and the island is recognised as a significant green turtle rookery (Conservation Commission 2010). In WA, the major nesting sites include Dampier Archipelago, along the Ningaloo and Jurabi Coasts, Thevenard Island and the Barrow-Lowendal-Montebello island complex (DoEE 2017b). In the NT, nesting occurs at Coburg Peninsula and between Nhulunbuy and northern Blue Mud Bay (East Arnhem Land) (DoEE 2017b). Satellite tracking studies have shown that green turtles migrate between breeding grounds and feeding grounds off the northwest coast (Pendoley 2005).

Sandy Islet at Scott Reef is a green turtle nesting site, with summer months from November through to February being the preferred nesting period (Guinea 2006a). While no published literature is available relating to turtle activities around Seringapatam Reef, it can be assumed that no nesting occurs due to the lack of permanent land (e.g. a sandy islet or island). However, turtles are likely to visit the reef system as part of transitory foraging behaviour. It has also been noted that green turtles may feed around Barracouta Shoal based on the proximity of the shoal to Cartier Island (Fugro 2009). Due to the presence of several rookery and foraging sites within the RISK EMBA, it is expected that green turtles will occur.

1.4.7.2 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).

The RISK EMBA intersect flatback turtle BIAs at the Sahul Shelf used for foraging off the West Australia coast, and the internesting BIA in the coastal waters off Arnhem Land in the Northern Territory (Figure 1-9). Subsequently, the species is expected to be present within the RISK EMBA.

1.4.7.3 Hawksbill Turtle (Vulnerable/Migratory)

Hawksbill turtles (*Eretmochelys imbricata*) are found in tropical, subtropical and temperate waters in all oceans of the world. In WA, the Dampier Archipelago is an important part of the migration route for hawksbill turtles, as are Scott Reef and the Joseph Bonaparte Gulf. Hawksbill turtles nest all year round in WA, with a peak in October and January (DoEE 2017b).

In WA, the major nesting sites include the Dampier Archipelago, along the Ningaloo and Jurabi Coasts, Thevenard Island and the Barrow-Lowendal-Montebello island complex (DoEE 2017b). In the NT, nesting occurs at Coburg Peninsula and between Nhulunbuy and northern Blue Mud Bay (East Arnhem Land) (DoEE 2017b). Hawksbill turtles are also found in the reserves of Ashmore Reef and Cartier Island where they feed throughout the year (Guinea 1995).

The EMBA intersects with hawksbill turtle BIAs at Scott Reef, Ashmore Reef and Cartier Island (Figure 1-10). Subsequently, hawksbill turtles are expected to occur within the RISK EMBA.

1.4.7.4 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). The RISK EMBA intersect with one leatherback turtle BIA, an internesting area off the Cobourg Peninsula in NT waters (Figure 1-11). The species is likely to be present within the RISK EMBA.

1.4.7.5 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 Montara field are found at Muiron Island and the beaches of the Northwest Cape (Baldwin et al. 2003), approximately 1,500 km south-west of the wellhead platform and outside the RISK EMBA. Loggerhead turtles have also been recorded in the reserves of Ashmore Reef (125 km) and Cartier Island (84 km), west- northwest of the Operational Area (Guinea 1995). The EMBA intersects with one loggerhead turtle BIA, a foraging area on the Sahul Bank off NT waters (Figure 1-11).

This species is likely to be present, in limited numbers, within the RISK EMBA.

1.4.7.6 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 observed 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). The EMBA intersects with a number of olive-ridley turtle BIAs (foraging and internesting areas) of the Sahul Bank in the Joseph Bonaparte Gulf and in NT waters off the Arnhem Land coast (Figure 1-10). This species may be encountered in limited numbers within the RISK EMBA.

1.4.7.7 Short-nosed Sea-snake (critically endangered)

The short-nosed seasnake (*Aipysurus apraefrontalis*) is listed as critically endangered under the EPBC Act and the Biodiversity Conservation Act 2016. It is a fully aquatic, small snake and is endemic to WA. It has been recorded from Exmouth Gulf, WA to the reefs of the Sahul Shelf, in the eastern Indian Ocean. This species is believed to show strong site fidelity to shallow coral reef habitats in less than 10 m of water, with most specimens having been collected from Ashmore and Hibernia reefs (Guinea & Whiting 2005; Minton & Heatwole 1975).

The species prefers the reef flats or shallow waters along the outer reef edge in water depths to 10 m (Cogger 2000; McCosker 1975). The species has been observed during daylight hours, resting beneath small coral overhangs or coral heads in 1–2 m of water (McCosker 1975). Guinea and Whiting (2005) reported that very few short-nosed sea-snakes moved even as far as 50 m away from the reef flat and are therefore unlikely to be expected in high numbers in deeper offshore waters.

1.4.7.8 Leaf-scaled Sea-snake (critically endangered)

The leaf-scaled seasnake (*Aprasia rostrate rostrata*) is listed as critically endangered under the EPBC Act and the Biodiversity Conservation Act 2016. It occurs in shallow water (less than 10 m in depth), in the protected parts of the reef flat, adjacent to living coral and on coral substrates (DoE 2014). The species is found only on the reefs of the Sahul Shelf in Western Australia, especially on Ashmore and Hibernia reefs (Minton & Heatwole 1975). The leaf-scaled seasnake forages by searching in fish burrows on the reef flat (DoE 2014) and are therefore unlikely to be expected in high numbers in deeper offshore waters, but may occur within the RISK EMBA.

1.4.7.9 Salt water crocodile (migratory)

The species' distribution ranges from central Queensland throughout coastal Northern Territory to northern Western Australia. It is the largest species of crocodile in the world, reaching up to 7m and occurs in tidal rivers, coastal floodplains and billabongs and swamps. Individuals have been known to travel large distances, including across open ocean. Most prevalent in coastal areas they are therefore unlikely to be expected in high numbers in deeper offshore waters, but may occur within the RISK EMBA.

1.4.8 Avifauna

No avifauna migration, resting, foraging or breeding BIAs are present within the Operational area (Figure 1-12). However, a number of BIAs overlap the RISK EMBA and these are shown in Figure 1-12. The nearest breeding/roosting site to the Operational Area is Cartier Island approximately 80km away.

Numerous species of birds frequent the Timor Sea or fly through the area on annual migrations and a number of BIAs overlap. 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 RISK EMBA during their annual migrations (Table 1-19). Protected avifauna species are described below, with migratory species described in Table 1-20.

Table 1-19: Windows of sensitivity for avifauna

Key	Peak times											
	January	February	March	April	May	June	July	August	September	October	November	December
Avifauna												
Seabirds: Breeding												
Shorebirds: Migrating												

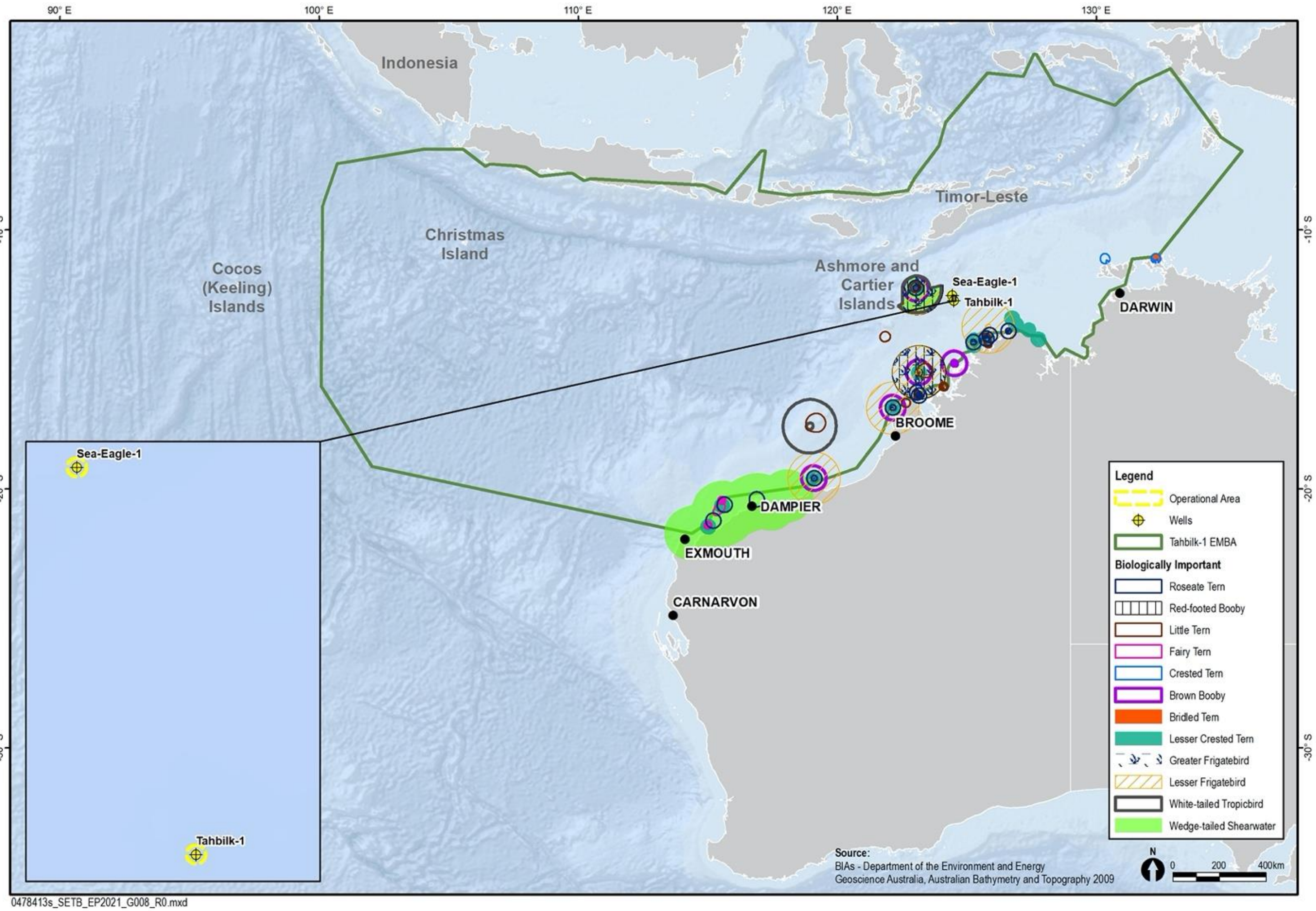


Figure 1-12: Avifauna BIAs

1.4.8.1 Red Knot (Endangered/Migratory)

The red knot, a migratory shorebird, is described with 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 RISK EMBA.

1.4.8.2 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). Based on known distribution and the location of rookeries the species is known to occur within the RISK EMBA.

1.4.8.3 Curlew Sandpiper (Critically Endangered/Migratory)

In Australia, curlew sandpipers (*Calidris ferruginea*) occur around the coasts and are widespread inland. In WA, they are found around coastal and subcoastal plains from Cape Arid to the 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). The species may be present within the RISK EMBA.

1.4.8.4 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 intermittently 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 2015g). The species may be present within the RISK EMBA.

1.4.8.5 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). The species is may be present foraging within the RISK EMBA.

1.4.8.6 Great Knot (Critically Endangered, Migratory)

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

1.4.8.7 Western Alaskan Bar tailed Godwit (Vulnerable) and Northern Siberian Bar tailed Godwit (Critically Endangered)

Two subspecies of the bar-tailed godwit exist, as determined by their breeding locations in Alaska (*Limosa lapponica bauera)* and Siberia (*Limosa lapponica menzbieri*) (Bamford et al. 2008). Non-breeding birds migrate to the coasts of Australia. The western Alaskan subspecies occurs especially on the north and east coasts of Australia whilst the northern Siberian subspecies occurs mainly along the coasts of north Western Australia (DoEE 2017b).

Nonbreeding birds are found on muddy coastlines, estuaries, inlets, mangrove-fringed lagoons and sheltered bays, feeding on annelids, bivalves and crustaceans (Higgins and Davies 1996 in Garnet et al. 2011). The species may occur within the RISK EMBA.

1.4.8.8 Greater Sand Plover (Vulnerable, Migratory)

During the non-breeding season, the species is recorded in many coastal areas of Australia. The Greater Sand Plover is one of the first migratory waders to return to north-western Australia, usually arriving in late July with most Plovers leaving the north-west by mid to late April. In Australia, the Greater Sand Plover occurs in coastal areas in all states, though the greatest numbers occur in northern Australia, especially the north-west. Greater Sand Plovers usually feed from the surface of wet sand or mud on open intertidal flats of sheltered embayments, lagoons or estuaries, feeding on molluscs, worms, crustaceans and insects. They usually roost on sand-spits and banks on beaches or in tidal lagoons, and occasionally on rocky points

1.4.8.9 Southern Giant Petrel (Endangered, Migratory)

The southern giant petrel is a highly migratory bird with a large natural range. This species occurs from Antarctic to subtropical waters and breeds on the Antarctic continent, peninsular and islands and on subantarctic islands and South America. Breeding occurs annually between August and March (DAWE 2020).

There are no BIAs for this species within the RISK EMBA, although the species may still occur.

1.4.8.10 Lesser Sand Plover (Endangered, Migratory)

The species is present at non-breeding grounds in Australasia mostly between September and April or May, with greatest numbers in northern Australia. Within Australia, the Lesser Sand-Plover is widespread in coastal regions, and has been recorded in all states. Internationally important sites in Australia and maximum counts in Western Australia and Northern Territory include Eighty Mile Beach, Roebuck Bay, Broome, Port Hedland Saltworks and Darwin area. This species usually occurs in coastal littoral and estuarine environments. It inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. It also sometime occurs in short saltmarsh or among mangroves. Lesser Sand Plovers eat invertebrates, such as molluscs (especially bivalves), worms, crustaceans (especially crabs) and insects.

1.4.8.11 Christmas Island Frigate bird (Endangered, Migratory)

The Christmas Island frigatebird is the ninth most evolutionary distinct and globally endangered bird in the world. Christmas Island is its home and the only place in the world where it breeds and nests in the forest canopy. Australia shares this bird with Indonesia. The male frigatebird has a bright red throat pouch called a 'gular', that it blows up like a fancy balloon to attract females during the mating season. It takes at least 15 months for a pair of Christmas Island frigatebirds to raise one chick to independence, and the birds can live as long as 50 years. Frigatebirds primarily forage in the ocean for food, scooping marine organisms such as fish and squid.

1.4.8.12 Christmas Island Goshawk (Endangered)

The Christmas Island Goshawk (*Accipiter fasciatus natalis*) is considered to be the rarest endemic bird on Christmas Island, where it occurs in all habitats from primary and marginal rainforests to suitable areas of secondary regrowth vegetation. The total population size is thought to be very small, perhaps as few as 100 adults, and is probably limited by the availability of suitable rainforest habitat.

Crazy Ants pose an unknown but potentially critical threat to the survival of this bird. The National recovery plan for the Christmas Island Goshawk (*Accipiter fasciatus natalis*) aims to downgrade the Christmas Island Goshawk from Endangered to Conservation Dependent, primarily through successful implementation of the Invasive Ants on Christmas Island Action Plan and protection of habitat critical to the survival of the species from clearance. An assessment of goshawk population dynamics is the most essential requirement of this recovery plan, and community awareness and participation in the conservation of this endemic raptor are also important actions.

Given the habitat preference of this species, it is not likely to be found in the RISK EMBA.

1.4.8.13 Christmas Island White-tailed Tropicbird (Endangered, Migratory)

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

There are no identified BIAs for this species within the RISK EMBA, however it may still occur.

1.4.8.14 Round Island Petrel (Critically Endangered)

In Australia, the Round Island petrel (*Pterodroma arminjoniana*) has only been recorded on North Keeling Island, where it may breed (DEH, 2003). There is concern about the future survival of the Round Island petrel in Australia. They only visit land to breed, nesting in sandy areas on the ground, sheltered under shrubs between February and July. At sea, they generally glide close to the surface of the water, only occasionally flapping their wings and hunting in the near-surface water layers. The Round Island petrel is expected to occur within the RISK EMBA.

1.4.8.15 Soft Plumaged Petrel (Vulnerable, Migratory)

The soft-plumaged petrel (*Pterodroma mollis*) is generally found over temperate and subantarctic waters in the South Atlantic, Southern Indian and western South Pacific Oceans. The species breeds colonially on islands in the southern oceans. Breeding occurs from August to May (Marchant & Higgins 1990 in DAWE 2020).

1.4.8.16 Australian Painted Snipe (Endangered)

The Australian painted snipe (*Rostratula australis*) has been recorded at wetlands in all states of Australia (DoEE 2019). The Australian painted snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia,* canegrass or sometimes tea-tree (Melaleuca). The Australian painted snipe sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber (DoE 2014). The Australian Painted snipe is expected to occur within the RISK EMBA due to its habitat preference.

1.4.8.17 Australian Fairy Tern (Vulnerable)

The fairy tern (*Sternula nereis*) has a large geographic range between Australia, New Zealand and New Caledonia. Three subspecies have been identified, one of which is found in Australia (the Australian fairy tern, *Sternula nereis nereis*). The Australian fairy tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago in WA (DoEE 2017a). The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine islands, wetlands and mainland coastline (Higgins & Davies 1996).

Australian fairy terns nest on sheltered sandy beaches, spits and banks, above the high tide line and below vegetation. The species breeds from August to February depending on the location of the breeding colony (Higgins & Davies 1996). They generally nest in small colonies of up to 100 birds, although larger colonies of more than 1,400 pairs have been reported in Western Australia (Hill et al. 1988).

The National Conservation Values Atlas (DoEE 2017b) identifies the vicinity of the lower north-west coast (north to Dampier Archipelago) and west coast (south to Peel Inlet) as BIAs for foraging. Breeding BIA's were also identified scattered along the coast from Shark Bay to the Pilbara. The Australian Fairy tern is expected to occur within the RISK EMBA.

Table 1-20: Protected and Migratory avifauna

Common name	Scientific name	EPBC Act Status	Particular Values or Sensitivities Within the EMBA
Roseate tern	*Sterna dougallii*	M	Breeding known to occur within area
Curlew sandpiper	*Calidris ferruginea*	CE, M	Species or species habitat known to occur within area
Red knot	*Calidris canutus*	E, M	Species or species habitat known to occur within area
Eastern curlew	*Numenius madagascariensis*	CE, M	Species or species habitat known to occur within area
Common noddy	*Anous stolidus*	M	Breeding known to occur within area
Streaked shearwater	*Calonectris leucomelas*	M	Species or species habitat known to occur within area
Lesser frigatebird	*Fregata ariel*	M	Breeding known to occur within area Overlaps with breeding, foraging BIA
Common sandpiper	*Actitis hypoleucos*	M	Species or species habitat known to occur within area
Sharp-tailed sandpiper	*Calidris acuminata*	M	Species or species habitat known to occur within area
Pectoral sandpiper	*Calidris melanotos*	M	Species or species habitat known to occur within area
Osprey	*Pandion haliaetus*	M	Breeding known to occur within area
Australian fairy tern	*Sternula nereis nereis*	V	Breeding known to occur within area Overlaps with breeding BIAs
Fork-tailed swift	*Apus pacificus*	M	Species or species habitat likely to occur within area
Wedge-tailed shearwater	*Ardenna pacifica*	M	Breeding known to occur within area Overlaps with breeding and foraging BIA
Western Alaskan bar-tailed godwit	*Limosa lapponica baueri*	V, M	Species or species habitat known to occur within area

Northern Siberian bar-tailed godwit	*Limosa lapponica menzbierii*	CE, M	Species or species habitat known to occur within area
White-tailed tropicbird	*Phaethon lepturus*	E,M	Breeding known to occur within area Overlaps breeding, foraging BIA
Greater frigatebird	*Fregata minor*	M	Breeding known to occur within area Overlaps breeding, foraging BIA
Caspian tern	*Hydroprogne caspia*	M	Breeding known to occur within area
Little tern	*Sternula albifrons*	M	Breeding known to occur within area Overlaps breeding, foraging BIA
Bridled tern	*Onychoprion anaethetus*	M	Breeding known to occur within area
Oriental plover	*Charadrius veredus*	M	Species or species habitat may occur within area
Oriental pratincole	*Glareola maldivarum*	M	Species or species habitat may occur within area
Crested tern	*Thalasseus bergii*	M	Breeding known occur within area
Common greenshank	*Tringa nebularia*	M	Species or species habitat likely n to occur within area
Australian lesser noddy	*Anous tenuirostris melanops*	V	Breeding known to occur within area
Abbott's booby	*Papasula abbotti*	E	Species or species habitat known to occur within area
Masked booby	*Sula dactylatra*	M	Breeding known to occur within area
Red-footed booby	*Sula sula*	M	Breeding known to occur within area Overlaps breeding, foraging BIA
Brown booby	*Sula leucogaster*	M	Breeding known to occur within area Overlaps breeding, foraging BIA
Australian painted snipe	*Rostratula australis*	E	Species or species habitat likely to occur within area
Christmas Island frigatebird	*Fregata andrewsi*	E, M	Breeding known to occur within area
Red-tailed tropicbird	*Phaethon rubricauda*	M	Breeding known to occur within area
Greater Sand Plover/Large Sand Plover	*Charadrius leschenaultia*	V, M	Species or species habitat likely to occur within area
Great Knot	*Calidris tenuirostris*	CE, M	Species or species habitat likely to occur within area.
Lesser Sand Plover/Mongolian Plover	*Charadrius mongolus*	EM	Species or species habitat likely to occur within area.
Round Island Petrel	*Pterodroma arminjoniana*	CE	Species or species habitat may occur within area
Ruddy Turnstone	*Arenaria interpres*	M	Species or species habitat likely to occur within area

Sanderling	*Calidris alba*	M	Species or species habitat known to occur within area
Asian Dowitcher	*Limnodromus semipalmatus*	M	Species or species habitat known to occur within area
Bar-tailed Godwit	*Limosa lapponica*	M	Species or species habitat known to occur within area
Black-tailed Godwit	*Limosa limosa*	M	Species or species habitat likely to occur within area
Whimbrel	*Numenius phaeopus*	M	Species or species habitat likely to occur within area
Grey Plover	*Pluvialis squatarola*	M	Species or species habitat likely to occur within area
Christmas Island Goshawk	*Accipiter hoigaster natalis*	E	Species or species habitat known to occur within area
Red Goshawk	*Erythrotriochis radiatus*	V	Species or species habitat known to occur within area
Grey Falcon	*Falco hypoleucos*	V	Species or species habitat known to occur within area
Oriental Reed-Warbler	*Acrocephalus orientalis*	M	Species or species habitat known to occur within area
Soft-plumaged Petrel	*Pterodroma mollis*	V	Foraging, feeding, or related behaviour likely to occur within area
Flesh-footed Shearwater	*Ardenna carneipes*	M	Species or species habitat may occur within area
Southern Giant-Petrel	*Macronectes giganteus*	E,M	Species or species habitat may occur within area

CE = Critically Endangered E = Endangered V = Vulnerable M = Migratory CD = Conservation Dependent

1.4.9 Indonesia and Timor-Leste

The Indonesian coastline is rich in tropical marine ecosystems such as sandy beaches, mangroves, coral reefs and seagrasses ecosystems (Hutomo and Moosa 2005). These are home to a wide variety of living communities and a high species diversity and richness.

The benthic habitat of the Indonesian coastline include seagrass meadows and coral reefs. The best environment for growth of seagrass is considered to be the sandy reef flats that occur in sheltered areas in the low tidal ranges. Wide areas of the Indonesian coastal waters are covered by dense beds of seagrass. Pioneering vegetation in the intertidal zone is dominated by *Halophila ovalis* and *Halodule pinifolia*, while *Thalassodendron ciliatum* dominate the lower subtidal zones.

Indonesia has an estimated 75,000 km^2 coral reef ecosystem distributed throughout the archipelago (Tomascik et al. 1997 cited in Hutumo and Moosa 2005). Fringing reefs are the most common reef types with scleractinian corals being the most dominant and important group. It is estimated that Indonesian waters are home to 452 species of hermatypic scleractinian coral and 590 species of scleractinian corals (Tomascik et al. 1997, cited in Hutumo and Moosa 2005; Suharsono 2004, cited in Hutumo and Moosa 2005).

The Java and Bali Province is rich in tropical marine ecosystems such as mangroves, coral reefs, seagrasses and seaweeds, sand beaches on the east coast of Java and rocky coasts on the south-eastern coast of Bali. The mangrove forests provide a valuable physical habitat for a variety of important coastal species such as crabs, shrimps, fishes, and commercial fishes. Turtles are commonly seen at Crystal Bay, Nusa Penida.

Maluku Province's inshore waters are rich in mangroves, seagrass beds and coral reef habitats for dugongs, green turtle, reef fish, shark, giant clam and trochus (Moss and Van Der Wal 1998).

West Nusa Tengarra Province consists of two islands: Lombok Island and Sumbawa Island. Mangroves, seagrass beds and coral reefs exist in the surrounding waters of Lombok (Tomascik et al. 1997 cited in Hutumo and Moosa 2005). It has been noted that fishermen in the west coast of Lombok collect seagrass from mixed seagrass meadows (Tomascik et al. 1997 cited in Hutumo and Moosa 2005). Green turtles and dugong likely feed on the seagrass beds located on the west coast of Lombok and north coast of Sumbawa.

Mangrove forests in Indonesia account for 76% of the total mangroves found in the southeast Asian region. The Timor-Leste coastline features mangrove communities surrounding entrance to rivers primarily on the south coast, whilst the north and eastern coast feature a higher degree of coral reef communities.

The below shoreline habitats are present in the East Nusa Tengarra Province and Timor-Leste:

- Rote Island features mangrove communities with sparse patches of seagrass habitats and high abundance of coral reef communities;
- The Savu sea region has an abundance of coral reef habitats that act as nurseries and feeding grounds for whales and dolphins. In particular, Savu and Raidjua Islands are surrounded by a fringing coral reef community. Savu Island features a small area of seagrass located in the north east corner of the Island;
- Sumba Island is surrounded by a fringing coral reef community, with sparse patches of seagrass and mangrove communities around the island;
- The majority of the West Timor coastline features a narrow fringing coral reef community with four dense areas of mangrove communities occurring primarily along the south coast;

- Pulau Dana, the southernmost island of Indonesia, is surrounded by exposed reefs and is known to be inhabited by a large number of bird species and nesting turtles;
- Alor Island is located at the border between Indonesia and Timor-Leste with mangroves, coral reefs and seagrasses; and
- The majority of the Pulau Semau coastline features a narrow fringing coral reef community with areas of mangrove and seagrass communities occurring primarily along the east coast.

1.5 Social Values

1.5.1 Commercial Fishing

Four Commonwealth, eleven WA state fisheries and two NT fisheries overlap the RISK EMBA. Of these, only two fisheries are expected to have fishing effort occur in the Operational Area (Table 1-21). Descriptions of commercial fisheries that are expected to have effort in the Operational Area are provided in EP Section 4.2.

Table 1-21: Commercial fisheries that overlap the RISK EMBA

	Commonwealth	WA	NT
Potential for effort in the Operational Area	Western Tuna and Billfish	Northern Demersal Scalefish Managed Fisheries	-
Effort not expected in the Operational Area	Northwest Slope Trawl Western Skipjack Tuna Fishery Southern Bluefin Tuna Fishery	Joint Authority Northern Shark Fishery Specimen Shell managed fishery Marine Aquarium West Coast Deep Sea Crustacean Pearl oyster fishery Abalone managed fishery Kimberly prawn fishery Mackerel managed fishery Nickol Bay Prawn Onslow Prawn South-West Coast Salmon	Timor Reef Fishery Northern Prawn

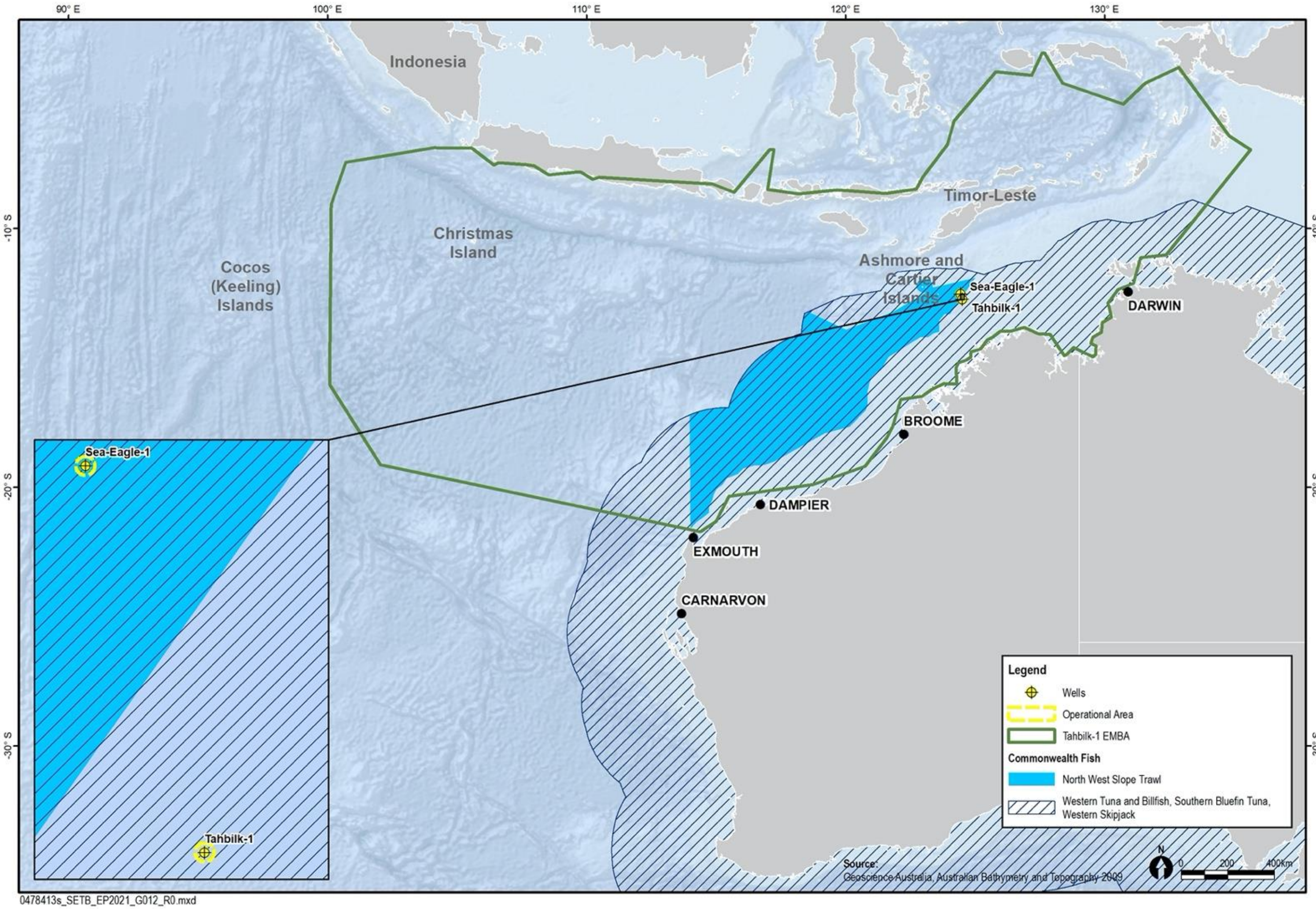


Figure 1-13: Commonwealth Fisheries within the RISK EMBA

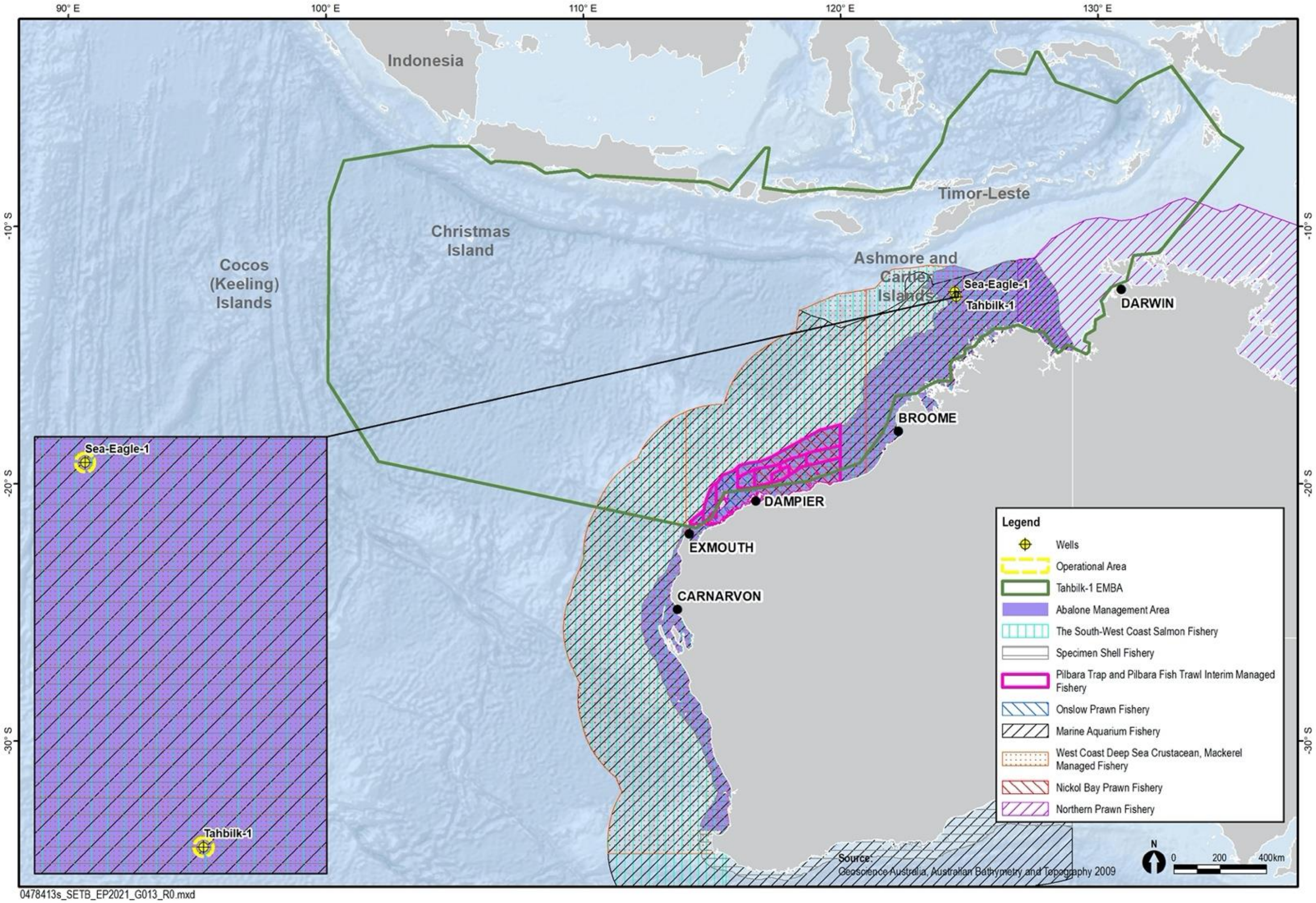


Figure 1-14: State Managed Fisheries within the RISK EMBA

1.5.1.1 Commonwealth fisheries

The Australian Fisheries Management Authority (AFMA) manages all Commonwealth fisheries under the Fisheries Management Act 1991.

Western Tuna and Billfish

The Western Tuna and Billfish Fishery extends westward from Cape York Peninsula, Queensland, down the West Australian coast and eastward across the Great Australian Bight to the South Australian–Victorian border.

This fishery targets broadbill swordfish (*Xiphias gladius*), albacore tuna (*Thunnus alalunga*), striped marlin (*Kajikia audax*), bigeye tuna (*T. obesus*) and yellowfin tuna (*T. albacares*). In recent years, fishing effort has concentrated off south-west Western Australia and South Australia, however commercial fishers of this fishery will potentially be active within both the RISK EMBA and the Operational Area (Department of Agriculture 2019).

Northwest Slope Trawl Fishery

The Northwest Slope Trawl Fishery extends from 114° E to approximately 125° E off the WA coast between the 200 m isobath and the outer limit of the Australian Fishing Zone (AFZ). The fishery targets scampi (crayfish), deepwater prawns and snapper, using demersal crustacean trawl methods seaward of the 200 m isobath. This fishery overlaps the RISK EMBA and should be considered relevant in the event of a significant hydrocarbon spill, however it does not overlap the Operational Area (Department of Agriculture 2019).

Western Skipjack Tuna Fishery

The Western Skipjack Fishery is part of the Skipjack Tuna Fishery, which contains two stocks: one to the east and one to the west, that are assessed separately but managed together under various management arrangements and general conditions in addition to the Fisheries Management Act 1991. The Western Skipjack Fishery targets only skipjack tuna *Katsuwonus pelamis*. While the RISK EMBA overlap the fishery, effort within the fishery is confined to the southern coast of Australia, several thousand kilometres away. No fishing effort has been recorded anywhere in the fishery since the 2008-2009 season (ABARES 2018).

Southern Bluefish Tuna Fishery

The Southern Bluefin Tuna Fishery targets southern bluefin tuna (*Thunnus maccoyii*) under the Southern Bluefin Tuna Fishery Management Plan 1995. Effort in this fishery is concentrated in the Great Australian Bight, several thousand kilometres from the location of the RISK EMBA, with this trend demonstrated historically from 2014 to 2018. Southern bluefin tuna spawn in the North West Shelf region of Western Australia between September and March. The larvae may be seasonally abundant in surface waters of the broader region during these months and migrating adult tuna may transit through the RISK EMBA.

1.5.1.2 Western Australian state fisheries

The Department of Primary Industries and Regional Development (DPIRD), fisheries division, manages WA state fisheries under the Fisheries Management Act 1991.

Northern Demersal Scalefish Managed Fisheries

The Northern Demersal Scalefish Fisheries includes the Pilbara Demersal Scalefish Fisheries (Pilbara Fish Trawl Managed Fishery, the Pilbara Trap Managed Fishery and the Pilbara Line Fishery).

PDSF licence holders operate within "Pilbara waters" (all waters bounded by a line commencing at the intersection of 21°56'S latitude and the highwater mark on the western side of the North West Cape on the mainland of Western Australia; thence west along the parallel to the intersection of 21°56'S latitude and the boundary of the Australian Fishing Zone and north to longitude 120°E.)

The PDSF collectively use a combination of vessels, effort allocations (time), gear limits, plus spatial zones (including extensive trawl closures) as management measures. The main species landed by the fisheries in the Pilbara subregion are bluespotted emperor, red emperor, and rankin cod.

This fishery overlaps the Operations area. Commercial fishers will be potentially active in this region.

Joint Authority Northern Shark Fishery

The Joint Authority Northern Shark Fishery is part of the WA North Coast Shark Fisheries which target sandbar (*Carcharhinus plumbeus)*, hammer head (*Sphyrnidae*), blacktip (*Carcharhinus melanopterus*) and lemmon sharks (*Negaprion brevirostris*). This fishery overlaps both the RISK EMBA and Operational area, however no recorded fishing effort has occurred in the Operational Area grid cells for last 5 years.

Specimen Shell managed fishery

The Specimen shell fishery covers all Western Australian waters from the high-water mark to the 200 m isobath. Effort is historically concentrated around population centres such as Broome, Karratha and Shark Bay. The primary method of collection is via hand while diving and wading along the coastal beaches, however a small number of operators utilise ROV's.

Marine Aquarium Fish Managed Fishery

The Marine Aquarium fish managed fishery covers all of WA coastal waters. Collection methods include diving with handheld nets and covers over 950 species of fish, live rock, coral, seagrass, algae and invertebrates.

West Coast Deep Sea Crustacean

The West Coast Deep-sea Crustacean Managed Fishery is a quota-based pot fishery that mostly operates in depths of 500–800 m, with no fishing is permitted on the landward side of the 150 m isobath. The only allowable method fishing is baited pots on long-lines, with most set on muddy seabed. The boundaries of this fishery include all WA waters of the Indian Ocean and the Timor Sea north of 34°24'S.

Pearl oyster fishery

The WA pearl oyster fishery is the only remaining significant wild-stock fishery for pearl oysters in the world. It is a quota-based, dive fishery, operating in shallow coastal waters (< 35 m depth) along the NWS from Exmouth to the NT border. The harvest method is drift diving.

Abalone managed fishery

The Abalone Managed Fishery is active in the southern region of Western Australia. Fishing methods are dive and wading. Fishing was closed in Area 8, the area of WA waters north of Moore River during the 2011/12 season due to the catastrophic mortality observed following a marine heatwave in 2010/11 and remains closed (ABARES 2018).

Kimberly prawn fishery

The jurisdiction of the Kimberley Prawn Managed Fishery overlaps the RISK EMBA. The gear used consists of otter trawls and is typically restricted to depths less than 60 m. The fishery is generally active between April and May, and August to November each year (ABARES 2018).

Mackerel managed fishery

The Mackerel Managed Fishery targets Spanish mackerel (*Scomberomorus commerson*), with smaller landings of other species such as grey mackerel (*S. semifasciatus*). The fishery extends from Cape Leeuwin on the southern west coast of Australia to the Western Australian/Northern Territory Border, and historically most of the catch is landed in the Pilbara and Kimberley regions (Lewis & Jones 2017).

Nickol Bay Prawn

The Nickol Bay Prawn fishery covers the waters between 116°45’E to 120°E on the landward side of the 200 m isobath. It operates as an otter trawl fishery for banana prawns (*Penaeus merguiensis*).

Onslow Prawn

The Onslow Prawn fishery operates as an otter trawl fishery between the Exmouth and Nickol Bay prawn fisheries east of 144°39.9’E on the landwards side of the 200 m isobath. The fishery targets western king prawns (*Penaeus latisulcatus)*, brown tiger prawns (*P. esculentus*) and endeavour prawns (*Metapenaeus* spp.).

Southwest Coast Salmon

There is insufficient information available on the Southwest Coast Salmon Managed Fishery and its catch efforts. However, the fishery’s target species is the Western Australian salmon (*Arripis truttaceus*) which is found along the coast from north of Perth stretching south across the Great Australian Bight to western Victoria and Tasmania. Fishing effort is therefore not expected to overlap the RISK EMBA.

1.5.1.3 Northern Territory fisheries

The Department of Primary Industry and Resources (DPIR), fisheries division, manages NT fisheries under the Fisheries Act 1988. There are 2 NT managed fisheries that overlap the RISK EMBA.

Timor Reef Fishery

The Timor Reef Fishery operates offshore in a zone covering roughly 8,400 NM^2 to the north-west of Darwin and targets tropical snappers (*Lutjanus* spp. and *Pristipomoides* spp.) using a variety of gear. The majority of the catch is taken using baited traps, but hand lines, droplines and demersal longlines may also be used.

Northern Prawn Fishery

The Northern Prawn Fishery targets banana prawns, tiger prawns and endeavour prawns in northern Australian waters, from Cape York in Queensland to Cape Londonderry in Western Australia. Two main fishing seasons exist from 1 April to 15 June and 1 August to 30 November, and the total catch effort of the fishery in 2018 was 6,751 tonnes (AFMA, 2019). The fishery uses bottom trawl fishing gear.

Fishing Tour Operator Fishery

Fishing Tour Operators assist their clients in the pursuit of a wide range of sport fish in the non-tidal and tidal waters of the NT to the outer limit of the AFZ. Guide vessels range in size from small dinghies to luxury mother ships. Some operators also utilise fan-propelled “air boats” or helicopters.

1.5.1.4 Recreational and Charter Fishing

Recreational fishing is a popular activity in the Kimberley region, however effort is concentrated around regional centres due to the remoteness. Transiting recreational vessels passing through the RISK EMBA will undertake recreational fishing activities for sustenance and leisure. A small group of recreational fishing and charter vessels do occasionally visit the Ashmore Reef and surrounds and other reefs in the RISK EMBA.

1.5.1.5 Customary fishing

Customary fishing occurs in the Dambimangari IPA, Djelk IPA and Uunguu IPA. The importance of customary fishing in WA and NT is to recognise Aboriginal cultural heritage and needs. Customary fishing is fishing for personal, domestic, ceremonial, educational or non-commercial needs. Fishers use modern fishing methods such as aluminium boats and outboard motors.

1.5.1.6 International subsistence fishing

As the world's largest archipelagic State with approximately 17,500 islands, fisheries form a significant socio-economic sector in Indonesia. As in Timor-Leste, the vast majority of fishery production (up to 95%) comes from artisanal fishing practices (FAO 2017). Fisheries management area 573 (South of Java – East Nusa Tenggara), encompasses the Lesser Sunda Ecoregion and is a particular productive area with a variety of target demersal and pelagic fisheries, including, lobster, tuna, sardines and shark fisheries. Many of these fisheries are under pressure from overexploitation, unsustainable fishing practices, under regulation and poor management/monitoring, nevertheless they significantly contribute to the economy and social fabric within coastal communities in the region (FAO 2017).

Coral reefs are vital sources of food and income for coastal communities. More than one-third of the Indonesian population living in coastal areas depends on nearshore fisheries for livelihood (ADB 2014). More than 60% of the animal protein consumed by the population in 2000 was derived from fisheries.

Discussions with Indonesian fishermen in Kupang and the Australian Fishery Management Authority (Sinclair Knight Merz 1993) and with fishermen at Suai, Timor-Leste, Pepela and East Rote (Ataupah) (BHPP 1996) indicated that two types of fisheries occur in the region that is likely to intersect the EMBA; trawl and longline. Trawl fishing is commonly undertaken in shallower, inshore areas, targeting scarlet and saddletail perch, snapper and emperor fish. Trawling is also concentrated in the vicinity of Sahul Bank and Echo Shoals and boats will pass through the RISK EMBA to reach these fishing grounds (BHP 2007).

1.5.1.7 Aquaculture

Aquaculture within the RISK EMBA is undertaken within estuarine and marine waters focusing on a variety of species and methods, including prawns, fish and seaweed. Trochus at Cape Leveque and Barramundi at Cone Bay are two larger scale operations along the Australian coastline, which lie outside the RISK EMBA. In Indonesia and Timor-Leste, aquaculture activities often contribute significantly to local employment and food production within the region (FAO 2017). Almost 50% of Indonesia's fisheries are produced from aquaculture (worth $4.3 billion USD).

1.5.1.8 Commercial Fish, Sharks and Ray species spawning

Within the RISK EMBA, potential spawning grounds exist for southern bluefin tuna, goldband snapper and red emperor. The spatial occurrence of spawning is variable and poorly understood; however, temporally it appears that southern bluefin tuna spawn from August to April (peak October to February), goldband snapper from January to April (peak March), and red emperor from October to March (peak October) (Table 1-16). None of these species are listed as threatened; however, they are commercially valuable.

1.5.2 Shipping and vessel movements

Heavy vessels following the charted Osborn Passage will pass through both permits to the north of the Montara Field (Figure 1-15). The area may also be utilised by support vessels from oil and gas operations in the Timor Sea Area.

Occasional interaction with Australian Commercial Fishing vessels, illegal foreign fishing vessels or other illegal vessels is also possible.

To monitor for illegal passage of immigrants and illegal fishing activity the Australian Border Force (ABF) and Royal Australian Navy (RAN) vessels undertake surveillance within an area extending roughly 200 nm from the mainland (Jones 2013). Due to the large geographic extent of these operations and the documenting development at the WHP and subsea fields AC/L7 and AC/L8, direct interaction with ABF or RAN vessels is not expected to occur.

Shipping activity over the past three years in the waters within the RISK EMBA were mapped using AMSA's Craft Tracking System and shown in Figure 1-15.

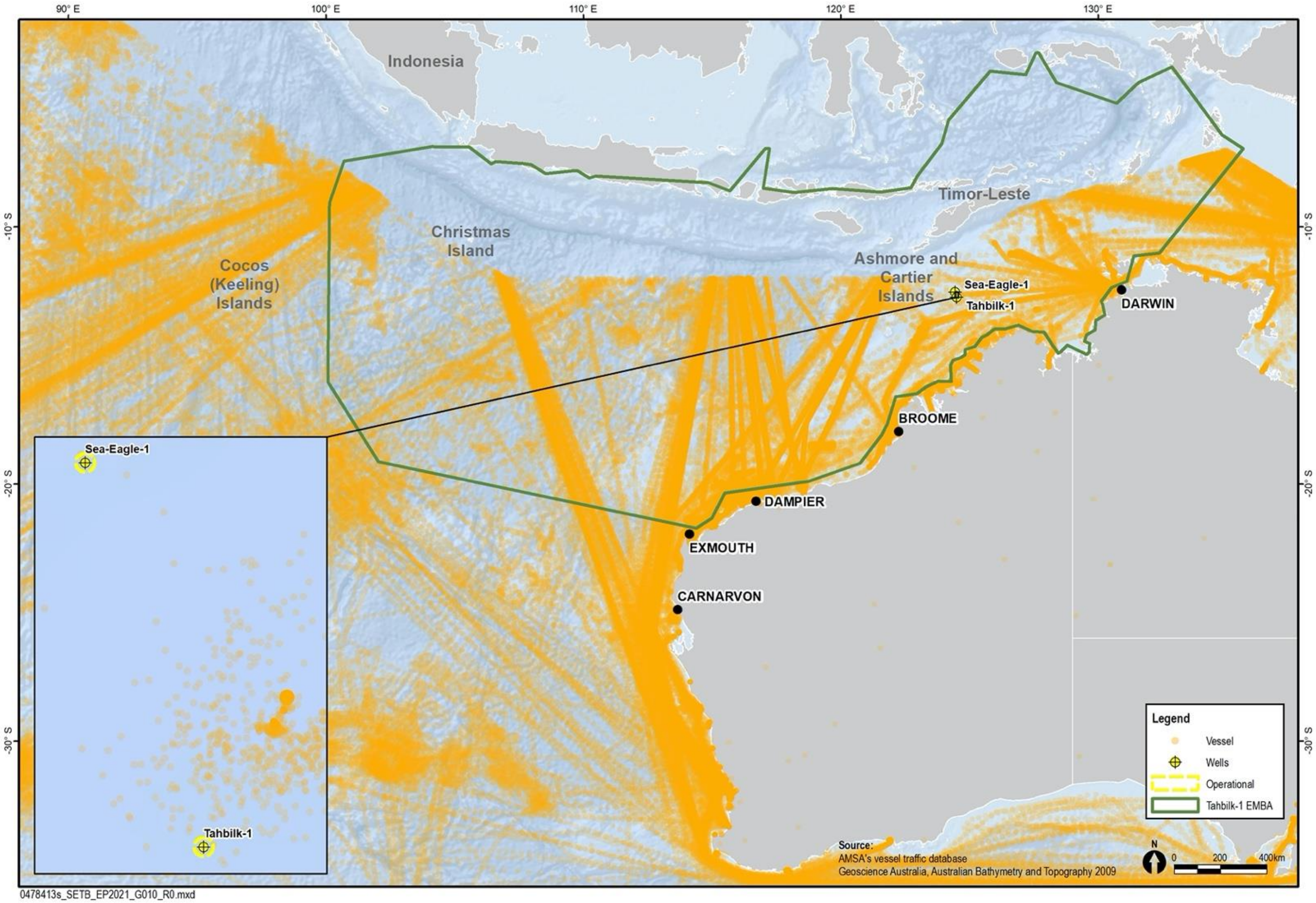


Figure 1-15: Shipping activity within the RISK EMBA (August 2021)

1.5.3 Oil and Gas Industry

There are numerous exploration and production oil and gas operators in the region. The closest to the WHP and subsea fields AC/L7 and AC/L8 include Auriga West 1 (Shell) and the Maple wells (PTTEP) which are 34 and 59 km away respectively. See Figure 1-16.

Table 1-22: Titleholders in vicinity of EMBA

Main Titleholder	Title blocks
Bounty Oil & Gas NL	AC/P32
Carnarvon Petroleum Limited	WA-523-P, AC/P62, AC/P63
Cornea Resources Pty Ltd	WA-54-R
ConocoPhillips Pty Ltd	WA-398-P, WA-315-P
Eni Australia Limited	AC/P21
Finder Exploration Pty Ltd	AC/P61, AC/P56, AC/P55, AC/P45
INPEX	AC/P36, WA-343-P, WA-56-R, WA-285-P
IPB Petroleum Limited	WA-471-P, WA-485-P
Murphy Australia Pty Ltd	AC/P57, AC/P59
Octanex Bonaparte Pty Ltd	WA-420-P
Santos Limited	WA-74-R, WA-274-P, WA-513-P, AC/P50
SGH Energy Pty Ltd	WA-377-P
Shell Australia	AC/P52, AC/P41, WA-44-L, AC/RL9, WA-371-P
Sinopec O&G Pty Ltd	AC/RL1
Timor Sea Oil & Gas Australia Pty Ltd	AC/L5
Total E&P Australia Exploration Pty Ltd	AC/P60

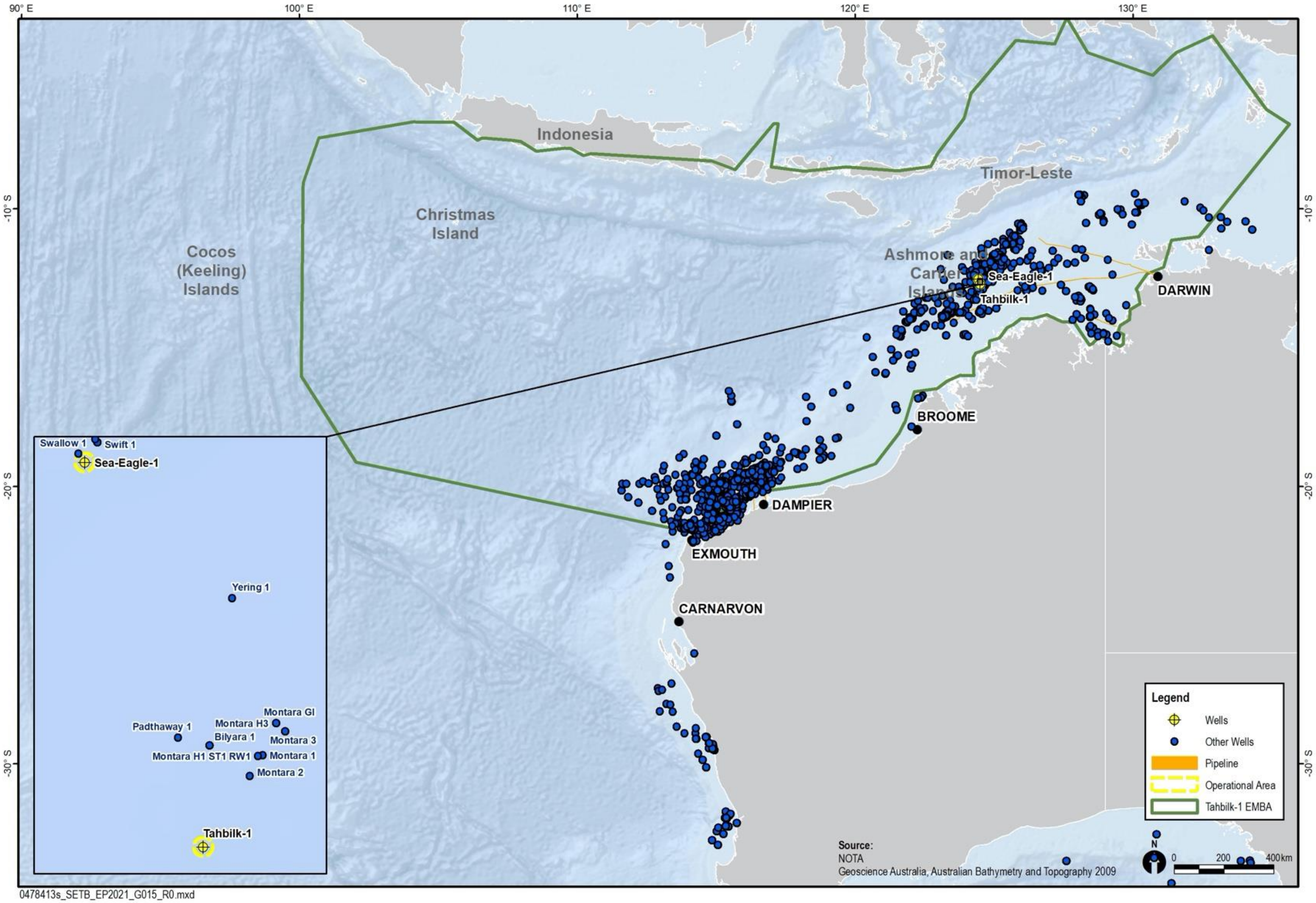


Figure 1-16 Oil and Gas Infrastructure within the RISK EMBA

1.5.4 Defence

The two closest defence training areas to the WHP and subsea fields AC/L7 and AC/L8 are the North Australian Exercise Area (NAXA) (approximately 370 km to the east) and the Curtin Air-to-Air Air Weapons Range (approximately 280 km south west). Defence estate also exists through the Kimberley shoreline.

1.5.5 Tourism

The tourism activities likely to occur within the RISK EMBA (e.g. recreational fishing and boating and charter boats operations) tend to be focussed around nearshore waters, islands and coastal areas. Some charter operations access islands and reefs (including Scott Reef, Ashmore Reef, Cartier Island and Ningaloo Reef) as part of regular itineraries.

Tourism is important to the economy and livelihood of Indonesia (ADB 2014) with particular tourist centres in Bali, Flores, Lombok, Komodo and the Gili Islands. Bali is one of the most popular holiday destinations for Western Australians, with the value estimated to be 30% of GDP. Tourists visit Bali and other Indonesian locations such as West Java and Jakarta to appreciate the culture, but also to enjoy the natural biodiversity found within them. The marine environment within these centres is a major attraction, with beach and coastal activities (snorkelling, surfing, diving and fishing) are common (ADB 2014).

Scuba diving is very popular in National Parks like Bali Barat and Komodo National Park because of the park's high marine biodiversity. The development of, largely marine-based, ecotourism is the main strategy to make the park self-financing and generate sufficient revenue through entrance fees and tourism licenses to cover operational and managerial costs.

Tourism in Timor-Leste represents a small percentage of the country’s economy at present, but the Government regards growth in tourism as critical to future economic development.

1.5.6 Population Centres

1.5.6.1 Australia

The nearest major population centres to the Operational Area are Broome and Darwin. The closest coastline to the Operational Area on the Australian mainland is the Kimberley Coast, which is sparsely populated.

1.5.6.2 Indonesia and Timor-Leste

The city of Kupang, the capital of the Indonesian province East Nusa Tenggara, is the closest major population centre to the Operational Area (~295 km). The city has a population of approximately 250,000 and supports a diverse range of industries including fishing, cement production and aquaculture. It is also an important focal point for the tourism industry.

Timor-Leste comprises the eastern half of the island of Timor, the nearby islands of Atauro and Jaco, and Oecusse, an exclave on the northwestern side of the island surrounded by Indonesian West Timor. The city of Suai is the closest major population area in Timor-Leste to the Operational Area.

1.5.7 Cultural Heritage

It has been recorded that Ashmore Reef Marine Park contains Indonesian artefacts and grave sites, and Ashmore lagoon is still accessed as a rest or staging area for traditional Indonesian fishers travelling to and from fishing grounds. The closest shipwreck is the Ann Millicent, approximately 110 km north-west of the Operational Area (DEWHA 2008b).

Within Australian waters and coastline that may be affected in the broader RISK EMBA, there are many places of cultural significance, including Registered Aboriginal Sites and communities (DPLH, 2019).

Along the Kimberley Coast and the Northern Territory there are many Native Title Determinations and Indigenous Land Use Agreements, including some that include sea country.

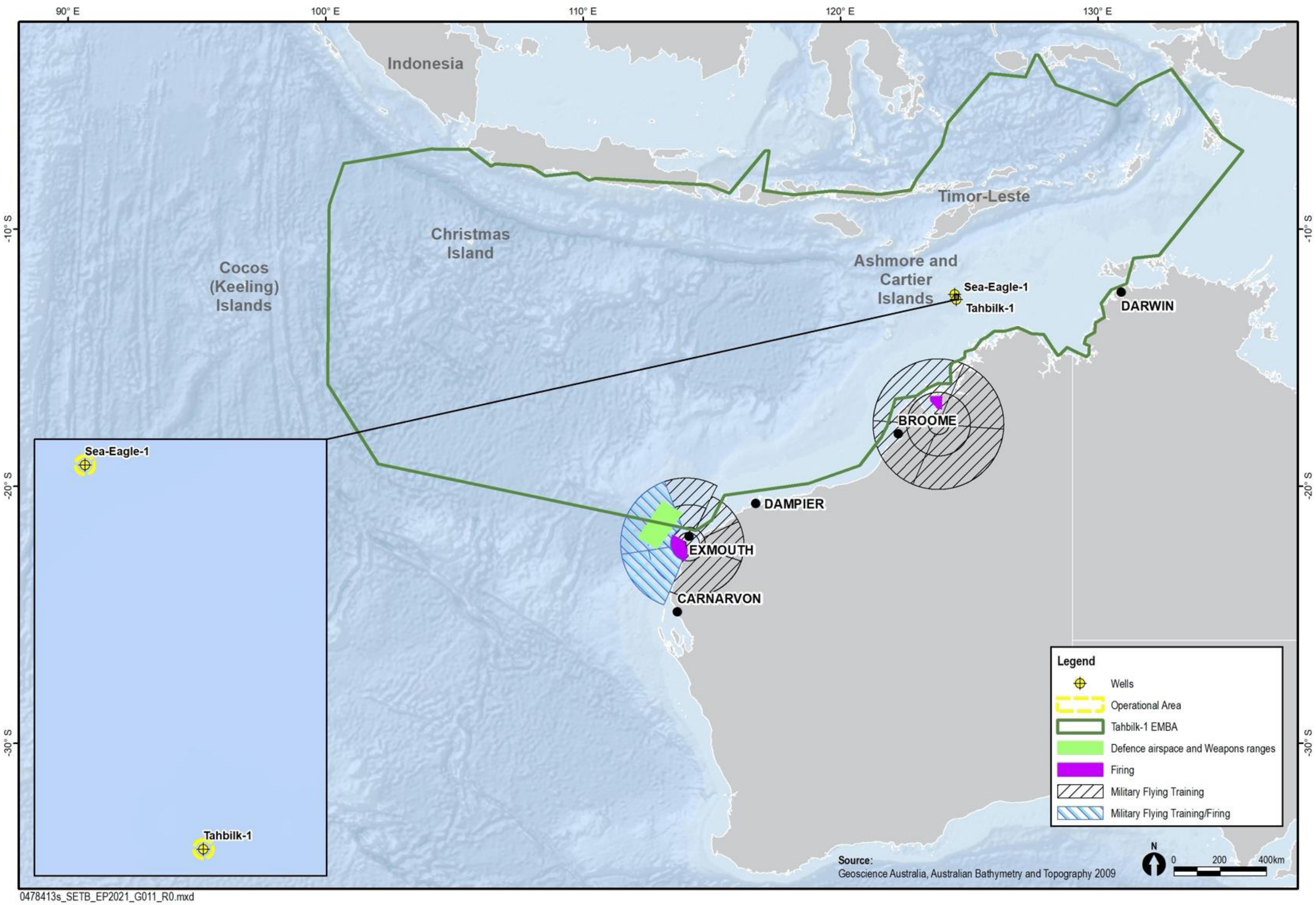


Figure-1-17 Defence Areas within the RISK EMBA

Sea Eagle-1 and Tahbilk-1 Vessel Based Activity Environment Plan

TM-50-PLN-I-00004

Rev 2

APPENDIX C - CONSULTATION

Appendix C – Consultation Report

1. INTRODUCTION

This Appendix outlines some additional detail underpinning the Relevant Person engagement undertaken in support of this EP. This appendix has been redacted prior to publishing to preserve the privacy of those persons or organisations consulted with. This can include the removal of personal information (as defined by the Privacy Act 1988) and the removal of any information that was provided during consultation where that person has requested for that information not to be published as per OPGGS(E) Regulations sub-regulation 11(A). Jadestone has made reasonable efforts to inform each relevant person consulted that they may request for particular information not to be published during all stages of the consultation.

The separate sensitive information report containing a log of all communications and copies of communications with relevant persons has not been published due to privacy reasons. Copies of the fact sheets provided during consultation are contained in Attachment 1 to this Appendix.

2. IDENTIFICATION OF RELEVANT PERSONS

2.1 Value mapping

Regulation 11A (1) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* identifies five groups as relevant persons who must be consulted with in the course of preparing an environment plan. The Beneficial Use/Value Mapping process involves listing the potential receptors (with a focus on socio-economic receptors) that may be affected by the proposed activity, and identifying the appropriate area of potential impact (which for this EP is the Operations Area as there is no spill risk potential and therefore no EMBA). Then this spatial area is used to determine relevant persons that may have functions, interests or activities in the area. This process was captured in a matrix (Table 1). The text below describes the scope of the search that was undertaken. In completing the value mapping process a number of parties (either self-identified or identified by Jadestone) were assessed against the relevant person criteria but were determined not to fulfill the requirements. For completeness these are listed below in Table 1.

<u>Marine-based Tourism and Recreation</u>

Recreational activities (including surfing, diving, recreational fishing and swimming) and tourism activities are very limited due to the remoteness of the location and lack of features in the operational area.

Fishing and dive charter operators provide deeper water recreational opportunities in offshore areas, such as the water depths around the operational area. A search of potential operations showed that Ashmore and Pandora reefs appear to the be closest targeted area, with very limited opportunities offered to these. With the sporadic nature of trips to this locale and the snagging/navigational hazard addressed through engagement with AHO engagement was conducted through the peak charter association of Western Australia and Northern Territory.

Table 1: Beneficial use and value mapping process

Potential Receptors	Potential impact or risk pathways	Area used to identify stakeholders	Known and Potential Risks that may affect a Relevant Person or has been identified by a relevant person	Relevant Persons Category a (Commonwealth), b (State or Territory) and c (Adjacent State or Territory)	Relevant Persons Category d (function, activity or interests that may be affected)	Relevant Persons Category e (any other person)
Aboriginal Heritage	No potential impact pathways identified from routine activities	Operational Area	There are no known sites of Aboriginal Heritage significance within the Operational Area. No identified risks from routine activities.	None identified	None identified	None identified
Aboriginal Heritage	LOWC release	LOWC spill EMBA	Shoreline oiling of sites	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		
Native Title	No potential impact pathways identified from routine activities	Operational Area	There are no known registered native title claims in the Operational Area No identified risks from routine activities.	None identified	None identified	None identified
Native Title	LOWC release	LOWC spill EMBA	Shoreline oiling of registered claim areas and associated cultural and socio-economic values	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		
Maritime Archaeological Heritage	No potential impact pathways identified from routine activities	Operational Area	There are no recorded historic shipwrecks or shipwreck protection zones within the Operational Area. No identified risks from routine activities.	None identified	None identified	None identified
Maritime Archaeological Heritage	LOWC release	LOWC spill EMBA	Shoreline, dissolved and entrained impact on maritime sites.	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		
Offshore Energy Exploration and Production	Displacement of or Interference of Third-party Vessels	Operational Area	There is no oil and gas infrastructure within the Operational Area. Adjacent titleholders included as courtesy.	• None identified	• Santos • Shell • Inpex	APPEA
Offshore Energy Exploration and Production	LOWC release	LOWC spill EMBA	Response assistance and safety considerations	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		
Tourism (including diving	Underwater sound from survey Accidental Discharges	Operational Area	Water depths exclude dive activities. Charter fishing may occur but unlikely.	None identified	• NT Guided Fishing Association • WAFIC	• None identified

Potential Receptors	Potential impact or risk pathways	Area used to identify stakeholders	Known and Potential Risks that may affect a Relevant Person or has been identified by a relevant person	Relevant Persons Category a (Commonwealth), b (State or Territory) and c (Adjacent State or Territory)	Relevant Persons Category d (function, activity or interests that may be affected)	Relevant Persons Category e (any other person)
and marine based activities)	Light impacts Displacement				•	
	LOWC release	LOWC spill EMBA	The King Island tourism sector is estimated to contribute just over 0.2% of the Tasmanian tourism output. It has a strong reputational link to pristine natural environment so potential socio-economic (reputational, income, loss of visual amenity) and economic impact due to loss of environmental values.	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		
Commercial Fisheries (Commonwealth)	Routine discharges Displacement of or interference with third-party vessels Introduction and establishment of Invasive Marine Species*	Operational Area	Some fisheries licenced to operate in the area with limited catch data	• Australian Fisheries Management Authority (AFMA) • Department of Agriculture, Water and the Environment – Biosecurity and Compliance • Department of Agriculture, Water and the Environment – Fisheries, Forestry and Engagement (Fisheries)	• Northern Prawn Fishery Industry Pty Ltd • Australian Council of Prawn Fisheries • Australian Southern Bluefin Tuna Industry Association • Western Tuna and Billfish Fisheries • Australian Fisheries Trade Association • Commonwealth Fisheries Association (CFA)	None identified
	LOWC release	LOWC spill EMBA	A number of Commonwealth Commercial Fishing licence holders have recorded catch and effort in the activity area. There is the potential for toxicology or direct impact to stocks.	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		
Commercial Fisheries (WA)	Routine discharges Displacement of or interference with third-party vessels	Operational Area	Commercial Fishing licence holders have recorded catch and effort in the operational area.	DPIRD	• Mackerel Managed Fishery (Area 1) (WA) (reviewed and no recent catch history so not deemed RP)	None identified

Potential Receptors	Potential impact or risk pathways	Area used to identify stakeholders	Known and Potential Risks that may affect a Relevant Person or has been identified by a relevant person	Relevant Persons Category a (Commonwealth), b (State or Territory) and c (Adjacent State or Territory)	Relevant Persons Category d (function, activity or interests that may be affected)	Relevant Persons Category e (any other person)
	Introduction and establishment of Invasive Marine Species*				• Northern Demersal Scalefish Fishery (WA) • Joint Authority Northern Shark Fishery (WA) (reviewed and no recent catch history so not deemed RP) • WAFIC	
	LOWC release	LOWC spill EMBA	A number of WA Commercial Fishing licence holders have recorded catch and effort in the EMBA. There is the potential for toxicology or direct impact to stocks.	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		
Commercial Fisheries (NT)	Routine discharges Displacement of or interference with third-party vessels Introduction and establishment of Invasive Marine Species	Operational Area	Not in NT waters but some vessels may transverse operational area	• Department of Primary Industry and Resources - Mines and Energy and Fisheries • Department of Environment and Natural Resources (NT)	• NT Seafood Council • Demersal Fishing Licence holders (NT) • Spanish Mackerel Managed Fishery (NT)	None identified
	LOWC release	LOWC spill EMBA	A number of NT Commercial Fishing licence holders have recorded catch and effort in the EMBA. There is the potential for toxicology or direct impact to stocks.	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		
Commercial Shipping	Displacement of or Interference of Third-party Vessels	Operational Area	Not a major shipping route but vessels may transverse	• Australian Hydrographic Office (AHO) • AMSA • Darwin Port Authority • Kimberley Port Authority (Port of Broome)	• Managed through AHO who issue notifications to individual companies and users	

Potential Receptors	Potential impact or risk pathways	Area used to identify stakeholders	Known and Potential Risks that may affect a Relevant Person or has been identified by a relevant person	Relevant Persons Category a (Commonwealth), b (State or Territory) and c (Adjacent State or Territory)	Relevant Persons Category d (function, activity or interests that may be affected)	Relevant Persons Category e (any other person)
	LOWC release	LOWC spill EMBA	Safety considerations	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance (xx insert ref)). Refer to OPEP.		
Defence activities	Displacement of or Interference of Third-party Vessels	Operational Area	Not a defence force area but activities may transverse	• Department of Defence	None identified	None identified
	LOWC release	LOWC spill EMBA	Safety considerations	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		
Recreational Vessels (including yachts)	Displacement of or Interference of Third-party Vessels	Operational Area	Recreational vessels utilising the activity area safety considerations	• Australian Hydrographic Office (AHO) • AMSA • Dept of Transport	• None identified	
	LOWC release	LOWC spill EMBA	Safety and amenity considerations	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		
Recreational Fishing	Displacement of or Interference of Third-party Vessels	Operational Area	Limited numbers due to remoteness and no shoreline	• DPIRD • Department of Environment and Natural Resources (NT)	• Recfishwest Amateur Fisherman's Association of the NT	None identified
	LOWC release	LOWC spill EMBA	Safety and amenity considerations	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		
Marine Parks	No potential impact pathways identified from routine activities	Operational Area	None	Director of National Parks (Parks Australia - Australia Marine Parks)	None identified	None identified

Potential Receptors	Potential impact or risk pathways	Area used to identify stakeholders	Known and Potential Risks that may affect a Relevant Person or has been identified by a relevant person	Relevant Persons Category a (Commonwealth), b (State or Territory) and c (Adjacent State or Territory)	Relevant Persons Category d (function, activity or interests that may be affected)	Relevant Persons Category e (any other person)
	LOWC release	LOWC spill EMBA	Impact on AMP values	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		
Biological Environment	No potential impact pathways identified from routine activities	Operational Area	Impact on biological values	None identified	None identified	None identified
	LOWC release	LOWC spill EMBA	Impact on biological values	Stakeholders identified for potential engagement should an unplanned spill event in accordance with NOPSEMA guidance. Refer to OPEP.		

3. FISHERIES STAKEHOLDER ASSESSMENT

3.1 Relevant person identification

A separate assessment of relevant fisheries was undertaken to identify which fisheries should be considered relevant parties (Table 2). The Operational Area overlapped by the jurisdiction of several Commonwealth and State-managed fisheries.

A summary of each of the fisheries is contained in Section 3.5.7 of the EP. To complete this summary in the EP the Commonwealth and State managed fisheries outlined above were researched further to identify actual fishing effort within the operational area over the last five years.

Fisheries were deemed to be relevant persons if they:

- Have jurisdiction to fish within the Operational Area;
- Have recent catch history within the Operational Area (within last 5 years); and
- Fishing methods would mean it was feasible to operate in the water depth or Operational Area.

Table 2: Fisheries Relevant Party Assessment

Jurisdiction	Name	Relevant party assessment?
Commonwealth	Western Tuna Billfish	✓ This fishery overlaps the Operations area. Commercial fishers will be potentially active in this region.
Commonwealth	Northwest slope fishery	✗ This fishery does not overlap the Operations area. The fishery does overlap the EMBA and should be considered relevant for EMBA acknowledgement and consideration in the event of a significant hydrocarbon spill.
Commonwealth	Southern Bluefin tuna	✗ There is no effort in WA. However, the spawning grounds for this fishery occur off the northwest of WA and this fishery should be considered in the event of a significant hydrocarbon spill. The industry association for this fishery has been contacted for consultation.
Commonwealth	Western Skipjack Fishery	✗Effort within this fishery is mainly confined to the southern coast of Australia. No fishing effort has been recorded since the 2008-2009 season and so there is no expected effort. Management arrangements are currently under review.
WA	Mackerel managed fishery (Area 1)	✓ This fishery overlaps the Operations area. No recorded fishing effort in the operational area grid cells for last 5 years.
WA	Northern shark fishery-joint authority	✓ This fishery overlaps the Operations area. No recorded fishing effort in the operational area grid cells for last 5 years.
WA	Northwest demersal scalefish managed fishery	✓ This fishery overlaps the Operations area. Commercial fishers will be potentially active in this region.
WA	Specimen shell managed fishery	✗ This fishery is primarily a dive and hand collect fishery, which excludes many operators, and there are no ROV fishers active in the area.
WA	Abalone managed fishery	✗ This fishery does not overlap the Operations area
WA	Kimberly prawn fishery	✗ Whilst the fishery overlaps the Operations area effort occurs in the coastal areas and does not overlap the Operations area.
WA	Pearl oyster fishery Zone 3	✗ This fishery is primarily a dive and hand collect fishery, which excludes many operators, and there are no ROV fishers active in the area. However, the industry association for this fishery has been contacted for consultation.

Jurisdiction	Name	Relevant party assessment?
WA	Mackerel managed fishery (Area 2) Marine aquarium fish managed fishery North coast shark fishery Nicol Bay Prawn Onslow Prawn Pearl oyster zone 4 Pilbara line Pilbara trap Pilbara fish trawl West coast deep sea crustacean managed fishery Beche der mer Broome managed prawn Trochus	✗ These fisheries do not overlap the Operations area.
NT	Coastal Line Fishery Coastal Net Fishery Spanish Mackerel Fishery Offshore Net and Line Fishery Demersal Fishery Barramundi Fishery Mud Crab Fishery Aquarium Fish/Display Fishery Trepang Fishery Timor Reef Fishery Fishing Tour Operator Fishery	✗ These fisheries do not overlap the Operations area.

3.2 Responding to merits of objections or claims

In assessing the consultative feedback a number of considerations need to be made, often depending on the response received. Jadestone implemented the following approach when determining if further follow-up was required regarding correspondence with relevant persons:

No response: Where no response has been received from the relevant person, Jadestone needs to have strong grounds for accepting the relevant person had no response or feedback. The lack of a response can be a function of insufficient time, not understanding the material, not having received the material, etc. Jadestone endeavours to always remind relevant persons of the process at least once prior to deeming it no response. With only a mailing address available for fishers a reminder was not sent to licence holders to reduce stakeholder fatigue. The additional consultation through WAFIC and other representative bodies was considered in determining a no response for this sector.

No issues: Where a relevant person has responded to consultative information and has no concerns or questions regarding the proposed activity, often this allows Jadestone to consider the consultative process for that relevant person and activity to have been satisfactorily closed out and no further follow up for a response required.

Clarification: Where a relevant person sought further information or clarification of information received, this was an opportunity to confirm acceptance of proposed activity and arrangements or if there are any issues that can be identified or may arise.

Objection: Where a relevant person raised an objection regarding the proposed activity, Jadestone representatives sought to understand the issue(s) held by the relevant person and undertake to negotiate arrangements that satisfy both parties. Negotiation processes in the instance an objection was raised were achieved through discussion with the direct parties involved.

For all responses received by Jadestone during the engagement, the merit of each of these responses was assessed. Assessment of merit for all other responses is found in Table 1 of the Sensitive Information Report.

3.3 Record keeping

All activities pertaining to relevant person consultation, including actions and commitments, are recorded and tracked using Jadestone's stakeholder management tool. The live consultation log that is systematically updated as consultation activities are undertaken. Jadestone's stakeholder engagement practice is to keep ongoing records of engagement with stakeholders, as such this practice will be continued post EP submission.

Attachment 1: Fact Sheets

Invitation for Consultation
Montara Field Wellhead Abandonment and Monitoring

Invitation for Consultation

Jadestone Energy (Jadestone) is the operator of the existing Montara Field in the Timor Sea. Jadestone is preparing for assessment by the National Offshore Petroleum Regulatory Authority (NOPSEMA) two Environment Plans for the

- ***activity associated with monitoring of 2 wellheads (Sea Eagle-1 and Tahbilk-1); and***
- ***the permanent abandonment of 4 wellheads (Montara-1, Montara-2, Montara-3 and Skua-1) proposed to be left in-situ.***

We invite you to provide comment for consideration in this process.

Jadestone Energy (Jadestone) is an Asia Pacific based oil and gas exploration and production company listed on the AIM market of the London Stock Exchange (JSE).

What is an Environment Plan?

The purpose of an Environment Plan (EP) is to identify the proposed petroleum activity's impacts on and risks to the receiving environment. The EP also sets out measures to reduce identified environmental impacts and risks due to the activity and describe how and to what level of performance those measures will be implemented throughout the activity; this includes emergency situations. There will be two EPs covering:

- The Sea Eagle-1 and Tahbilk-1 vessel-based activity EP will describe the proposed ongoing monitoring of the wellheads by annual surveys and the installation of a remote monitoring system.
- The Montara and Skua-1 Wellhead abandonment EP will describe the potential impacts of leaving the four wellheads in situ, no further activity is required as the wells are confirmed to be plugged and abandoned as per the NOPSEMA accepted Wellhead Operations and Management Plan (WOMP).

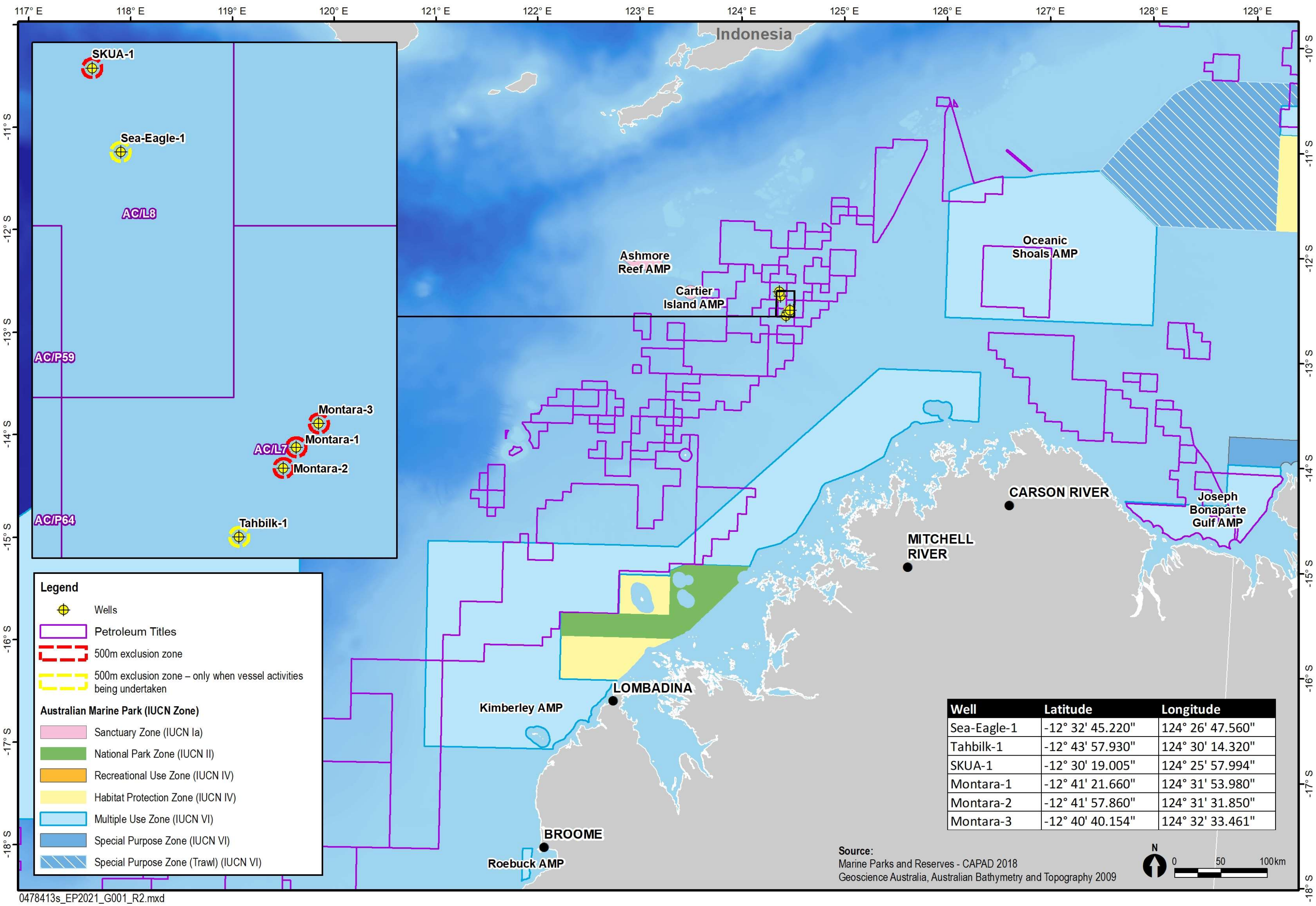
Location

The Montara development is located in the Timor Sea, approximately 690 km west of Darwin (Figure 1). The permit areas AC/L7 (Montara wells and Tahbilk-1) and AC/L8 (Skua-1 and Sea Eagle-1) are in Australian waters. All operational activities managed under the EP are in ~72–90 m water depth. Location details are shown on Figure 1, including key features in the area. The distance to Australian Marine Parks is summarised in Table 1.

Table 1: Distance to Australian Marine Parks (AMPs)

Australian Marine Park	Minimum distance from Wellheads
Ashmore AMP	131.9km
Cartier AMP	89.5km
Kimberley AMP	108.3km

In the event of an accidental event (e.g. hydrocarbon spill), the values in a broader Environment that May be Affected (EMBA) have been identified to enable key habitats or locations of particular value to be responded to as protection priorities. There is no risk of a loss of hydrocarbons from the Montara or Skua-1 wellheads.



Well	Latitude	Longitude
Sea-Eagle-1	-12° 32' 45.220"	124° 26' 47.560"
Tahbilk-1	-12° 43' 57.930"	124° 30' 14.320"
SKUA-1	-12° 30' 19.005"	124° 25' 57.994"
Montara-1	-12° 41' 21.660"	124° 31' 53.980"
Montara-2	-12° 41' 57.860"	124° 31' 31.850"
Montara-3	-12° 40' 40.154"	124° 32' 33.461"

Figure 1 – Location map

Sea Eagle-1 (AC/L8) was drilled and subsequently suspended with cement plugs in 2008, and Tahbilk-1 (AC/L7) in 1990. The wellheads sit between 3.1 and 4.3m above the seafloor. Both exploration wells were shut in and suspended with no gauges or pressure monitoring, therefore annual ROV surveillance has been used to visually check for any indications of mechanical damage (or change), or emission of fluids or gas that would indicate a barrier has failed. No indications have been noted. Jadestone proposes to continue surface vessel inspection surveys until a remote monitoring system is installed which will then require ongoing data retrieval, monitoring and maintenance. These monitoring activities are vessel-based and will involve:

Activity	Duration	Timing
Surface vessel inspection on location, no intervention at wellhead	<0.5 days	Frequently (up to every 2 weeks)
ROV survey visual inspection	1 day	Annually
Monitoring system installation	21 days for 24hr/day	2023
Ongoing data retrieval via vessel	<1 day	Frequently (up to every 2 weeks)
Ongoing monitoring and maintenance	<1 week per well	Annually (possible ROV[1])

These activities are proposed to monitor for any hydrocarbons whilst the future of these wells is determined.

The Sea Eagle-1 and Tahbilk-1 EP will be valid for up to five years to allow for the annual monitoring, installation of the remote monitoring system, and ongoing monitoring and maintenance.

Risks and Impacts

Risks from this activity are those associated with vessel movements on the surface. As the wellheads have not been permanently abandoned, the EP will also consider the risk of loss of well control.

Unplanned risks	
Vessel collision	During vessel-based activity in the field (e.g. monitoring system installation and data retrieval), a 500 m petroleum safety zone will be implemented around the vessel(s) and communicated via Notice to Mariners. No fishing vessels are to enter this zone.
Hydrocarbon spill	• Oil Pollution Emergency Plan • Appropriate vessel spill response plans, equipment and materials will be in place and maintained • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment
Introduced Marine Species (IMS)	• IMS Management will meet legal requirements and reduce risks to ALARP and Acceptable levels.

[1] ROV – remotely operated vehicle

Abandonment Environment Plan

The drilling of Montara-1 (AC/L7), Montara-2 (AC/L7), Montara-3 (AL/L7) occurred between 1988 and 2002. These wells have been formally abandoned, with both the primary and secondary barriers verified as per the NOPSEMA accepted well operations management plan (WOMP) (accepted 22/06/21). Skua-1 (AC/L8) was drilled and abandoned in 1974. The abandonment was approved by the regulator at the time, with no WOMP required. No further activities are proposed on these wellheads, with the wellheads remaining in-situ indefinitely at 4.4 m, 4.1 m, 2.8 m and 1.08 m, respectively, from the seafloor.

Jadestone is seeking permanent abandonment of the four wellheads in situ. Once the EP has been accepted, it will be closed out and no further activities will occur under this EP.

Risks and Impacts

Interference with fishing equipment due to the infrastructure left on the seafloor has been identified as the key risk. There is no risk of damage to the wellhead due to any interaction. Jadestone understands from the Department of Primary Industry and Resources that the **Northern Demersal Scalefish** is the only state managed fishery active since 2016 in the two 10 nautical mile grids where the wellheads are located. Other fisheries that are licensed to operate and were assessed as having a potential to utilise this area in the future (based on catch history over the last 5 years) include:

- Western Tuna and Billfish (Commonwealth)
- North West Slope Trawl Fishery (Commonwealth)
- Mackerel Fishery (Western Australia)

Unplanned risks	
Interference with fishing equipment and/or snagging	There is currently no Petroleum Safety Zones or exclusion zones around any of the wellheads listed, and the wellheads are marked on nautical charts and will continue to be in the future. A cautionary zone of 2.5 nautical mile radius is maintained around subsea structures including the wellheads. 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.

Providing Feedback

If you would like to comment on the proposed activities outlined in this fact sheet or would like additional information, please contact Jadestone before 20 September 2021.

Email: consult@jadestone-energy.com
Phone: 08 9486 6600

L8, 1 William Street, Perth, Western Australia, 6000

In September 2021 we are moving to:
The Atrium, Level 2, 168 St Georges Terrace, Perth WA 6000

Invitation for Consultation
Montara Field Wellhead Abandonment and Monitoring

Fishing sector

Invitation for Consultation

Jadestone Energy (Jadestone) is the operator of the existing Montara Field in the Timor Sea. Jadestone is preparing for assessment by the National Offshore Petroleum Regulatory Authority (NOPSEMA) two Environment Plans for the

- ***activity associated with monitoring of 2 wellheads (Sea Eagle-1 and Tahbilk-1); and,***
- ***the permanent abandonment of 4 wellheads (Montara-1, Montara-2, Montara-3 and Skua-1) proposed to be left in-situ.***

We invite you to provide comment for consideration in this process.

Jadestone Energy (Jadestone) is an Asia Pacific based oil and gas exploration and production company listed on the AIM market of the London Stock Exchange (JSE).

What is an Environment Plan?

The purpose of an Environment Plan (EP) is to identify the proposed petroleum activity's impacts on and risks to the receiving environment. The EP also sets out measures to reduce identified environmental impacts and risks due to the activity and describe how and to what level of performance those measures will be implemented throughout the activity; this includes emergency situations. There will be two EPs covering:

- The Sea Eagle and Tahbilk vessel based activity EP will describe the proposed ongoing monitoring of the wellheads by annual surveys and the installation of a remote monitoring system.
- The Montara and Skua Wellhead abandonment EP will describe the potential impacts of leaving four wellheads in situ, no further activity is required as the wells are confirmed to be plugged and abandoned as per the NOPSEMA accepted WOMP.

Location

The Montara development is located in the Timor Sea, approximately 690 km west of Darwin (Figure 1). The permit areas AC/L7 (Montara wells and Tahbilk-1) and AC/L8 (Sea Eagle-1 and Skua-1) are in Australian waters.

All operational activities managed under the EP are in ~72-90 m water depth. Location details are shown on Figure 1.

In the event of an accidental event (e.g. hydrocarbon spill), the values in a broader Environment that May be Affected (EMBA) have been identified to enable key habitats or locations of particular value in the region to be responded to as protection priorities. There is no risk of a loss of hydrocarbons from the Montara or Skua wellheads.

"Jadestone Energy is committed to preventing all health, safety and environmental incidents and complying with all regulatory requirements. Incidents of this nature are preventable, and we will strive to operate in a way that does not harm the environment."

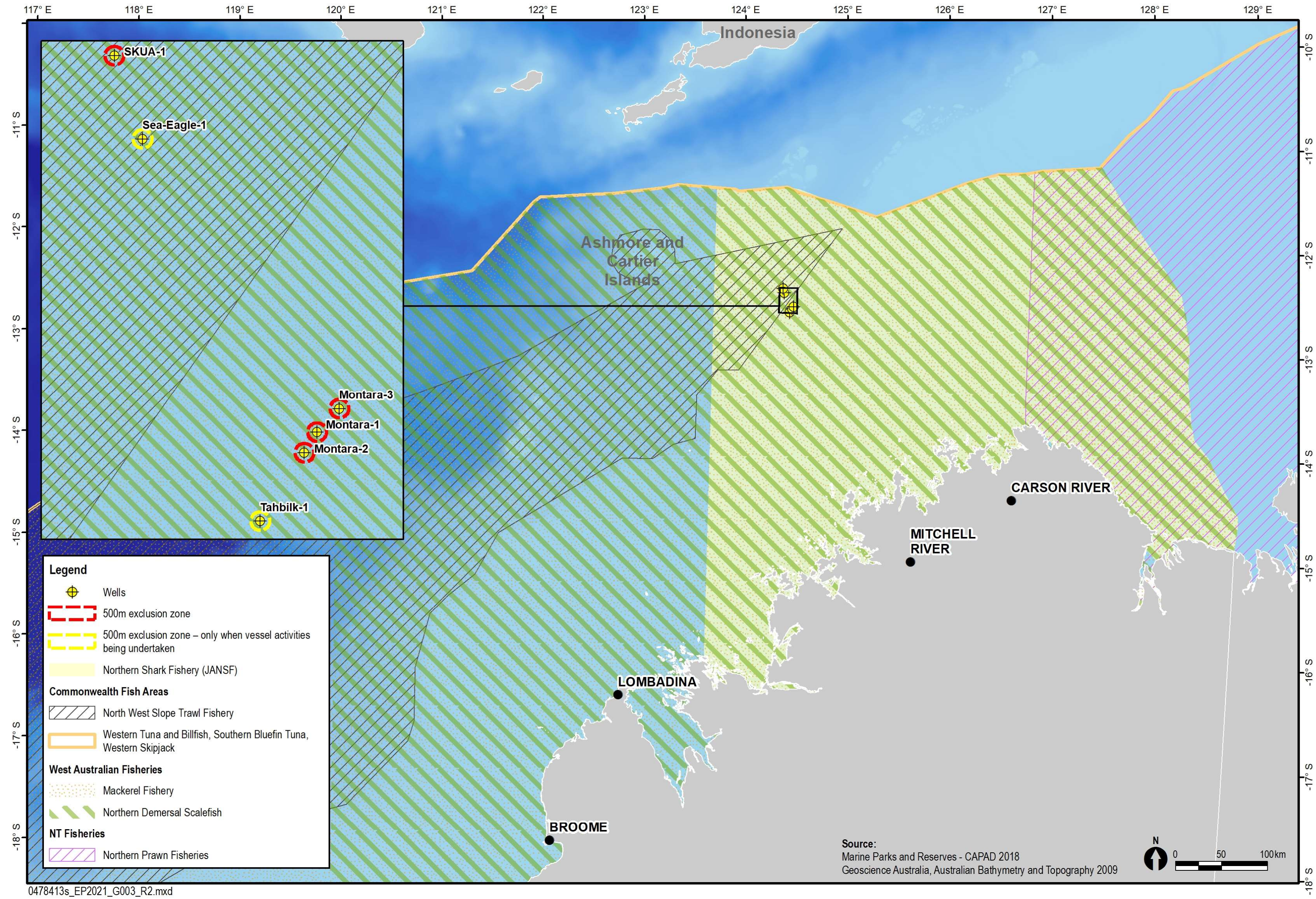


Figure 1 – Location and fisheries that may utilise the Operations Area

What fisheries may be affected?

As Figure 1 indicates, there are a number of fisheries permitted to operate in the operations area. However, Jadestone understands from the Department of Primary Industry and Resources that the **Northern Demersal Scalefish** is the only state managed fishery active since 2016 in the two 10 nM grids where the wellheads are located. Other fisheries that are licensed to operate and were assessed as having a potential to utilise this area in the future (based on catch history over the last 5 years) include:

- **Western Tuna and Billfish (Commonwealth)**
- **North West Slope Trawl Fishery (Commonwealth)**
- **Mackerel Fishery (WA)**

These fisheries will be Jadestone's focus for consultation. Consultation for other fisheries regarding the development of the EP will take place through notification of State and Commonwealth representative bodies. In the unlikely event of a hydrocarbon spill, Jadestone will conduct extensive and immediate consultation with other fisheries licensed to operate within the broader Environment that May be Affected.

Vessel Based Activity Environment Plan

Sea Eagle-1 (AC/L8) was drilled and subsequently suspended with cement plugs in 2008, and Tahbilk-1 (AC/L7) in 1990. The wellheads sit between 3.1-4.3m from the seafloor. Both exploration wells were shut in and suspended with no gauges or pressure monitoring, therefore annual ROV surveillance has been used to visually check for any indications of mechanical damage (or change), or emission of fluids or gas that would indicate a barrier has failed. No indications have been noted. Jadestone proposes to continue surface vessel inspections surveys until a remote monitoring system is installed which will then require ongoing data retrieval, monitoring and maintenance. These monitoring activities are vessel-based and will involve:

Activity	Duration	Timing
Surface vessel inspection on location, no intervention at wellhead	<0.5 days	Frequently (up to every 2 weeks) until RMS installed
ROV survey visual inspection	1 day	Annually
Monitoring system installation	21 days for 24hr/day	2023
Ongoing Data retrieval via vessel	<1 day	Frequently (up to every 2 weeks)
Ongoing monitoring and maintenance	<1 week per well	Annually (possible ROV[1])

These activities are proposed to monitor for any hydrocarbons whilst the future of these wells is determined. The Sea Eagle-1 and Tahbilk-1 EP will be valid for up to five years to allow for the annual monitoring, RMS installation and ongoing monitoring and maintenance.

[1] ROV – remotely operated vehicle

Risks and Impacts to Fishers

Risks from this activity are those associated with vessel movements on the surface. As the wellheads have not been permanently abandoned, the EP will also consider the risk of loss of well control.

Unplanned risks	
Vessel collision	During vessel-based activity in the field (e.g. monitoring system installation and data retrieval), a 500 m PSZ will be implemented around the vessel(s) and communicated via Notice to Mariners. No fishing vessels are to enter this zone.
Hydrocarbon spill	• Oil Pollution Emergency Plan • Appropriate vessel spill response plans, equipment and materials will be in place and maintained • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment
Introduced Marine Species (IMS)	• IMS Management will meet legal requirements and reduce risks to ALARP and Acceptable levels.

Abandonment Environment Plan

The drilling of Montara-1 (AC/L7), Montara-2 (AC/L7), Montara-3 (AL/L7) occurred between 1988 and 2002. These wells have been formally abandoned, with both the primary and secondary barriers verified as per the NOPSEMA accepted WOMP (accepted 22/06/21). Skua-1 (AC/L8) was drilled and abandoned in 1974. The abandonment was approved by the regulator at the time, with no WOMP required. No further activities are proposed on these wellheads with the wellheads remaining in-situ indefinitely at 4.4 m, 4.1m, 2.8m and 1.08m respectively from the seafloor.

Jadestone is seeking permanent abandonment of the four wellheads in situ and therefore once the EP is accepted, it will be closed out and no further activities required under the EP.

Risks and Impacts to Fishers

Interference with fishing equipment due to the infrastructure left on the seafloor has been identified as the key risk to fishing operations. There is no risk of damage to the wellhead due to any interaction.

Unplanned risks	
Interference with fishing equipment and/or snagging	There is currently no Petroleum Safety Zones (PSZ) or exclusion zones around any of the wellheads, however the wellheads are marked on nautical charts and will continue to be going forward. A cautionary zone of 2.5 NM radius is maintained around subsea structures including the wellheads. 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.

Providing Feedback

If you would like to comment on the proposed activities outlined in this fact sheet or would like additional information, please contact Jadestone before 20 September 2021.

Email: consult@jadestone-energy.com **Phone: 08 9486 6600**

L8, 1 William Street, Perth, Western Australia, 6000

In September 2021 we are moving to:
The Atrium, Level 2, 168 St Georges Terrace, Perth WA 6000

Sea Eagle-1 and Tahbilk-1 Vessel Based Activity Environment Plan

TM-50-PLN-I-00004

Rev 2

APPENDIX D - PMST OPERATIONAL AREA

Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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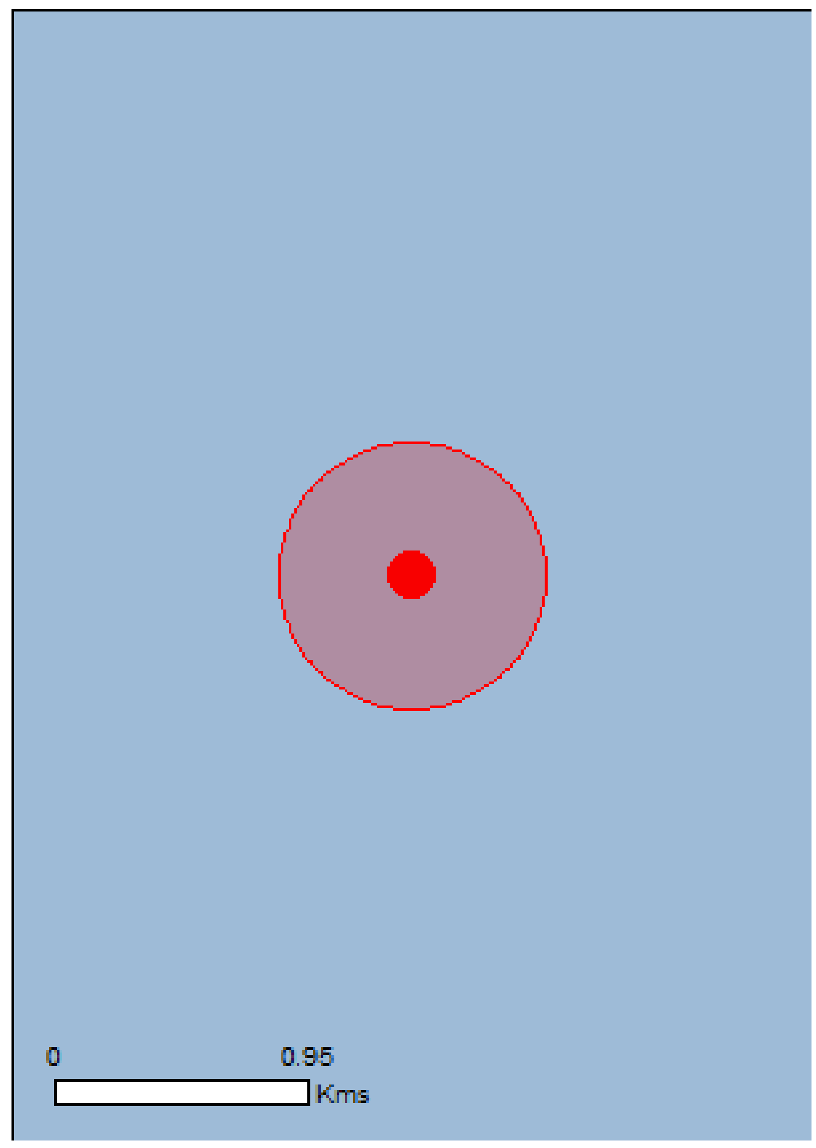
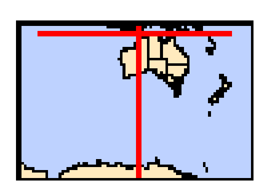


Coordinates

Buffer: 0.5Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	19
Listed Migratory Species:	33

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	59
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		

Name	Status	Type of Presence
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		

Name	Threatened	Type of Presence
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Caveat
The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

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- marine

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- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

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- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-12.54589 124.44654

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
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-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government

Department of Agriculture, Water and the Environment

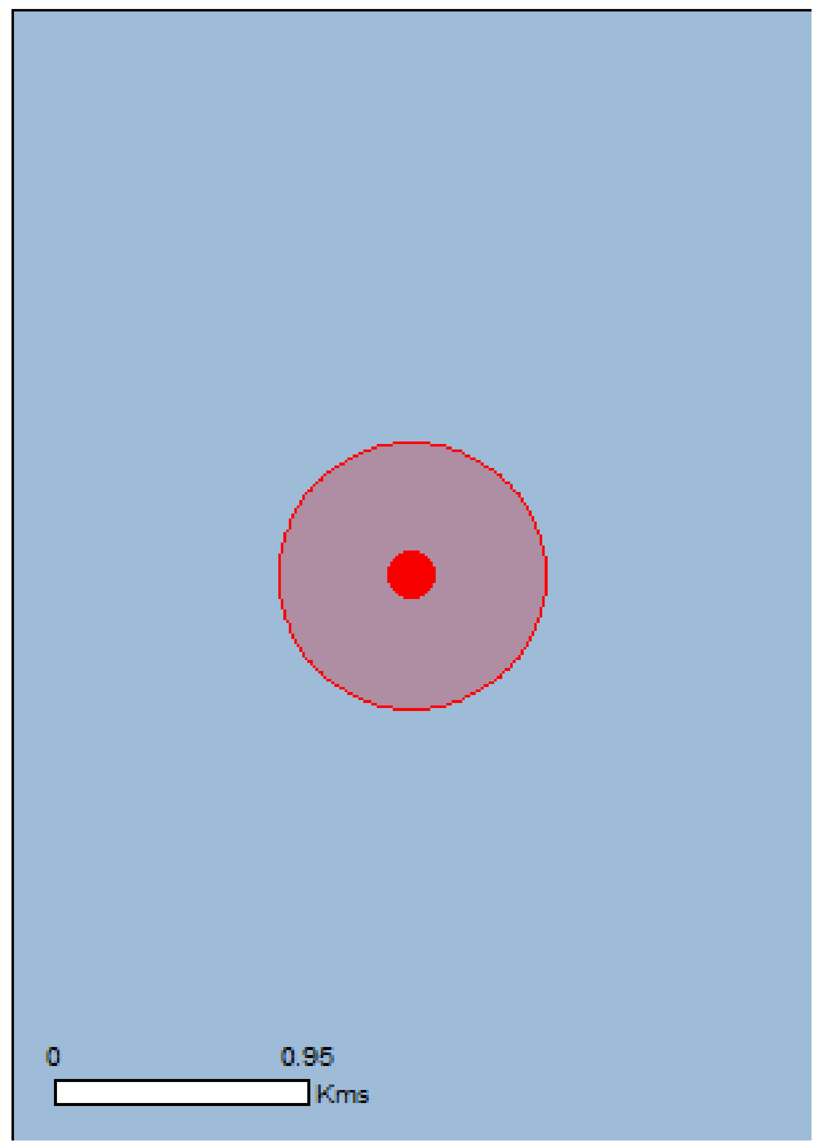
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

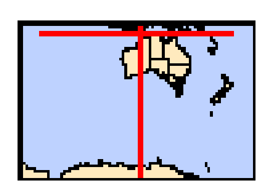
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 19/08/21 12:18:02



Coordinates

Buffer: 0.5Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	19
Listed Migratory Species:	33

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	58
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		

Name	Status	Type of Presence
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations)		
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus		
Common Noddy [825]		Species or species habitat may occur within area
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris acuminata		
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Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
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Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		

Name	Threatened	Type of Presence
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		

Name	Status	Type of Presence
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat may occur within area
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- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

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Coordinates

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-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
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-Royal Botanic Gardens and National Herbarium of Victoria
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-Western Australian Herbarium
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-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Sea Eagle-1 and Tahbilk-1 Vessel Based Activity Environment Plan

TM-50-PLN-I-00004

Rev 2

APPENDIX E - PMST RISK EMBA

Australian Government
Department of Agriculture, Water and the Environment

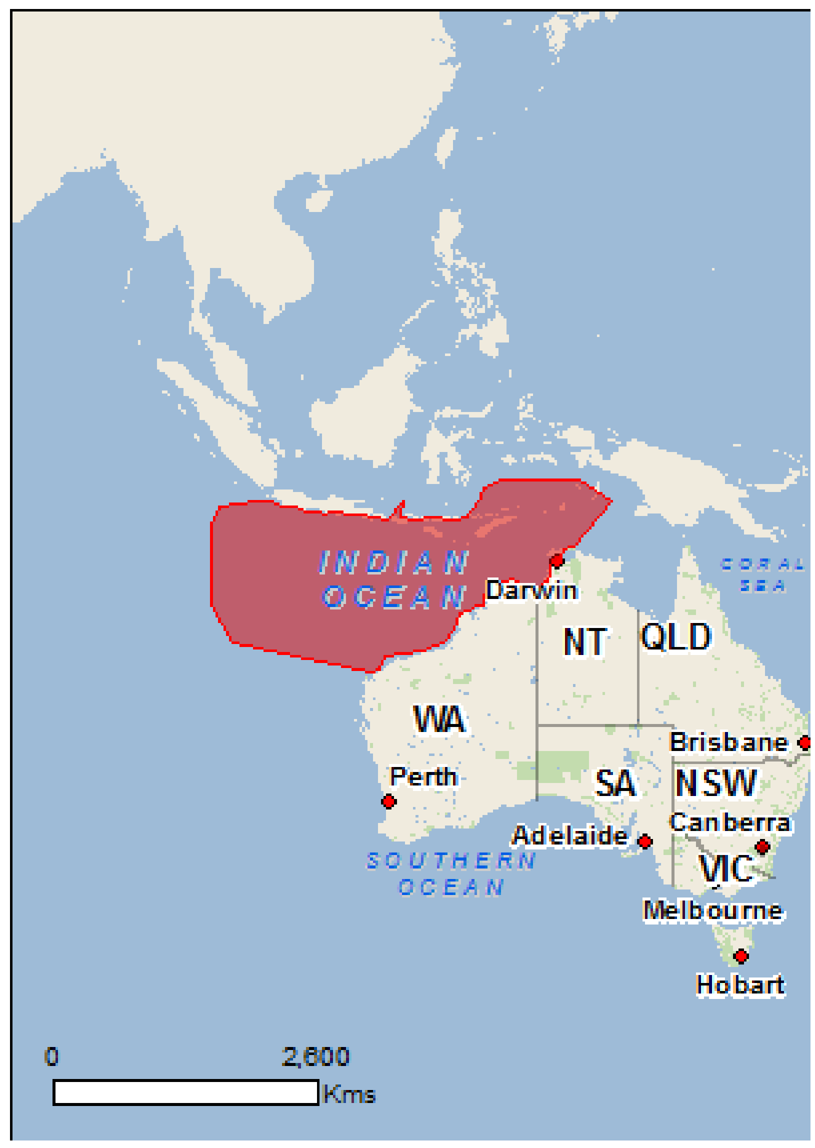
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 17/08/21 16:26:12



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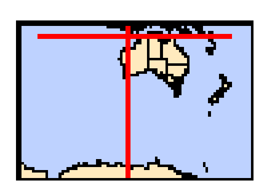

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	2
Wetlands of International Importance:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	83
Listed Migratory Species:	77

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	4
Commonwealth Heritage Places:	16
Listed Marine Species:	145
Whales and Other Cetaceans:	32
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	1
Australian Marine Parks:	23

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	23
Regional Forest Agreements:	None
Invasive Species:	32
Nationally Important Wetlands:	7
Key Ecological Features (Marine)	16

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
The Ningaloo Coast	WA	Listed place
The West Kimberley	WA	Listed place

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Ashmore reef national nature reserve	Within Ramsar site
Hosnies spring	Within Ramsar site
Ord river floodplain	Within Ramsar site
The dales	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North
North-west

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Accipiter hiogaster natalis Christmas Island Goshawk [82408]	Endangered	Species or species habitat known to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat likely to occur within area
Chalcophaps indica natalis Christmas Island Emerald Dove, Emerald Dove (Christmas Island) [67030]	Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Breeding known to occur within area
Geophaps smithii blaauwi Partridge Pigeon (western) [66501]	Vulnerable	Species or species habitat likely to occur within area
Geophaps smithii smithii Partridge Pigeon (eastern) [64441]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Melanodryas cucullata melvillensis Tiwi Islands Hooded Robin, Hooded Robin (Tiwi Islands) [67092]	Critically Endangered	Species or species habitat known to occur within area
Mirafra javanica melvillensis Horsfield's Bushlark (Tiwi Islands) [81011]	Vulnerable	Species or species habitat known to occur within area
Ninox natalis Christmas Island Hawk-Owl, Christmas Boobook [66671]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Breeding likely to occur within area
Pterodroma arminjoniana Round Island Petrel, Trinidade Petrel [89284]	Critically Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Turdus poliocephalus erythropleurus Christmas Island Thrush [67122]	Endangered	Species or species habitat likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely to occur within area
Tyto novaehollandiae melvillensis Tiwi Masked Owl, Tiwi Islands Masked Owl [26049]	Endangered	Species or species habitat known to occur within area
Mammals		
Antechinus bellus Fawn Antechinus [344]	Vulnerable	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat known to occur within area
Crocidura trichura Christmas Island Shrew [86568]	Critically Endangered	Species or species habitat likely to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat known to occur

Name	Status	Type of Presence
		within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesembriomys gouldii gouldii Black-footed Tree-rat (Kimberley and mainland Northern Territory), Djintamoonga, Manbul [87618]	Endangered	Species or species habitat may occur within area
Mesembriomys gouldii melvillensis Black-footed Tree-rat (Melville Island) [87619]	Vulnerable	Species or species habitat known to occur within area
Petrogale concinna canescens Nabarlek (Top End) [87606]	Endangered	Species or species habitat may occur within area
Petrogale concinna monastria Nabarlek (Kimberley) [87607]	Endangered	Species or species habitat likely to occur within area
Phascogale pirata Northern Brush-tailed Phascogale [82954]	Vulnerable	Species or species habitat known to occur within area
Pteropus natalis Christmas Island Flying-fox, Christmas Island Fruit-bat [87611]	Critically Endangered	Roosting known to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area
Sminthopsis butleri Butler's Dunnart [302]	Vulnerable	Species or species habitat known to occur within area
Trichosurus vulpecula arnhemensis Northern Brushtail Possum [83091]	Vulnerable	Species or species habitat known to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat known to occur within area
Plants		
Asplenium listeri Christmas Island Spleenwort [65865]	Critically Endangered	Species or species habitat known to occur within area
Burmannia sp. Bathurst Island (R.Fensham 1021) [82017]	Endangered	Species or species habitat likely to occur within area
Hoya australis subsp. oramicola a vine [55436]	Vulnerable	Species or species habitat known to occur within area
Mitrella tiwiensis a vine [82029]	Vulnerable	Species or species habitat likely to occur within area
Pneumatopteris truncata fern [68812]	Critically Endangered	Species or species habitat known to occur within area
Tectaria devexa [14767]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Typhonium jonesii a herb [62412]	Endangered	Species or species habitat known to occur within area
Typhonium mirabile a herb [79227]	Endangered	Species or species habitat known to occur within area
Xylopia monosperma a shrub [82030]	Endangered	Species or species habitat known to occur within area
Reptiles		
Acanthophis hawkei Plains Death Adder [83821]	Vulnerable	Species or species habitat likely to occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Cryptoblepharus egeriae Christmas Island Blue-tailed Skink, Blue-tailed Snake-eyed Skink [1526]	Critically Endangered	Species or species habitat likely to occur within area
Cyrtodactylus sadleiri Christmas Island Giant Gecko [86865]	Endangered	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Lepidodactylus listeri Christmas Island Gecko, Lister's Gecko [1711]	Critically Endangered	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Ramphotyphlops exocoeti Christmas Island Blind Snake, Christmas Island Pink Blind Snake [1262]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Breeding known to occur within area

Name	Status	Type of Presence
Glyphis glyphis Speartooth Shark [82453]	Critically Endangered	Species or species habitat known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat may occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Breeding known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area

Name	Threatened	Type of Presence
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat known to occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat likely to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius phaeopus		
Whimbrel [849]		Species or species habitat likely to occur within area
Pandion haliaetus		
Osprey [952]		Breeding known to occur within area
Pluvialis squatarola		
Grey Plover [865]		Species or species habitat likely to occur within area
Thalasseus bergii		
Greater Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Christmas Island National Park
Defence - BRADSHAW FIELD TRAINING AREA
Defence - MT GOODWIN RADAR SITE

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ashmore Reef National Nature Reserve	EXT	Listed place
Bradshaw Defence Area	NT	Listed place
Christmas Island Natural Areas	EXT	Listed place
Mermaid Reef - Rowley Shoals	WA	Listed place
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place
Scott Reef and Surrounds - Commonwealth Area	EXT	Listed place
Historic		
Administrators House Precinct	EXT	Listed place
Bungalow 702	EXT	Listed place
Drumsite Industrial Area	EXT	Listed place
Industrial and Administrative Group	EXT	Listed place
Malay Kampong Group	EXT	Listed place
Malay Kampong Precinct	EXT	Listed place
Phosphate Hill Historic Area	EXT	Listed place
Poon Saan Group	EXT	Listed place
Settlement Christmas Island	EXT	Listed place
South Point Settlement Remains	EXT	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Acrocephalus orientalis		
Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Anous minutus Black Noddy [824]		Breeding known to occur within area
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Breeding known to occur within area

Name	Threatened	Type of Presence
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden	Endangered	Breeding likely to occur

Name	Threatened	Type of Presence
Bosunbird [26021]		within area
Phaethon rubricauda		
Red-tailed Tropicbird [994]		Breeding known to occur within area
Pluvialis squatarola		
Grey Plover [865]		Species or species habitat likely to occur within area
Pterodroma mollis		
Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat may occur within area
Puffinus pacificus		
Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons		
Little Tern [813]		Breeding known to occur within area
Sterna anaethetus		
Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis		
Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii		
Crested Tern [816]		Breeding known to occur within area
Sterna caspia		
Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii		
Roseate Tern [817]		Breeding known to occur within area
Sula dactylatra		
Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster		
Brown Booby [1022]		Breeding known to occur within area
Sula sula		
Red-footed Booby [1023]		Breeding known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura larsonae		
Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata		
Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni		
Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys sculptus Sculptured Pipefish [66197]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys haematopterus Reef-top Pipefish [66201]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Cosmocampus maxweberi Maxweber's Pipefish [66209]		Species or species habitat may occur within area
Doryrhamphus baldwini Redstripe Pipefish [66718]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus macrorhynchus Whiskered Pipefish, Ornate Pipefish [66222]		Species or species habitat may occur within area
Halicampus mataafae Samoan Pipefish [66223]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area
Hippichthys parvicarinatus Short-keel Pipefish, Short-keeled Pipefish [66230]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippichthys spicifer Belly-barred Pipefish, Banded Freshwater Pipefish [66232]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus brevirostris thorntail Pipefish, Thorn-tailed Pipefish [66254]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus fuscus Dusky Seasnake [1119]		Species or species habitat known to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773]		Species or species habitat may occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis inornatus Plain Seasnake [1107]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Hydrophis pacificus Large-headed Seasnake, Pacific Seasnake [1112]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Parahydrophis mertoni Northern Mangrove Seasnake [1090]		Species or species habitat may occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common		Species or species

Name	Status	Type of Presence
Dolphin [60]		habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area

Name	Status	Type of Presence
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Commonwealth ReservesTerrestrial [Resource Information]

Name	State	Type
Christmas Island	EXT	National Park (Commonwealth)

Australian Marine Parks [Resource Information]

Name	Label
Arafura	Multiple Use Zone (IUCN VI)
Arafura	Special Purpose Zone (Trawl) (IUCN VI)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Ashmore Reef	Recreational Use Zone (IUCN IV)
Ashmore Reef	Sanctuary Zone (IUCN Ia)
Cartier Island	Sanctuary Zone (IUCN Ia)
Eighty Mile Beach	Multiple Use Zone (IUCN VI)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Joseph Bonaparte Gulf	Multiple Use Zone (IUCN VI)
Joseph Bonaparte Gulf	Special Purpose Zone (IUCN VI)
Kimberley	Habitat Protection Zone (IUCN IV)
Kimberley	Multiple Use Zone (IUCN VI)
Kimberley	National Park Zone (IUCN II)
Mermaid Reef	National Park Zone (IUCN II)
Montebello	Multiple Use Zone (IUCN VI)
Ningaloo	Recreational Use Zone (IUCN IV)
Oceanic Shoals	Habitat Protection Zone (IUCN IV)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	National Park Zone (IUCN II)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Adele Island	WA
Balanggarra	WA
Bardi Jawi	WA
Bedout Island	WA
Browse Island	WA
Channel Point	NT
Dambimangari	WA
Keep River	NT
Lesueur Island	WA
Marri-Jabin (Thamurrurr - Stage 1)	NT
Mijing	WA
Muiron Islands	WA
Niiwalarra Islands	WA
Ord River	WA
Swan Island	WA
Tanner Island	WA
Unnamed WA28968	WA
Unnamed WA41775	WA
Unnamed WA44669	WA
Unnamed WA44672	WA
Unnamed WA44673	WA
Unnamed WA44677	WA
Uunguu	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Gallus gallus Red Junglefowl, Feral Chicken, Domestic Fowl [917]		Species or species habitat likely to occur within area
Lonchura oryzivora Java Sparrow [59586]		Species or species habitat likely to occur within area
Meleagris gallopavo Wild Turkey [64380]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Bubalus bubalis Water Buffalo, Swamp Buffalo [1]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Rattus exulans Pacific Rat, Polynesian Rat [79]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Hymenachne amplexicaulis Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Mimosa pigra Mimosa, Giant Mimosa, Giant Sensitive Plant, ThornySensitive Plant, Black Mimosa, Catclaw Mimosa, Bashful Plant [11223]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Pennisetum polystachyon		
Mission Grass, Perennial Mission Grass, Missiongrass, Feathery Pennisetum, Feather Pennisetum, Thin Napier Grass, West Indian Pennisetum, Blue Buffel Grass [21194]		Species or species habitat likely to occur within area
Salvinia molesta		
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Vachellia nilotica		
Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area
Lycodon aulicus		
Wolf Snake, Common Wolf Snake, Asian Wolf Snake [83178]		Species or species habitat likely to occur within area
Lygosoma bowringii		
Christmas Island Grass-skink [1312]		Species or species habitat likely to occur within area
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat known to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
"The Dales", Christmas Island	EXT
Ashmore Reef	EXT
Daly-Reynolds Floodplain-Estuary System	NT
Hosine's Spring, Christmas Island	EXT
Mermaid Reef	EXT
Moyle Floodplain and Hyland Bay System	NT
Ord Estuary System	WA

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Carbonate bank and terrace system of the Van	North
Pinnacles of the Bonaparte Basin	North
Shelf break and slope of the Arafura Shelf	North
Tributary Canyons of the Arafura Depression	North
Ancient coastline at 125 m depth contour	North-west
Ashmore Reef and Cartier Island and surrounding	North-west
Canyons linking the Argo Abyssal Plain with the	North-west
Canyons linking the Cuvier Abyssal Plain and the	North-west
Carbonate bank and terrace system of the Sahul	North-west
Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west
Pinnacles of the Bonaparte Basin	North-west
Seringapatam Reef and Commonwealth waters in	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-13.0031763488094 130.167001440364,-13.4243409462776 130.25028257568,-13.635161191236 129.899074131266,-13.9949356952261 129.870520599646,-14.202424695743 129.533588920592,-14.4418096311095 129.464744832308,-14.5331633113377 129.663824196829,-14.8690306958099 129.645304615316,-14.9546912924691 129.535849408823,-14.5947978153669 128.799009650275,-14.8546349573373 128.533580775632,-14.913661788061 128.441104512164,-14.607171012732 128.225202629098,-14.0951110043693 127.892078087834,-14.0650256934809 127.42993718895,-13.8186515599215 126.892846904061,-13.9710369843693 126.357871032322,-13.9723928418561 125.958958835982,-14.1815003099913 125.683032096854,-14.2826274031321 125.468880606555,-14.6556475727772 125.194449437292,-14.7584402885884 124.836578501297,-14.9792542695689 124.819446382145,-15.0862917377734 124.655831238421,-15.192216029646 124.346647480097,-15.36710641363 124.250279309642,-16.0107506156484 124.281212302606,-15.9981394729583 123.780930626048,-16.19979879278 123.334781687625,-16.4806941648038 122.951807439362,-16.599952750519 122.131167029635,-17.6457258619589 121.802801411056,-18.0883056097161 121.577942346063,-19.1965395726431 120.736802880449,-19.8976874155417 118.740038520162,-20.3512126833186 115.482366046056,-21.3277434803773 114.987438156846,-21.7157145975506 114.376392570461,-19.1368547592397 102.032879116378,-16.0316581463064 100.069823786239,-9.07075218516519 100.132833896867,-7.44677004919839 100.697955885356,-6.87558043468925 104.083155571972,-6.88497930605007 105.560324964026,-7.53933108186391 106.412172004335,-7.45723967766895 106.581946547195,-7.53276377003192 107.643424102241,-7.5819392975605 107.968775736511,-7.9245816823987 108.525569612548,-7.81290564597873 109.539378631319,-7.82608785996672 109.773588978249,-8.08830446238096 110.224972730907,-8.02231011162229 110.484916948858,-8.18934827380377 113.286732283268,-8.27857806202792 114.851227894652,-8.59385664456846 115.684039246014,-6.94558417716797 117.06412662984,-6.94558417716797 117.230688900472,-8.49578215891944 116.984548373009,-8.65650807139036 118.183767123254,-8.49818248363465 119.669636430877,-8.64293302813667 121.547031164357,-8.47875021884749 122.7248643628,-8.0033339101318 122.976135445195,-6.74983385195065 123.92554038618,-5.84325920884538 124.180737579476,-5.0 125.790442949183,-5.0 127.181237907703,-5.0 127.571469512208,-5.0 127.680924718701,-5.0 128.362997216149,-5.1934284076948 130.712714959228,-5.0 131.559803076851,-5.0 132.864144285231,-6.42489999773665 134.80640709721,-6.95042241466268 135.626555745052,-11.0115674861505 132.373832550432,-11.1289470085975 131.381450837186,-12.1068333870511 131.100701939543,-12.3489749486349 130.517306085008,-12.8933606095045 130.118605581882,-13.0031763488094 130.167001440364

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX F - HYDROCARBON IMPACT THRESHOLDS

Hydrocarbon thresholds

Hydrocarbon impact pathways and thresholds

The modelling method described is able to track hydrocarbon concentrations of floating oil, entrained oil and dissolved aromatic hydrocarbons below biologically significant impact levels. Consequently, threshold concentrations are specified for the model to control what contact is recorded for surface (floating oil) and subsurface locations (entrained oil and dissolved aromatic hydrocarbons) to ensure that recorded contacts are for biologically meaningful concentrations.

The determination of biologically meaningful impact levels is complex since the degree of impact will depend on the sensitivity of the biota contacted, the duration of the contact (exposure) and the toxicity of the hydrocarbon mixture making the contact. The toxicity of a hydrocarbon will change over time, due to weathering processes altering the composition of the hydrocarbon. To ensure conservatism in the environmental impact assessment process, the threshold concentrations applied to the model are selected to adopt the most sensitive receptors that may be exposed, the longest likely exposure times and the more toxic hydrocarbons.

Impact pathways and impact threshold concentrations are detailed below for surface (floating) oil, entrained oil and dissolved aromatic hydrocarbons (DAHs).

Surface (floating) oil

The impact threshold concentration for exposure to surface (floating) oil is derived from levels likely to cause adverse impacts to marine/ coastal fauna and habitats. Marine/ coastal fauna, habitats and socio-economic receptors may be impacted by floating oil in the following way:

- Marine mammals, reptiles and birds can be exposed to oil when at the water surface. For marine mammals and reptiles this can occur when surfacing within a slick to breathe while for birds this includes contact from diving into a slick or floating on the sea surface while feeding or resting. For marine fauna surfacing in floating oil contact to sensitive areas may occur (e.g. eyes, mouth and respiratory system) creating irritation and potentially cell damage. Volatile compounds evaporating form surface oil may be inhaled by marine mammals and reptiles, particularly when the oil is fresh and relatively unweathered. Inhalation of these compounds may cause damage to internal respiratory structures. It is generally considered that marine mammals with smooth skin (e.g. cetaceans) are less susceptible to coating of oil than those covered with hair given hair has a greater potential to trap and retain oil causing longer exposure times. Birds are particularly susceptible to impact from floating oil in that feathers retain oil, particularly when the oil is 'sticky' (e.g. heavy crudes). The coating of oil on birds may hinder flight and feeding, reduce the ability of the bird to thermoregulate (control body temperature) and irritate/damage sensitive surfaces such as eyes, ears and nasal structures. Secondary impacts can occur through the ingestion of oil as birds attempt to preen contaminated feathers. Ingestion may lead to oil absorption and further toxic impacts;
- Surface oil can coat emergent habitats such as coral or rocky reefs and intertidal and shoreline areas around islands or along coastlines. Habitats that can be affected include rocky shorelines, sandy beaches, mangrove communities and intertidal areas which may support seagrass, algae and coral reef communities. The physical coating of mangroves, in particular their root system, can prevent gas exchange and/or cause toxicity at the cellular level. Mangrove response to oil contact includes deforestation, yellowing of leaves and mortality. Other chronic responses include reduced growth, reduced reproductive output and success and genetic mutation. Intertidal areas may be contacted at low tides where emergent habitat is coated by oil. Seagrass, algae and sessile fauna such as hard corals, soft corals and sponges may be smothered as well as small low mobility fauna that live in close association with these and other benthic habitats or within/on sediments. Smothering of intertidal photosynthetic organisms such as seagrass, algae and hard coral may reduce their capacity for photosynthesis (energy production) or lead to a

toxic response at the cellular level. For seagrass and algae this could lead to plant death, shedding of leaves/thalli, reduced growth, reduced reproductive output/success and genetic mutation. Similarly, for hard corals, bleaching, colony death, reduced growth and reduced reproductive capacity may occur. Such impacts may be exacerbated if these organisms are already under stress from marginal environmental conditions or if impacts occur during critical life-history stages (e.g. spawning periods). Small fauna smothered by oil may be hindered in their ability to move and feed or may suffer a toxic response from mortality to reduced growth rate or reproductive success. The coating of habitats can lead to secondary impacts to marine/coastal fauna. For example, marine turtles and shorebirds may be contacted by oil when using nesting beaches or when roosting/feeding along shorelines, respectively. Marine/coastal fauna may also ingest oil when feeding on coated habitats, e.g. dugongs or turtles ingesting coated seagrass/algae and shorebirds ingesting coated intertidal organisms such as molluscs and crabs; and

- Surface oil may impact on socio-economic receptors such as the oil and gas industry, commercial shipping, fisheries/aquaculture and tourism. The presence of floating oil may pose a human health risk from volatile compounds depending on the nature and freshness of the oil (i.e. fresh light oils and condensates posing the greatest risk) while oil spill response activities targeting floating oil may preclude or disrupt activities by other users in the area both offshore and at oil affected shorelines. This could have an economic impact on affected industries. In addition, floating and stranded oil may be highly visible to the general public and have a resultant negative effect on tourism in affected areas. Real or perceived deterioration of nearshore and coastal habitats may also have long lasting effect on the tourism value of an area and of fisheries activities that may rely on those areas to support healthy fish stocks.

There is a paucity of data on floating oil concentrations with respect to impacts to marine organisms. The impact of floating oil on birds is better understood than other receptors. Estimates for the minimum oil thickness that will harm seabirds (through ingestion from preening of contaminated feathers or loss of thermal protection of their feathers) range from at 10 g/m_2 (O'Hara and Morandin, 2010) to 25 g/m^2 (Koops *et al*., 2004). A conservative threshold of 10 g/m^2 has been applied to impacts from floating diesel and Legendre crude oil. This hydrocarbon threshold is also considered appropriate for turtles, sea snakes and marine mammals (NRDAMCME, 1997) and has also been applied herein to determine impacts of surface oils to emergent habitat such as coral reefs.

A $1g/m^2$ threshold was also modelled which may appear as a rainbow sheen and may be indicative of socio-economic impacts.

Entrained oil

Entrained oil is oil that is dispersed within the water column as oil droplets. For oil spills released at surface, entrained oil is created in the top few meters of the water column through mixing of surface oil by wave action. For oil spills released subsea (e.g. pipelines leaks, well blowouts) entrained oil may be distributed deeper within the water column.

The concentrations of entrained droplets output by SIMAP represent hydrocarbons that are not bioavailable. The soluble and semi-soluble fractions dissolve from the droplets over time, and a potential effects analysis based on the dissolved hydrocarbons characterizes their risk.

Because PAHs are the most toxic components of oil and crude oils typically contain about 1% PAHs by mass (French-McCay 2002; Forth et al. 2017), the sublethal concentration threshold (PNEC) expressed as total hydrocarbon concentration (THC, not TPH) based on the most toxic components would be ~100 µg/L (100 ppb) for fresh oil. However, as oil weathers, PAHs are lost to volatilization and degradation. Thus, the whole-oil threshold of 100 ppb is appropriate for fresh oil and conservative (highly protective of aquatic resources) for weathered oil. An exposure concentration of 1,000 ppb (1 ppm or 1 mg/L) of (total) oil hydrocarbons was deemed a low level of concern for sensitive life stages in marine organisms by Kraly et al. (2001). The 1 mg/L concentration is at the low end of the range where sub-lethal impacts from acute exposure have been observed (NRC, 2005). Based on the review of toxicity studies by Bejarano et al. (2017), a THC lethal threshold of 3–28 mg/L (or 3–30 mg/L with rounding, given uncertainties) would be appropriate for a range of oils and states of weathering for species from all geographical areas globally.

Based on this information, a contact threshold of 100 ppb was considered a conservative contact threshold for the assessment of impacts from entrained oil.

Dissolved Aromatic Hydrocarbons

Dissolved hydrocarbons are taken up into organisms directly through external surfaces and gills, as well as through the digestive tract. Thus, soluble and semi-soluble hydrocarbons are bioavailable, whereas insoluble compounds in oil are not bioavailable to aquatic organisms. Laboratory studies have shown that the dissolved hydrocarbons exert the most effects on aquatic biota (Carls et al. 2008; Nordtug et al. 2011; Redman 2015). The volatilization rates of hydrocarbons from surface slicks are faster than the dissolution rates. Thus, dissolution from oil droplets in the water column is the main source of concentrations dissolved in the water.

The most toxic components of oil to water-column and benthic organisms are lower-molecular-weight compounds, which are both volatile and soluble in water (generally in the water accommodated fraction – WAF). The polynuclear aromatic hydrocarbons (PAHs) exert the most toxic effects because they are semi-soluble and not highly volatile, so they persist in the environment long enough for significant exposure to occur (Anderson et al., 1974, 1987; Neff and Anderson, 1981; Malins and Hodgins, 1981; McAuliffe, 1987; NRC 2003, 2005). The monoaromatic hydrocarbons (MAHs), including BTEX (benzene, toluene, ethylbenzene, and xylenes), and the soluble alkanes also contribute to toxicity, but these compounds are highly volatile, so exposures of aquatic biota are minimal or negligible except when light oils are discharged at depth where volatilization does not occur (French-McCay 2002).

French McCay (2018) provides an outline of the measured total PAH concentrations within the water accommodated fraction of medium crude oils as being 74.9 to 282 µ/l.

Within the soluble and semi-soluble hydrocarbons, toxicity is inversely related to solubility, typically quantified by the octanol-water partition coefficient (Kow), a measure of hydrophobicity (Nirmalakhandan and Speece 1988; Hodson et al. 1988; Blum and Speece 1990; McCarty 1986; McCarty et al. 1992a, b; Mackay et al. 1992; McCarty and Mackay 1993; Verhaar et al. 1992, 1999; Swartz et al. 1995; French-McCay 2002; McGrath et al 2009).

Due to the toxic nature of MAHs and low molecular weight PAHs, and the ability for these to be transferred across cellular structures, DAHs contribute to the acute toxicity of an oil. The proportion of BTEX, and other DAHs that are readily dissolved or evaporated, diminish over time. DAH concentration is therefore higher around fresh oil than weathered oil. The toxicity of DAHs to an organism is dependent on both the concentration of the oil and the amount of time an organism is exposed to a given concentration.

The range of LC50s varies from ~10 mg/L (ppb) for 3-ring PAHs (which are semi-soluble) to ~10-100 mg/L (ppm) for the highly soluble BTEX compounds (French-McCay 2002). Thus, the toxicity of an oil hydrocarbon mixture is strongly related to the chemical composition, which varies as the oil weathers since the soluble and semi-soluble hydrocarbons are all volatile to varying degree. Aurand and Coelho (2005) suggest that, based on the wide variation of toxicity data, a threshold of 1,000 ppb will represent a reasonable level for protection of more sensitive life stages of organisms residing in the water column.

For most oil spills, exposures of water column biota to concentrations above potential thresholds of concern are typically on time scales of minutes to hours, even for spills lasting weeks or months because of the varying movements of the oil in the water, dilution and losses to biodegradation and volatilization. Furthermore, the concentrations vary in time over the short exposure periods (McAuliffe et al. 1980, 1981; McAuliffe 1987; Lunel 1994; French McCay 2002, 2004; Bejarano et al. 2014). Thus, the use of LC50s for >48 hours of exposure, or chronic endpoints for longer exposure times, as thresholds for oil spills is highly conservative. Acute aquatic toxicity thresholds would be sufficiently conservative for oil spills in open water systems (as opposed to ponds or other contained systems). There is no need for an ACR correction for evaluating acute toxicity to aquatic biota from oil spills in open waters.

Based on this information, a contact threshold of 50 ppb was considered a conservative contact threshold for the assessment of impacts from dissolved aromatic hydrocarbons.

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APPENDIX G - PRIORITY RECEPTOR KEY VALUES AND CONTACT

Protection Priority	Key Values and Potential Impacts
Ashmore Reef/Cartier Island (including Ashmore Reef and Cartier Island and surrounding Commonwealth waters Ashmore Reef AMP Cartier Island AMP)	See below

- Ashmore is an atoll-like structure with three low vegetated islands, sandbanks, lagoon areas, and surrounding reef largest of only three emergent oceanic reefs present in the north-eastern Indian Ocean. Only oceanic reef in the region with vegetated islands.
- Cartier Island includes an unvegetated sand island (Cartier Island), mature reef flat, a small, submerged pinnacle (Wave Governor Bank), and two shallow pools to the north-east of the island.
- Encompasses ecosystems, habitats and communities associated with the North-West Shelf, Timor Province, and emergent oceanic reefs. These locations are Important biological stepping-stones facilitating transport of biological material to the reef systems along the WA coast and Subject to the Memorandum of Understanding between Australia and Indonesia (MoU Box).

Physical Habitat

	Present	Notes	Key periods	Impacts
Coral reefs	✔	Very high diversity; Ashmore supports the highest number of coral species of any reef off the West Australian coast	Spawning: Mar/Apr & Oct/Nov	Contact from shoreline oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion. Contact from entrained oil may impact shoreline through accumulation, although constant tidal and current motions will re-mobilise oil and create further dilution. Contact from entrained oil may impact submerged habitats, such as coral reefs and seagrasses, resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution.
Seagrasses	✔	Supports a small dugong population at Ashmore	Flowering and fruiting: Oct-Jan	
Macroalgae and non-coral benthic invertebrates	✔	Algal reef flats important foraging habitat for marine turtles High diversity and abundance of soft corals, gorgonians, sea fans and sponges		
Mangroves	✘			
Rocky shoreline	✘			

Marine Fauna

	Present	Comment	Key periods	Impacts
Invertebrates	✔	High diversity of molluscs at Ashmore		Contact from shoreline oil is likely to impact marine fauna by coating (causing skin/eye irritation and affect ability to thermo-regulate) and oil contact from movement across the shoreline. In addition, ingestion may occur from preening/cleaning body and/or eating oil covered food resulting in internal toxicity. Contact from entrained oil may impact marine fauna by causing skin irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food. Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile.
Fish and sharks	✔	Foraging habitat for whale sharks	SBF Tuna: Spawn Oct - Feb Goldband: Spawn - Mar Red Emperor spawn: Oct Whale shark migration: June - Nov	
Birds	✔	Some of the most important seabird rookeries on the North West Shelf. 43 CAMBA and JAMBA listed species at Ashmore	Breeding: May – June/Oct Migrating: Feb-Apr/Sept-Oct	
Marine reptiles	✔	• Critical nesting and inter-nesting habitat for green turtles at Ashmore and Cartier (DoE 2015a) • Moderate nesting of hawksbill turtles at Ashmore • Low nesting activity by loggerhead turtles (single report of nesting on West Island, Ashmore)	Turtles • Mating: Oct • Nesting: Nov – March (peaks Jan – Feb) • Hatching: Peaks Mar – Apr Foraging: Year-round Sea snakes: Mating: ~September	

Oil Spill Modelling Parameter[1]		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
Cartier Islands			
Probability of contact by shoreline oil at $\geq 10 g/m^2$	%	76.7	95.3
Probability of contact shoreline oil at $\geq 100 g/m^2$	%	73.3	95.3
Probability of contact by total submerged oil at ≥100ppb	(%)	41.3	82
Probability of contact by dissolved aromatics at ≥ 50 ppb	(%)	NC	NC
Maximum oil loading on shorelines ($>100 g/m^2$)	tonnes	16	24
Minimum time to contact by shoreline oil at $\geq 10\ g/m^2$	days	1.9	3.6
Minimum time to contact by shoreline oil at $\geq 100\ g/m^2$	days	1.9	3.6
Maximum time-averaged concentration of total submerged oil at ≥100ppb	ppb	420	297.1
Maximum concentration of dissolved aromatics at ≥ 50 ppb	ppb	NC	NC
Ashmore			
Probability of contact by shoreline oil at $\geq 10 g/m^2$	%	72.7	92.7

		• Large and significant feeding populations of green, hawksbill and loggerhead turtles • World's highest abundance and diversity of sea snakes at Ashmore		
Marine Mammals	✔	• Migratory pathway for pygmy blue whales • Small population of dugongs at Ashmore (approx. 50 individuals)	Dugong calving/breeding: Sept-Dec Pygmy Blue whale migration north: May-Aug Pygmy Blue whale migration south – Sept-Dec	

Protected Areas

	Present	Comment	Impacts
AMP	✔	Ashmore and Cartier AMPs	Oil contacting these values are described under the individual receptors. The habitat and marine fauna which may be contacted by oil (as described above) may then impact upon the socio-economic values (tourism) with impacts on reputation.
State MP	✔		
KEF	✔	Ashmore Reef and Cartier Island and surrounding Commonwealth waters Continental Slope Demersal Fish Communities	
RAMSAR	✔	Wetland of International Importance	

	Present	Comment	Key periods	Impacts
Traditional Owner values	✔	Sea country		Oil contacting shorelines will impact upon these values, in particular, tourism and fishing activities from visible stranded oil and tainted fish • Heritage value: onshore graves and artefacts highly unlikely to be contacted by oil. Supports key cultural values and future socio-economic opportunities The habitat and marine fauna which may be contacted by oil (as described above) will then impact upon the socio-economic values.
Indonesian	✔	Artefacts and graves Current resting and staging area from MOU Box		
Commonwealth heritage list	✔	Ashmore reef only *Ann Millicent* historical shipwreck at Cartier Island		
Tourism	✔			
Recreation	✔			
Scientific Research	✔			

Probability of contact by shoreline oil at ≥100g/m^2	%	68.7	90.7
Probability of contact by total submerged oil at ≥100ppb	(%)	21.3	74
Probability of contact by dissolved aromatics at ≥ 50 ppb	(%)	NC	NC
Maximum oil loading on shorelines (>100g/m^2)	tonnes	176.9	268.8
Minimum time to contact by shoreline oil at ≥10 g/m^2	days	4.3	7.0
Minimum time to contact by shoreline oil at ≥100 g/m^2	days	4.3	7.0
Maximum time-averaged concentration of total submerged oil at ≥100ppb	ppb	249.9	353.7
Maximum concentration of dissolved aromatics at ≥ 50 ppb	ppb	NC	NC

[1] Throughout the modelling results, total submerged oil refers to entrained plus dissolved oil

Protection Priority	Key Values and Potential Impacts	Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
International Waters (including Indonesia coastline and Timor Leste)	See Physical Habitat, Marine Fauna and Protected Areas below	See modelling parameters below			

Physical Habitat

	Present	Notes	Key periods	Impacts
Coral reefs	✔	Fringing reefs are the most common reef types with scleractinian corals being the most dominant and important group ~600 coral species recorded in Indonesia	Spawning: Mar/Apr & Oct/Nov	Contact from shoreline oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Mangroves and intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion. Contact from entrained oil may impact shoreline through accumulation, although constant tidal and current motions will re-mobilise oil and create further dilution. Contact from entrained oil may impact submerged habitats, such as coral reefs and seagrasses, resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution.
Seagrasses	✔	Indonesia (west), Kepulauan Seribu National Park, Timor-Leste	Flowering and fruiting: Oct-Jan	
Macroalgae and non-coral benthic invertebrates	✔			
Mangroves	✔	Timor Leste coastline features mangrove communities surrounding entrance to rivers primarily on the south coast		
Rocky shoreline	✔			

Marine Fauna

	Present	Comment	Key periods	Impacts
Invertebrates	✔			Contact from shoreline oil is likely to impact marine fauna by smothering (causing skin/eye irritation and affect ability to thermo-regulate) and oil contact from movement across the shoreline. In addition, ingestion may occur from preening/cleaning body and/or eating oil covered food resulting in internal toxicity. Contact from entrained oil may impact marine fauna by causing skin irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food. Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile.
Fish and sharks	✔	Whale shark foraging	Whale sharks: year round Goldband: Spawn - Mar Red Emperor spawn: Oct	
Birds	✔	Pulau Dana, Sulawesi, Lesser Sunda Islands, Lombok	Breeding: May – June/Oct Migrating: Feb-Apr/Sept-Oct	
Marine reptiles	✔	Marine turtle nesting at Sukamade Beach (mainly green turtles with smaller numbers of leatherback, hawksbill and olive ridley turtles; Meru Betiri National Park), Komodo and Nino Komis National Parks and Pulau Dana Nature Reserve	Turtles • Mating: Oct • Nesting: Nov – March (peaks Jan – Feb) • Hatching: Peaks Mar – Apr Foraging: Year-round	
Marine Mammals	✔	Savu sea breeding and feeding for whales and dolphins	Dugong calving/breeding: Sept-Dec Pygmy Blue whale migration north: May-Aug Pygmy Blue whale migration south – Sept-Dec	

Protected Areas

	Present	Comment	Impacts
National Park	✔	Kepulauan Seribu, Meru Betiri and Komodo National Parks, Pulau Dana Nature Reserve	Oil contacting these values are described under the individual receptors.

Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
Indonesia			
Probability of contact by shoreline oil at% ≥10g/m^2	%	42.0	72
Probability of contact by shoreline oil at ≥100g/m^2	%	36.0	70
Probability of contact by total submerged oil at ≥100ppb	(%)	9.3	54.73
Probability of contact by dissolved aromatics at ≥ 50 ppb	(%)	NC	NC
Maximum oil loading on shorelines (>100g/m^2)	tonnes	7529	2283
Minimum time to contact by shoreline oil at ≥10 g/m^2	days	14.9	14.6
Minimum time to contact by shoreline oil at ≥100 g/m^2	days	14.9	14.6
Maximum time-averaged concentration of total submerged oil at ≥100ppb	ppb	161.1	389.9
Maximum concentration of dissolved aromatics at ≥ 50 ppb	ppb	NC	NC
Timor-Leste			
Probability of contact by shoreline oil at% ≥10g/m^2	%	13.3	28.7
Probability of contact by shoreline oil at ≥100g/m^2	%	12.0	28.0
Probability of contact by total submerged oil at ≥100ppb	(%)	NC	NC

	Present		Impacts
RAMSAR	✔		The habitats and marine fauna which may be contacted by oil (see individual receptors) may then impact upon the socio-economic values (tourism) with impacts on reputation.

	Present	Comment	Key periods	Impacts
Traditional Owner values	✘			Oil contacting shorelines will impact upon these values, in particular, tourism and fishing activities from visible stranded oil and tainted fish The habitat and marine fauna which may be contacted by oil (as described above) will then impact upon the socio-economic values
Indonesian	✔			
Commonwealth heritage list	✘			
Tourism	✔		Year-round	
Recreation	✔		Year-round	
Scientific Research	✔			

Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
Probability of contact by dissolved aromatics at ≥ 50 ppb	(%)	NC	NC
Maximum oil loading on shorelines (>100g/m^2)	tonnes	81.2	869
Minimum time to contact by shoreline oil at ≥10 g/m^2	days	31	30.8
Minimum time to contact by shoreline oil at ≥100 g/m^2	days	31	30.8
Maximum time-averaged concentration of total submerged oil at ≥100ppb	ppb	NC	NC
Maximum concentration of dissolved aromatics at ≥ 50 ppb	ppb	NC	NC

Protection Priority	**Key Values and Potential Impacts**	**Oil Spill Modelling Parameter**		**Sea Eagle-1 LOWC**	**Tahbilk-1 LOWC**
Joseph Bonaparte Gulf coastline NT	The Joseph Bonaparte Gulf Marine Park covers an area of 8,600 km^2 and contains key examples of the ecosystems of the Northern Shelf Province.	Probability of contact by shoreline oil at% ≥10g/m^2	%	1.3	6.0
		Probability of contact by shoreline oil at ≥100g/m^2	%	1.3	5.3
		Probability of contact by total submerged oil at ≥100ppb	(%)	0.7	2.7
		Probability of contact by dissolved aromatics at ≥ 50 ppb	(%)	NC	NC
		Maximum oil loading on shorelines (>100g/m^2)	tonnes	1556	1453
		Minimum time to contact by shoreline oil at ≥10 g/m^2	days	48.6	52.0
		Minimum time to contact by shoreline oil at ≥100 g/m^2	days	48.6	52.0
		Maximum time-averaged concentration of total	ppb	122.8	181.8

Physical Habitat

	Present	Notes	Key periods	Impacts
Coral reefs	✔	Benthic substrate mostly shifting sands with high energy water movement. Small isolated specimens of hard corals on the muddy inner shelf		Contact from shoreline oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Mangroves and intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion. Contact from entrained oil may impact shoreline through accumulation, although constant tidal and current motions will re-mobilise oil and create further dilution. Contact from entrained oil may impact submerged habitats, such as coral reefs and seagrasses, resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution
Seagrasses	✔	Not significant areas due to high tidal movements		
Macroalgae and non-coral benthic invertebrates	✔	Habitat within the emergent reef systems, shoals and banks		
Mangroves	✔			
Rocky shoreline	✔			

Marine Fauna

	Present	Comment	Key periods	Impacts
Invertebrates	✔	Key banana prawn habitat Mud crabs	Mud crab spawning: Sept - Nov	Contact from shoreline oil is likely to impact marine fauna by smothering (causing skin/eye irritation and affect ability to

Fish and sharks	✔	Sawfish, barramundi and threadfin salmon habitat	Sawfish pupping: early wet season (Nov) Barramundi spawning: Sept - March	thermo-regulate) and oil contact from movement across the shoreline. In addition, ingestion may occur from preening/cleaning body and/or eating oil covered food resulting in internal toxicity. Contact from entrained oil may impact marine fauna by causing skin irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food. Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile
Birds	✔	Significant feeding and breeding sites	Breeding: May – June/Oct Migrating: Feb-Apr/Sept-Oct	
Marine reptiles	✔	Green turtle foraging area (BIA) Olive ridley turtle foraging and internesting BIA Hawsbill migration route Significant flatback nesting at Turtle Point	Turtles • Flatback Nesting: year round (peaks June-Aug) • Foraging: Year-round	
Marine Mammals	✔	Whales not likely due to shallow water depth Dugongs not expected to be abundant due to lack of seagrass Potential for common, bottlenose, Irrawaddy, Risso's, Indo-Pacific and pantropical spotted dolphin. Snubfin dolphin breeding and foraging area	Snubfin dolphin mating: Mar - June	

Protected Areas

	Present	Comment	Impacts
AMP	✔		Oil contacting these values are described under the individual receptors. The habitats and marine fauna which may be contacted by oil (see individual receptors) may then impact upon the socio-economic values (tourism) with impacts on reputation.
State MP	✔		
KEF	✔	Carbonate banks of the Sahul Shelf	
RAMSAR	✔	Adjacent to Ord River Floodplain	

	Present	Comment	Key periods	Impacts
Traditional Owner values	✔	Sea country Sacred sites		Oil contacting shorelines will impact upon these values, in particular, tourism and fishing activities from visible stranded oil and tainted fish • Commercial fishing: a number are licensed to operate in the area The habitat and marine fauna which may be contacted by oil (as described above) will then impact upon the socio-economic values
Indonesian	✔			
Commonwealth heritage list	✔			
Tourism	✔			
Recreation	✔			
Commercial Fishing	✔	Major prawn fishery		

submerged oil at ≥100ppb			
Maximum concentration of dissolved aromatics at ≥ 50 ppb	ppb	NC	NC

Protection Priority	Key Values and Potential Impacts
Seringapatam and Scott Reef	(see below)

Physical Habitat

	Present	Notes	Key periods	Impacts
Coral reefs	✓		Spawning: Mar/Apr & Oct/Nov	Contact from shoreline oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion. Contact from entrained oil may impact shoreline through accumulation, although constant tidal and current motions will re-mobilise oil and create further dilution. Contact from entrained oil may impact submerged habitats, such as coral reefs and seagrasses, resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution
Seagrasses	✓		Flowering and fruiting: Oct-Jan	
Macroalgae and non-coral benthic invertebrates	✓			
Mangroves	X			
Rocky shoreline	X			

Marine Fauna

	Present	Comment	Key periods	Impacts
Invertebrates	✓			Contact from shoreline oil is likely to impact marine fauna by smothering (causing skin/eye irritation and affect ability to thermo-regulate) and oil contact from movement across the shoreline. In addition, ingestion may occur from preening/cleaning body and/or eating oil covered food resulting in internal toxicity. Contact from entrained oil may impact marine fauna by causing skin irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food. Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile
Fish and sharks	✓			
Birds	✓	Scott Reef Little Tern		
Marine reptiles	✓	Sea snakes Nesting and internesting habitat for marine turtles Turtle BIA	Turtles • Mating: Oct • Nesting: Nov – March (peaks Jan – Feb) • Hatching: Peaks Mar – Apr Foraging: Year-round	
Marine Mammals	✓	Blue whale BIA	migration north: May-Aug migration south – Sept-Dec	

Protected Areas

	Present	Comment	Impacts
Commonwealth Heritage Place	✓	Scott Reef and surrounds	Oil contacting these values are described under the individual receptors. The habitat and marine fauna which may be contacted by oil (as described above) may then impact upon the socio-economic values (tourism) with impacts on reputation
AMP	✓	Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex	
State MP	X		
KEF	✓	Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex	
RAMSAR	X		

Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
Scott Reef North			
Probability of contact by shoreline oil at% ≥10g/m^2	%	39.3	65.3
Probability of contact by shoreline oil at ≥100g/m^2	%	32.7	65.3
Probability of contact by total submerged oil at ≥100ppb	(%)	1.3	34.7
Probability of contact by dissolved aromatics at ≥ 50 ppb	(%)	NC	NC
Maximum oil loading on shorelines (>100g/m^2)	tonnes	642.3	1026
Minimum time to contact by shoreline oil at ≥10 g/m^2	days	10.4	17.8
Minimum time to contact by shoreline oil at ≥100 g/m^2	days	10.4	17.8
Maximum time-averaged concentration of total submerged oil at ≥100ppb	ppb	132.0	266.2
Maximum concentration of dissolved aromatics at ≥ 50 ppb	ppb	NC	NC
Scott Reef South			
Probability of contact by shoreline oil at% ≥10g/m^2	%	43.3	78.7
Probability of contact by shoreline oil at ≥100g/m^2	%	32.7	78.0
Probability of contact by total submerged oil at ≥100ppb	(%)	4.7	53.3
Probability of contact by dissolved	(%)	NC	NC

Protection Priority	Key Values and Potential Impacts

	Present	Comment	Key periods	Impacts
Traditional Owner values	✓			Oil contacting shorelines will impact upon these values, in particular, tourism and fishing activities from visible stranded oil and tainted fish The habitat and marine fauna which may be contacted by oil (as described above) will then impact upon the socio-economic values
Tourism	✓			
Recreation	✓			
Shipwrecks	X			

Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
aromatics at ≥ 50 ppb			
Maximum oil loading on shorelines (>100g/m^2)	tonnes	786.2	1108
Minimum time to contact by shoreline oil at ≥10 g/m^2	days	11.8	15.3
Minimum time to contact by shoreline oil at ≥100 g/m^2	days	11.8	15.3
Maximum time-averaged concentration of total submerged oil at ≥100ppb	ppb	181.1	262.4
Maximum concentration of dissolved aromatics at ≥ 50 ppb	ppb	NC	NC
Seringapatam Reef			
Probability of contact by shoreline oil at% ≥10g/m^2	%	37.3	72.0
Probability of contact by shoreline oil at ≥100g/m^2	%	33.3	71.3
Probability of contact by total submerged oil at ≥100ppb	(%)	5.3	50.7
Probability of contact by dissolved aromatics at ≥ 50 ppb	(%)	NC	NC
Maximum oil loading on shorelines (>100g/m^2)	tonnes	302.1	464
Minimum time to contact by shoreline oil at ≥10 g/m^2	days	11.0	16.5
Minimum time to contact by shoreline oil at ≥100 g/m^2	days	11.0	16.5
Maximum time-averaged concentration of	ppb	153.0	300.4

Protection Priority	Key Values and Potential Impacts	Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
		total submerged oil at ≥100ppb			
		Maximum concentration of dissolved aromatics at ≥ 50 ppb	ppb	NC	NC

<table>
<tr><th>Protection Priority</th><th>Key Values and Potential Impacts</th><th colspan="2">Oil Spill Modelling Parameter</th><th>Sea Eagle-1 LOWC</th><th>Tahbilk-1 LOWC</th></tr>
<tr><td rowspan="9">Kimberley Coast (including North Kimberley Marine Park, Kimberley Coast</td><td rowspan="9">
Physical Habitat
<table>
<tr><th></th><th>Present</th><th>Notes</th><th>Key periods</th><th>Impacts</th></tr>
<tr><td>Coral reefs</td><td>✓</td><td></td><td>Spawning: Mar/Apr & Oct/Nov</td><td rowspan="5">Contact from shoreline oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Mangroves and intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion.
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<tr><td>Seagrasses</td><td>✓</td><td></td><td>Flowering and fruiting: Oct-Jan</td></tr>
<tr><td>Macroalgae and non-coral benthic invertebrates</td><td>✓</td><td></td><td></td></tr>
<tr><td>Mangroves</td><td>✓</td><td></td><td></td></tr>
<tr><td>Rocky shoreline</td><td>✓</td><td></td><td></td></tr>
</table>
Marine Fauna
<table>
<tr><th></th><th>Present</th><th>Comment</th><th>Key periods</th><th>Impacts</th></tr>
<tr><td>Invertebrates</td><td>✓</td><td></td><td></td><td rowspan="4">Contact from shoreline oil is likely to impact marine fauna by smothering (causing skin/eye irritation and affect ability to thermo-regulate) and oil contact from movement across the shoreline. In addition, ingestion may occur from preening/cleaning body and/or eating oil covered food resulting in internal toxicity.
Contact from entrained oil may impact marine fauna by causing skin irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food. Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile</td></tr>
<tr><td>Fish and sharks</td><td>✓</td><td>Adjacent to important foraging and pupping areas for sawfish
Important foraging grounds for whale sharks</td><td>SBF Tuna: Spawn Oct - Feb
Goldband: Spawn - Mar
Red Emperor spawn: Oct
Sawfish pupping: Nov
Whale shark migration: June - Nov</td></tr>
<tr><td>Birds</td><td>✓</td><td>Some of the most important seabird rookeries on the North West Shelf. CAMBA and JAMBA listed species</td><td>Breeding: May – June/Oct
Migrating: Feb-Apr/Sept-Oct</td></tr>
<tr><td>Marine reptiles</td><td>✓</td><td>Sea snakes
Flatback turtle foraging
Nesting and internesting habitat for marine turtles</td><td>Turtles
Mating: Oct
Nesting: Nov – March (peaks Jan – Feb)
Hatching: Peaks Mar – Apr
Foraging: Year-round</td></tr>
</table>
</td><td>Probability of contact by shoreline oil at% ≥10g/m^2</td><td>%</td><td>1.3</td><td>6</td></tr>
<tr><td>Probability of contact by shoreline oil at ≥100g/m^2</td><td>%</td><td>0.7</td><td>5.3</td></tr>
<tr><td>Probability of contact by total submerged oil at ≥100ppb</td><td>(%)</td><td>NC</td><td>3.3</td></tr>
<tr><td>Probability of contact by dissolved aromatics at ≥ 50 ppb</td><td>(%)</td><td>NC</td><td>NC</td></tr>
<tr><td>Maximum oil loading on shorelines (>100g/m^2)</td><td>tonnes</td><td>7.5</td><td>22.6</td></tr>
<tr><td>Minimum time to contact by shoreline oil at ≥10 g/m^2</td><td>days</td><td>11.7</td><td>47.6</td></tr>
<tr><td>Minimum time to contact by shoreline oil at ≥100 g/m^2</td><td>days</td><td>11.7</td><td>47.6</td></tr>
<tr><td>Maximum time-averaged concentration of total submerged oil at ≥100ppb</td><td>ppb</td><td>NC</td><td>173.2</td></tr>
<tr><td>Maximum concentration of dissolved aromatics at ≥ 50 ppb</td><td>ppb</td><td>NC</td><td>NC</td></tr>
</table>

Protection Priority	Key Values and Potential Impacts	Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC

Marine Mammals	✓	Dugong Australian snubfin dolphin Indo-Pacific humpback dolphin Spotted bottlenose dolphin Pygmy blue whale migration Calving, migratory pathway and nursing habitat for humpback whales	Dugong calving/breeding: Sept-Dec Pygmy Blue whale migration north: May-Aug Pygmy Blue whale migration south – Sept-Dec	

Protected Areas

	Present	Comment	Impacts
AMP	✓	Kimberley AMP	Oil contacting these values are described under the individual receptors. The habitat and marine fauna which may be contacted by oil (as described above) may then impact upon the socio-economic values (tourism) with impacts on reputation.
State MP	✓	North Kimberley MP	
KEF	x	the ancient coastline at the 125-m depth contour and continental slope demersal fish communities	
RAMSAR	✓	Roebuck Bay	

	Present	Comment	Key periods	Impacts
Traditional Owner values	✓	Wunambal Gaambera, Dambimangari, Bardi Jawi and the Nyul Nyul people's sea country		Oil contacting shorelines will impact upon these values, in particular, tourism and fishing activities from visible stranded oil and tainted fish • Heritage value: onshore graves and artefacts unlikely to be contacted by oil. Supports key cultural values and future socio-economic opportunities The habitat and marine fauna which may be contacted by oil (as described above) will then impact upon the socio-economic values
Tourism	✓			
Recreation	✓			
Shipwrecks	✓	More than 40 known shipwrecks listed under the Historic Shipwrecks Act 1976		

Protection Priority	Key Values and Potential Impacts	Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
Adele Island		Probability of contact by shoreline oil at% ≥10g/m^2	%	0.7	12.7
		Probability of contact by shoreline oil at ≥100g/m^2	%	0.7	11.3

Physical Habitat

	Present	Notes	Key periods	Impacts
Coral reefs	✓		Spawning: Mar & Oct	

Protection Priority	Key Values and Potential Impacts	Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC

Seagrasses				Contact from shoreline oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion. Contact from entrained oil may impact shoreline through accumulation, although constant tidal and current motions will re-mobilise oil and create further dilution. Contact from entrained oil may impact submerged habitats, such as coral reefs, resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution
Macroalgae and non-coral benthic invertebrates	✓			
Mangroves				
Rocky shoreline				

Marine Fauna

	Present	Comment	Key periods	Impacts
Invertebrates				Contact from shoreline oil is likely to impact marine fauna by coating (causing skin/eye irritation and affect ability to thermo-regulate) and oil contact from movement across the shoreline. In addition, ingestion may occur from preening/cleaning body and/or eating oil covered food resulting in internal toxicity. Contact from entrained oil may impact marine fauna by causing skin irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food. Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile
Fish and sharks				
Birds	✓	Important seabird nesting- supporting large numbers of Lesser frigatebird, brown boobies, and common noddies Large numbers of migratory shorebirds (internationally important site)	Shorebird migration: Aug to Nov	
Marine reptiles	✓	Green turtle critical nesting habitat	Turtles nesting: Summer and early Autumn	
Marine Mammals				

Protected Areas

	Present	Comment	Impacts
AMP	✓	Adjacent to Kimberley AMP	Oil contacting these values are described under the individual receptors. The habitat and marine fauna which may be contacted by oil (as described above) may then impact upon the socio-economic values (tourism) with impacts on reputation.
State MP	✓	Adele Island Nature Reserve	
KEF	X		
RAMSAR	X		

	Present	Comment	Key periods	Impacts
Traditional Owner values	X			Oil contacting shorelines will impact upon these values, in particular, tourism and fishing activities from visible stranded oil and tainted fish
Tourism	✓			
Recreation	X			

Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
Probability of contact by total submerged oil at ≥100ppb	(%)	NC	2.7
Probability of contact by dissolved aromatics at ≥ 50 ppb	(%)	NC	NC
Maximum oil loading on shorelines ($>100 g/m^2$)	tonnes	3.2	29.1
Minimum time to contact by shoreline oil at $\geq 10\ g/m^2$	days	54.4	51.6
Minimum time to contact by shoreline oil at $\geq 100\ g/m^2$	days	54.4	51.6
Maximum time-averaged concentration of total submerged oil at ≥100ppb	ppb	NC	160.2
Maximum concentration of dissolved aromatics at ≥ 50 ppb	ppb	NC	NC

Protection Priority	Key Values and Potential Impacts					Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
	Shipwrecks	X			The habitat and marine fauna which may be contacted by oil (as described above) will then impact upon the socio-economic values				

Protection Priority	Key Values and Potential Impacts	Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
Imperieuse Reef Marine Park	(see Physical Habitat and Marine Fauna tables below)	Probability of contact by shoreline oil at% ≥10g/m²	%	2	11.3
		Probability of contact by shoreline oil at ≥100g/m²	%	2	11.3
		Probability of contact by total submerged oil at ≥100ppb	(%)	NC	0.7
		Probability of contact by dissolved aromatics at ≥ 50 ppb	(%)	NC	NC
		Maximum oil loading on shorelines (>100g/m²)	tonnes	4.3	26.5
		Minimum time to contact by shoreline oil at ≥10 g/m²	days	49.8	69.7
		Minimum time to contact by shoreline oil at ≥100 g/m²	days	49.8	69.7
		Maximum time-averaged concentration of total submerged oil at ≥100ppb	ppb	NC	202.1
		Maximum concentration of dissolved aromatics at ≥ 50 ppb	ppb	NC	NC

Physical Habitat

	Present	Notes	Key periods	Impacts
Coral reefs	✓	Exceptionally rich and diverse intertidal and subtidal reefs Provide a source of invertebrate and fish recruits for reefs further south and are therefore regionally significant	Spawning: Mar & Oct	Contact from shoreline oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion. Contact from entrained oil may impact shoreline through accumulation, although constant tidal and current motions will re-mobilise oil and create further dilution. Contact from entrained oil may impact submerged habitats, such as coral reefs and seagrasses, resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution
Seagrasses	✓	Sparse seagrass found within subtidal areas in Rowley Shoals		
Macroalgae and non-coral benthic invertebrates	✓	Small patches may be present in lagoonal area		
Mangroves	X			
Rocky shoreline	X			
Sandy beaches	✓	Area of sand banks (intertidal) and Cunningham Island (an unvegetated sand cay)		

Marine Fauna

	Present	Comment	Key periods	Impacts
Invertebrates	✓	A number of invertebrate (echinoderms, cnidarians, molluscs and crustaceans) species commonly found at Scott Reef are also found here although in higher densities due to lack of fishing/collection (Commercial collection is prohibited)		Contact from shoreline oil is likely to impact marine fauna by smothering (causing skin/eye irritation and affect ability to thermo-regulate) and oil contact from movement across the shoreline. In addition, ingestion may occur from preening/cleaning body and/or eating oil covered food resulting in internal toxicity. Contact from entrained oil may impact marine fauna by causing skin irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food. Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile.
Fish and sharks	✓	Fish populations similar to those on shelf edge reefs in the Indo-Pacific region but unique in WA waters Rich diversity of fish (500+ species)		
Birds	✓	Wide range of seabirds observed at Rowley Shoals		

Protection Priority	Key Values and Potential Impacts	Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC

Marine reptiles	✓	Green and hawksbill turtles are present at the Rowley Shoals Reefs not known to be regionally significant turtle habitats		
Marine Mammals	✓	Northward humpback whale migration pathway adjacent to Rowley Shoals; therefore, individuals may be present Variety of toothed and baleen whales likely to be visitors to the area but not Rowley Shoals are not a key aggregation/calving/mating/foraging area	Humpback whale migration: June to Jul	

Protected Areas

	Present	Comment	Impacts
AMP	X		Oil contacting these values are described under the individual receptors. The habitat and marine fauna which may be contacted by oil (as described above) may then impact upon the socio-economic values (tourism) with impacts on reputation.
State MP	✓	Rowley Shoals Marine Park (including the Commonwealth-managed Mermaid Reef Marine National Nature Reserve)	
KEF	✓	Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals Canyons linking the Argo Abyssal Plain with the Scott Plateau	
RAMSAR	X		

	Present	Comment	Key periods	Impacts
Traditional Owner values	X			Oil contacting shorelines will impact upon these values, in particular, tourism and fishing activities from visible stranded oil and tainted fish The habitat and marine fauna which may be contacted by oil (as described above) will then impact upon the socio-economic values.
Tourism	✓	Nature-based tourism (charter boats, diving, snorkelling)	Tourism: Sep to Dec	
Recreation	✓	Recreational fishing (although prohibited in certain zones) low usage, given distance to mainland		
Shipwrecks	X			

Protection Priority	Key Values and Potential Impacts	Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
Clerke Reef Marine Park	**Physical Habitat**	Probability of contact by shoreline oil at% $\geq 10 g/m^2$	%	1.3	10

Protection Priority	Key Values and Potential Impacts	Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC

	Present	Notes	Key periods	Impacts
Coral reefs	✓	Exceptionally rich and diverse intertidal and subtidal reefs Provide a source of invertebrate and fish recruits for reefs further south and are therefore regionally significant	Spawning: Mar & Oct	Contact from shoreline oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion. There is no contact from entrained (> 100ppb) or dissolved oil for these receptors.
Seagrasses	✓	Sparse seagrass found within subtidal areas in Rowley Shoals		
Macroalgae and non-coral benthic invertebrates	✓	Small patches may be present in lagoonal area		
Mangroves	X			
Rocky shoreline	X			
Sandy beaches	✓	Bedwell Island is a supratidal, unvegetated, elongated cay about 1.3 km long		

Marine Fauna

	Present	Comment	Key periods	Impacts
Invertebrates	✓	A number of invertebrate (echinoderms, cnidarians, molluscs and crustaceans) species commonly found at Scott Reef are also found here although in higher densities due to lack of fishing/collection Diverse molluscan fauna on flats		Contact from shoreline oil is likely to impact marine fauna by smothering (causing skin/eye irritation and affect ability to thermo-regulate) and oil contact from movement across the shoreline. In addition, ingestion may occur from preening/cleaning body and/or eating oil covered food resulting in internal toxicity. There is no contact from entrained (>100 ppb) or dissolved oil for these receptors.
Fish and sharks	✓	Fish populations similar to those on shelf edge reefs in the Indo-Pacific region but unique in WA waters Rich diversity of fish (500+ species)		
Birds	✓	Bedwell island is site of second largest breeding colony of red-tailed tropic birds, an uncommon species in WA Wide range of seabirds observed at Rowley Shoals	Nesting: Sept to Feb	
Marine reptiles	✓	Green and hawksbill turtles are present at the Rowley Shoals Reefs not known to be regionally significant turtle habitats		

Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
Probability of contact by shoreline oil at ≥100g/m^2	%	0.7	9.3
Probability of contact by total submerged oil at ≥100ppb	(%)	NC	NC
Probability of contact by dissolved aromatics at ≥ 50 ppb	(%)	NC	NC
Maximum oil loading on shorelines (>100g/m^2)	tonnes	1.7	21.2
Minimum time to contact by shoreline oil at ≥10 g/m^2	days	45	54.2
Minimum time to contact by shoreline oil at ≥100 g/m^2	days	45	54.2
Maximum time-averaged concentration of total submerged oil at ≥100ppb	ppb	NC	NC
Maximum concentration of dissolved aromatics at ≥ 50 ppb	ppb	NC	NC

Protection Priority	Key Values and Potential Impacts	Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC

Marine Mammals	✓	Northward humpback whale migration pathway adjacent to Rowley Shoals; therefore, individuals may be present Variety of toothed and baleen whales likely to be visitors to the area but not Rowley Shoals are not a key aggregation/calving/mating/foraging area	Humpback whale migration: Jun to Jul	

Protected Areas

	Present	Comment	Impacts
AMP	X		Oil contacting these values are described under the individual receptors. The habitats and marine fauna which may be contacted by oil (see individual receptors) may then impact upon the socio-economic values (tourism) with impacts on reputation.
State MP	✓	Rowley Shoals Marine Park (including the Commonwealth-managed Mermaid Reef Marine National Nature Reserve	
KEF	X	Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals Canyons linking the Argo Abyssal Plain with the Scott Plateau	
RAMSAR	X		

	Present	Comment	Key periods	Impacts
Traditional Owner values	X			Oil contacting shorelines will impact upon these values, in particular, tourism and fishing activities from visible stranded oil and tainted fish The habitat and marine fauna which may be contacted by oil (as described above) will then impact upon the socio-economic values
Tourism	✓	Nature-based tourism (charter boats, diving and snorkelling)	Tourism: Sep to Dec	
Recreation	✓	Recreational fishing (although prohibited in certain zones) low usage, given distance to mainland		
Shipwrecks	X			

Protection Priority	Key Values and Potential Impacts	Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
Cassini Island	Cassini island is comprised mainly of a laterite mesa about 15-20 m high, breaking away to cliffs undercut with caves, or with narrow beaches in sheltered areas. The coastline is a mixture of promontories and bays, with sandy beaches backed by vegetated dunes. **Physical Habitat**	Probability of contact by shoreline oil at% ≥10g/m^2	%	3.3	11.3
		Probability of contact by shoreline oil at ≥100g/m^2	%	2	10

	Present	Notes	Key periods	Impacts

Protection Priority	Key Values and Potential Impacts	Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC

Coral reefs	✓	Corals abundant on outer edges of reef system		Contact from shoreline oil is likely to impact the shoreline and result in accumulated stranded oil at discrete locations. Intertidal areas may be impacted by being smothered, although continuous tidal movements will mobilise oil and add to dispersion. Contact from entrained oil may impact shoreline through accumulation, although constant tidal and current motions will re-mobilise oil and create further dilution. Contact from entrained oil may impact submerged habitats, such as coral reefs, resulting in smothering and/or contact toxic impacts; although constant tidal and current motions will re-mobilise oil and create further dilution.
Seagrasses	X			
Macroalgae and non-coral benthic invertebrates	X			
Mangroves	X			
Rocky shoreline	✓	Many cliffs providing important seabird habitat		

Marine Fauna

	Present	Comment	Key periods	Impacts
Invertebrates				Contact from shoreline oil is likely to impact marine fauna by smothering (causing skin/eye irritation and affect ability to thermo-regulate) and oil contact from movement across the shoreline. In addition, ingestion may occur from preening/cleaning body and/or eating oil covered food resulting in internal toxicity. Contact from entrained oil may impact marine fauna by causing skin irritation/toxicity as fauna move through water, or internal toxicity from ingesting oil tainted food. Although constant tidal and current motions will re-mobilise oil and create further dilution and fauna are mobile.
Fish and sharks	✓	Many northern Australian varieties of fish associated with corals on outer edges of reef system		
Birds	✓	A relatively diverse population of birds		
Marine reptiles	✓	Green turtle nesting and a significant green turtle rookery		
Marine Mammals	X			

Protected Areas

	Present	Comment	Impacts
AMP	X		There are no protected areas within this priority area to be impacted by oil contact.
State MP	X	(Proposed nature reserve)	
KEF	X		
RAMSAR	X		

	Present	Comment	Key periods	Impacts
Traditional Owner values	✓	Traditional owners visit the island to gather turtle eggs and meat occasionally and several significant sites are known.		Oil contacting these values are described under the individual receptors. • Traditional owner values relating to marine fauna will be affected by those impacts described above, however, onshore significant sites unlikely to be contacted by oil.
Tourism	X			
Recreation	X			
Shipwrecks	X			

Oil Spill Modelling Parameter		Sea Eagle-1 LOWC	Tahbilk-1 LOWC
Probability of contact by total submerged oil at ≥100ppb	(%)	0.7	6.7
Probability of contact by dissolved aromatics at ≥ 50 ppb	(%)	NC	NC
Maximum oil loading on shorelines (>100g/m^2)	tonnes	84.5	104.9
Minimum time to contact by shoreline oil at ≥10 g/m^2	days	11.5	22.2
Minimum time to contact by shoreline oil at ≥100 g/m^2	days	11.5	22.2
Maximum time-averaged concentration of total submerged oil at ≥100ppb	ppb	122.1	217.7
Maximum concentration of dissolved aromatics at ≥ 50 ppb	ppb	NC	NC

Sea Eagle-1 and Tahbilk-1 Vessel Based Activity Environment Plan

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APPENDIX H - POTENTIAL MONITORING SITES AND SMPs

	Surface 1g/m^2	Total submerged 10ppb	Water Quality SMP 1	Sediment Quality SMP 2	Shorelines and Coastal Habitats – sandy beaches, rocky shores SMP 3	Shorelines and Coastal Habitats -Mangroves SMP 4	Shorelines and Coastal Habitats – intertidal mudflats SMP 5	Benthic Habitats SMP 6	Seabirds and Shorebirds SMP 7	Marine Megafauna SMP 8	Marine Reptiles SMP 9	Seafood Quality, Fisheries and Aquaculture SMP 10	Fish, Invertebrates (Crustaceans and Cephalopods) SMP 11
Argo-Rowley Terrace AMP	X	X	X							X		X	
Ashmore Reef AMP	X	X	X	X	X			X	X	X	X	X	X
Cartier Island AMP	X	X	X	X	X			X	X	X	X	X	X
Joseph Bobaparte Gulf AMP	X		X	X	X	X	X	X	X	X	X	X	X
Kimberley AMP	X	X	X	X	X	X	X	X	X	X	X	X	X
Browse Island		X	X										
Oceanic Shoals AMP	X	X	X					X		X		X	X
Acient Coastline at 125m Depth Contour	X	X	X										
Ashmore Reef and Cartier Island and surrounding Commonwealth Waters	X	X	X	X	X			X	X	X	X	X	X
Canyons linking the Argo Abyssal Plain with the Scott Plateau	X	X	X										
Carbonate Bank and Terrace System of the Sahul Shelf	X	X	X										
Carbonate Bank and Terrace System of the Van Diemen Rise	X	X	X										

			Water Quality	Sediment Quality	Shorelines and Coastal Habitats – sandy beaches, rocky shores	Shorelines and Coastal Habitats -Mangroves	Shorelines and Coastal Habitats – intertidal mudflats	Benthic Habitats	Seabirds and Shorebirds	Marine Megafauna	Marine Reptiles	Seafood Quality, Fisheries and Aquaculture	Fish, Invertebrates (Crustaceans and Cephalopods)
	Surface 1g/m^2	Total submerged 10ppb	SMP 1	SMP 2	SMP 3	SMP 4	SMP 5	SMP 6	SMP 7	SMP 8	SMP 9	SMP 10	SMP 11
Continental Slope Demersal Fish Communities	X	X	X					X				X	X
Pinnacles of the Bonaparte Basin	X	X	X										
Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex	X	X	X	X				X	X	X	X	X	X
Shelf Break and Slope of the Arafura Shelf		X	X										
Baldwin Bank	X	X	X										
Barracouta Shoal	X	X	X										
Barton Shoal	X	X	X										
Bellona Bank		X	X										
Big Bank Shoals	X	X	X										
Dillon Shoal		X	X										
East Holothuria Reef	X	X	X										
Echo Shoals	X	X	X										
Echuca Shoal	X	X	X										

			Water Quality	Sediment Quality	Shorelines and Coastal Habitats – sandy beaches, rocky shores	Shorelines and Coastal Habitats -Mangroves	Shorelines and Coastal Habitats – intertidal mudflats	Benthic Habitats	Seabirds and Shorebirds	Marine Megafauna	Marine Reptiles	Seafood Quality, Fisheries and Aquaculture	Fish, Invertebrates (Crustaceans and Cephalopods)
	Surface 1g/m²	Total submerged 10ppb	SMP 1	SMP 2	SMP 3	SMP 4	SMP 5	SMP 6	SMP 7	SMP 8	SMP 9	SMP 10	SMP 11
Heywood Shoal	X	X	X								X	X	X
Hibernia Reef	X	X	X								X	X	X
Holothuria Banks	X	X	X										
Jabiru Shoals	X	X	X										
Johnson Bank	X	X	X										
Karmt Shoal	X	X	X										
Margaret Harries Bank		X	X										
Penguin Shoal	X	X	X										
Sahul Bank	X	X	X										
Sandy Islet		X	X	X	X				X		X		
Scott Reef North	X	X	X	X					X	X	X	X	X
Scott Reef South	X	X		X	X				X	X	X	X	X
Seringapatam Reef	X	X		X				X		X	X	X	X
The Boxers Area		X	X										
Van Cloon Shoal	X	X	X										

	Surface $1g/m^2$	Total submerged 10ppb	Water Quality SMP 1	Sediment Quality SMP 2	Shorelines and Coastal Habitats – sandy beaches, rocky shores SMP 3	Shorelines and Coastal Habitats -Mangroves SMP 4	Shorelines and Coastal Habitats – intertidal mudflats SMP 5	Benthic Habitats SMP 6	Seabirds and Shorebirds SMP 7	Marine Megafauna SMP 8	Marine Reptiles SMP 9	Seafood Quality, Fisheries and Aquaculture SMP 10	Fish, Invertebrates (Crustaceans and Cephalopods) SMP 11
Vulcan Shoal	X	X	X										
Woodbine Bank	X	X	X										
Cartier Islands	X	X	X	X	X			X	X		X		
Ashmore Reef	X	X	X	X				X	X	X	X		X
Indonesia	X	X	X	X	X	X	X	X	X	X	X	X	X
Timor-Leste	X	X	X	X	X	X	X	X	X	X	X	X	X

Sea Eagle-1 and Tahbilk-1 Vessel Based Activity Environment Plan

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APPENDIX I - SMP FRAMEWORK

Framework for Scientific Monitoring
GF-70-PR-I-00035
Rev 4

FACILITY	All Operations
REVIEW INTERVAL	12 months

Rev No	Date	Approval			
			Owner	Reviewer	Approver
		Originator	HSE Manager	Operations Superintendent	Country Manager
0	27/07/2017	Helen Astill/Gill Starling	John Williams	Melissa Patt	Mark Robertson
1	28/07/2017	Helen Astill/Gill Starling	John Williams	Melissa Patt	Mark Robertson
2	18/10/2017	Helen Astill	John Williams	Andrew Gibbons	Mark Robertson
3	24/05/2018	Helen Astill	John Williams	Helen Astill	Mark Robertson
4	12/12/18	Helen Astill	Helen Astill	Brendan White	David Lamb

Holders of Controlled Copies:

Perth Office – General Manager

All Operations – facilities, MODUs and vessels (as relevant)

Any hard copy of this document, other than those identified above, are uncontrolled. Please refer to the Jadestone Energy EDMS site for the latest revision.

REVISION HISTORY

Revision	Author / Editor	Amendment
0	Helen Astill / Gill Starling	Final for submission to NOPSEMA
1	Helen Astill	Revised submission to NOPSEMA
2	Helen Astill	Revised submission to NOPSEMA
3	Helen Astill	Revised submission to NOPSEMA
4	Helen Astill	Revised submission to NOPSEMA

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Acronyms and Abbreviations

Abbreviation	Description
ALARP	As Low As Reasonably Practicable
AMOSC	Australian Marine Oil Spill Centre
AMSA	Australian Maritime Safety Authority
BTEX	benzene, toluene, ethylbenzene and xylene
BRUV	Baited Remote Underwater Video
CMR	Commonwealth Marine Reserve
DA	Designated Authority
DAWR	Department of Agriculture and Water resources
DOT	Department of Transport
EMBA	Environment that May Be Affected
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
HMA	Hazard Management Authority
HSE	Health Safety Environment
IEUL	IMT Environment Unit Lead
IGEMs	Industry-Government Environmental Meta-database
IMPS	Introduced Marine Pest Species
IMT	Incident Management Team
IMTRP	Incident Management Team Response Plan
KEFs	Key Ecological Features
LAT	Lowest astronomical tide
MP	Monitoring Personnel
MPRA	Marine Parks Reserves Authority
MSA	Master Services Agreement
NEBA	Net Environmental Benefit Assessment
NES	National Environmental Significance
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority

Abbreviation	Description
NWS	North West Shelf
OGP	Oil and gas producers (association)
OIM	Offshore Installation Manager
OIW	Oil-in-water
OMP	Operational Monitoring Plan
OMT	Operational Monitoring Tactic
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
OSMP	Operational Scientific Monitoring Plan
OSRP	Oil Spill Response Organisation
OSTM	Oil Spill Trajectory Model
ppm	parts per million
ROV	Remote Operated Vehicle
SME	Subject Matter Expert
SMP	Scientific Monitoring Plan
SMPIP	Scientific Monitoring Plan Implementation Plan
SoW	Scope of Work
TL	Technical Lead
TPH	Total petroleum hydrocarbons
UAV	Underwater Automated Vehicle
WA	Western Australia
WAF	Water accommodated fraction

1. INTRODUCTION

1.1 Purpose

The *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (the Environment Regulations) require a Titleholder to have a plan for monitoring environmental and social impacts due to an oil pollution event and the associated response activities.

Monitoring is needed to characterise the environmental and social impacts, and recovery from these impacts. Monitoring activities are commonly needed for Level 2 (notionally, 1 to 10 tonne of oil released) spill events, and usually in greater complexity in Level 3 (>10 tonne of oil released) spill events.

Whilst scientific monitoring will generate data that provides information relating to remediation activities (e.g. marine fauna observation data will inform oiled wildlife response activities), the purpose of scientific monitoring is to provide quantitative data on environmental and social impacts – and recovery – arising from a spill to inform the incident management planning cycle.

Scientific monitoring does not replace the need to develop remediation plans in the event they are required. For example, shoreline clean-up is a remediation activity provided for in the relevant OPEP. Scientific monitoring information will inform decisions to commence and terminate shoreline clean-up; however, scientific monitoring does not replace the need for clean-up activities.

To anticipate remediation activities now – including defining objectives, action requirements and close out measures – before the level of impact is known would be inefficient. In addition, the development of remediation plans would be highly dependent on the relevant HMA (i.e. State or Commonwealth representative) for a given incident.

1.2 Documentation

This Framework document provides an overview of how monitoring activities are developed and delivered by Jadestone's Incident Management Team, and interfaces with other Jadestone documents:

- **Incident Management Team Response Plan (IMTRP) (JS-70-PLN-F-00008)** – The IMTRP describes the onshore response planning and incident management that would operate under emergency conditions. The document describes how the Incident Management Team (IMT) operates and interfaces with the Group Crisis Team and external parties including third party contractors, emergency services, designated authorities, joint operations Agreement Partners, families of personnel involved and the media;
- **Oil Spill Response Arrangements (OSRA) (JS-70-PLN-I-00037)** – This document outlines the standard processes to be followed when managing an oil pollution event;
- **Oil Pollution Emergency Plan (OPEP)** – This document is activity specific and makes clear the detailed requirements and considerations foe the management of an oil pollution event associated with that activity/location;
- **Operational Monitoring Tactics (OMTs)** – OMTs are described in the activity-specific OPEP. The operational monitoring tactics support Planning and Operations activities of the response by informing the Incident Management Team of the spill behaviour and assist tracking the effectiveness of spill response measures being used;
- **Scientific Monitoring Plans (SMPs)** – Appendix 2 details the technical aspects of each plan such as initiation and termination criteria, field method, data analysis and reporting and other information; and
- **Scientific Monitoring Plan – Implementation Plan (SMPIP)** – Implementation of scientific monitoring activities is provided by Jacobs to Jadestone. The SMPIP is the operational document that outlines how Jacobs will coordinate its response arrangements for Jadestone including procedures, logistics and coordination, resourcing and preliminary study specifications. This document is contained within the MSA with Jacobs.

1.3 Document Updates

The currency of the information provided in the SMP Framework will be maintained by review:

- Every 12-months, following an annual OPEP exercise;
- In response to acquiring approval for a new or modified activity that affects the content of this document;
- Management of Change processes that require a change of the content of this document.

2. RESPONSE MANAGEMENT

2.1 Incident Action Planning Cycle

The Jadestone Incident Action Planning cycle for oil spill response is presented in **Error! Reference source not found.**. For further information, please refer to Jadestone's Oil Spill Response Arrangements (JS-70-PLN-I-00037).

2.2 Identifying Receptors at Risk

During the approvals process for Jadestone activities, predictions of environmental and social receptors that may be affected during an oil spill event were identified. This information can be found in the applicable Environment Plan (EP) and the Oil Pollution Emergency Plan (OPEP), specific to the activity, and will be available to the Incident Management Team for planning purposes in the early stages of a spill response. In the event of a spill, regular review and update of the receptors at risk will occur based on monitoring information constantly feeding the Incident Action Planning process. By constant review of the receptors at risk in the incident planning process, this allows the environmental monitoring provisions to be flexible, adaptable and sufficiently conservative to accommodate all receptors at risk.

Predicted sensitive receptors have been identified during preparation of the environment plan and assigned an appropriate SMP to ensure potential impacts are identified and monitored in a formal Scientific Monitoring Program. Once the SMPs are activated, they become part of the IAP process (refer Figure 6-1 of the OSR Arrangements) and impacts to sensitive receptors are captured, documented and monitored until recovery (as determined by the specific SMP). This enables a check to occur to ensure that any contacted sensitive receptors (as identified by operational monitoring) are included in an SMP (as operational monitoring showing potential or actual hydrocarbon contact of a sensitive receptor is a trigger of the SMP) and then part of the IAP. Appendix 1 shows the relevant management plans, and their key performance indicators for meeting management targets for protected areas, both associated with the sensitive receptors identified during the activity approval process and for which SMPs are to be implemented to monitor impact and recovery.

2.3 Implementation of SMPs

Table 2.1 provides a summary of the SMP Implementation Plan (SMPIP) that details how Jacobs will implement the monitoring activites on behalf of Jadestone in the event of an oil spill. Full detail of the SMPIP is provided in the Contract for Service.

Table 2.1: SMPIP Summary

SMPIP content details	Description	Reference
Initiation and termination criteria	• Initiation criteria, based on data from operational activities. • Termination criteria, based on analysis of scientific monitoring data translated to the IMT through the planning function.	• Appendix 2
Implementation	• Roles and responsibilities • Lines of communication • Requirements of monitoring activities • Implementation phases • HSE requirements • Survey logistics including mobilisation, support and demobilisation • Data management • Technical reporting • Internal review, external audit and testing • Maintenance and review	• OPEP • OPEP/SMPIP • Appendix 2 • SMPIP • SMPIP • SMPIP • EP / OPEP
Resources	• Organisations and personnel • Support equipment (e.g. vessels) • Monitoring equipment	• SMPIP
Scientific monitoring considerations	• Sites during reactive baseline surveys • Additional sites • Impact assessment approach.	• SMPIP

2.3.1 Initiation and Termination of Monitoring Activities

Initiation of monitoring occurs in the event of a Level 2 or 3 oil spill through a decision process described within Jadestone's OSRA and illustrated in **Error! Reference source not found.**. Each SMP is triggered by initiation criteria linked to information provided by the operational monitoring as described in the OSRA. The specific initiation criteria are defined in the SMPs (Appendix 2).

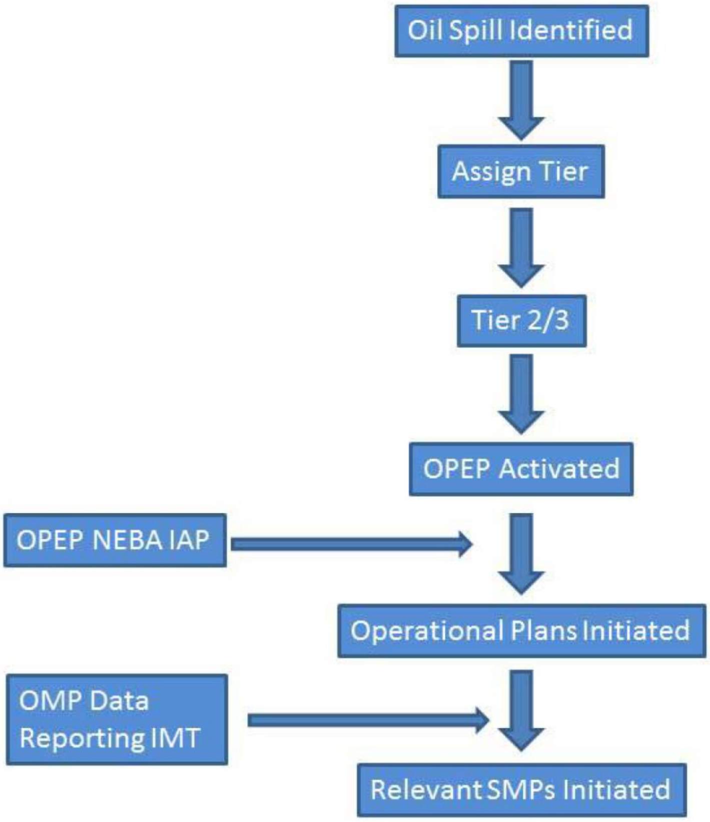

Figure 2-1 SMP Activation

Predictive modelling results obtained through operational monitoring will provide direction on what SMPs (if any) are to be initiated and the spatial extent of the monitoring in the first week, HSE arrangements permitting. Other operational monitoring plans such as aerial surveillance, tracking buoy data, vessel surveillance once activated can then provide realtime confirmation and better direct the SMPs.

SMPs may occur concurrently with and/or directly after the operational response phase. The individual monitoring activities initiated may be directly determined by the response activities implemented and the information collected during the response phase.

The monitoring activity is stopped when termination criteria associated with the SMP are achieved. These criteria are defined in the SMPs (Appendix 2). Where there is a Protected Area Management Plan in place for any SMP, defined management targets will guide the termination criteria (Refer Appendix 1).

SMPs will be activated and terminated in consultation with stakeholders such as government, community or fishing groups in response to particular concerns or claims, and under the direction of the IMT Leader.

2.3.2 Roles and Responsibilities

The Jadestone Incident Management Team (IMT) will be activated in the event of a level 2 or 3 oil spill. The Jadestone response structure to a major emergency is detailed in the Incident Management Team Response Plan – onshore (IMTRP) (JS-70-PLN-F-00008).

The Planning Team, specifically the Jadestone Environmental Team Lead, is responsible for the delivery of the SMPs. The roles and responsibilities of the for all personnel involved in the response are detailed in the OSRA.

External Support

During and post-spill, scientific monitoring activities require resources external to Jadestone which include specialist technical capabilities. Jacobs is nominated as Jadestone's primary support agency for scientific response monitoring activities; a Purchase Order is in place with Jacobs for intial mobilisation and work. An MSA is in place for ongoing support.

Jacobs has the ability to increase resourcing for SMPs through the hiring of personnel and equipment through sub-contracted companies, as may be required to provide for the varied disciplines and fields of expertise for each of the SMPs, and to accommodate the scaling up of monitoring as the spatial extent of a spill increases. This is considered normal practice for environmental monitoring providers given the limited ability of any single provider to provide all expertise and equipment across the multitude of marine and coastal scientific disciplines.

Vessels to mobilise field teams to monitoring sites or for on-water sampling activities will be mobilised through Jadestone existing MSAs through multiple vessel providers. Given that sampling locations for the SMPs would in many instances be coincident to sites targeted for operational monitoring and spill response strategies, there exists opportunities for shared vessel usage during a spill.

Jacobs' Capability

The service provider, Jacobs provides the following key personnel to support the execution of the SMP. These are:

- Project Manager – manages project and is 'on call' pre-spill
- Technical Director – manages the full scientific monitoring program
- Field Operations Coordinator – across full program
- Field Technical Lead
- Field Scientist
- Lead Surveyor (for beach profiling etc. if required)
- Surveyor (for beach profiling etc. if required)

The resourcing strategy in the event of a spill basically draws upon marine and environmental resources that can be made available from:

- Jacobs Perth Operations
- The remainder of Jacobs Australia / New Zealand Operations
- Sole Contractor
- MOUs Jacobs has in place
- Jacobs UK operations as bench strength (Jacobs has a large marine and aquatic science team in the UK).

When Jacobs provide their OSMP Monthly Readiness Reports, Jacobs will make certain reasonable assumptions with respect to personnel availability (based on knowledge of workload and data from Jacobs internal resourcing tools); and the ability to make people who are committed to projects available in the event of a spill. In addition, the monthly readiness report will illustrate how the roles within the SMP program requirements are resourced for that month.

In terms of equipment, Jacobs maintains a register of suppliers and contacts these each month. They provide an estimate of the likely available of the equipment for the following months which Jacobs report on. Where possible, Jacobs identify multiple suppliers for each piece of equipment to provide redundancy.

Further details of the equipment and personnel to execute the monitoring plan are provided in the SMPIP.

2.3.3 Implementation Readiness

Implementation phases of response monitoring include a readiness phase and a monitoring phase upon notification of the spill through to post spill recovery monitoring.

An SMPIP prepared by Jacobs is the guiding document for the initiation and delivery of the scientific monitoring plans. The SMPIP is appended to the Contract for Service between Jacobs and Jadestone. As part of Jadestone's Contractor Management activities, Jacobs will be audited and monitored for readiness arrangements in the provision of scientific monitoring services, including how science quality is assured earlier in the pre-implementation phase of a response to ensure experimental designs are robust and defensible prior to their implementation. The audit scope will include review of the capability requirements as per Section 2.3.2.

As an overarching document that ties together the delivery of the separate SMPs, the SMPIP provides:

- Linkages between Jadestone's and Jacobs relevant emergency response documentation;
- An overview of the organisational chart and communication protocol applicable to the Planning/ Environmental Team Lead responsible for coordinating the monitoring activities, and the Operations Team Leader responsible for implementing the monitoring activities in the field;
- Information on personnel, equipment and management team requirements;
- Implementation steps (preparedness, project execution and scientific methodology);
- Independent service provider preparedness requirements;
- SMP initiation procedures and actions; and
- SMP implementation activities (including logistical considerations, reporting and data management requirements).

Table 2.2 explains when each phase will commence, what activities will be undertaken and their intended purpose and output.

Table 2.2: SMP Implementation Phases

Phase	When / Timing	Activity	Purpose	Output
Readiness	Ongoing	Review and update of SMPIP, SMPs as necessary Maintain contracting arrangements for personnel and equipment. Maintain testing and exercising requirements	'Readiness' to ensure timely response to implement SMP.	Mobilisation of SMP in event of an incident as soon as possible, to manage risks and impacts to ALARP.
Monitoring	Upon Notification of Spill	Mobilise as per implementation plan.	Ensure potential impacts can be ascertained and monitored Gather baseline and reference data (both IGEMs and new) Inform response planning and management of hydrocarbon spill.	Information (data, reports etc.) to IMT to inform a response which manages risks and impacts to ALARP.
	During Spill	Continue monitoring activities as required.	SMP to inform response. SMP to monitor contacted sensitivities.	Information (data, reports etc.) to IMT to inform a response which manages risks and impacts to ALARP.
	During Spill	Collate and assess existing baseline data for key sensitivities.	Establish baseline condition of sensitivities Identify gaps in baseline to acquire from scientific monitoring studies.	Baseline data reports for each scientific study.
	Post Spill Long-Term Monitoring	Continued implementation of scientific monitoring	Scientific monitoring studies to monitor impact and recovery of sensitivities.	Reports on impact and recovery to sensitivities.
	Post Spill Long-Term Monitoring	Terminate scientific monitoring when termination criteria met.	Environmental sensitivities sufficiently recovered from hydrocarbon impacts or	Final Reports.

Phase	When / Timing	Activity	Purpose	Output
			assessed to satisfaction of stakeholders.	

As a measure of readiness, Jacobs will maintain the following during contract tenure:

- Development and maintenance of the SMP Implementation Plan;
- Maintenance of operational readiness including MOUs with service providers to ensure capability and capacity;
- Monthly reporting of resource (people and equipment) availability against the resourcing requirements of the scientific monitoring programs detailed within this document;
- General support such as drill participation; and
- A commitment to support Jadestone in the undertaking of operational and scientific monitoring in the event of an activation of a Jadestone OSMP, including taking all reasonable endeavours to mobilise the required resources (people and equipment) within the specified mobilisation times.

2.3.4 Reporting

Each study will provide daily reports on progress and relevant findings to the Environment Team Lead during the response to an incident.

For the scientific monitoring activities, regulators and relevant stakeholders will be provided with reports through the Jadestone IMT.

2.3.5 Review, Auditing and Testing

Readiness to implement each SMP will be assessed in accordance with the schedule outlined in the EP.

2.3.6 Monitoring Equipment

The required equipment capacity to meet the monitoring needs of an incident will be specified in the SMPIP. This will include a catalogue of monitoring equipment and systems (e.g. water and sediment samples, marine autonomous vehicles, aerial drones etc.).

3. SCIENTIFIC MONITORING

3.1 Scientific Monitoring Plans – List of SMPs

In the event the need for scientific monitoring is triggered, for example, shoreline contact of oil is predicted, scientific monitoring activities will be triggered according to the environmental and social sensitivities that may be impacted by the event.

A summary of the scientific monitoring plans that may be implemented during a spill response are listed in Table 3.1.

Table 3.1: Summary of the SMPs

Reference	Study Name	Aim
SMP 1	Water Quality	To determine the presence and spatial extent of hydrocarbon compounds in marine waters
SMP 2	Sediment Quality	To determine the presence and extent of hydrocarbon compounds in marine sediments
SMP 3	Intertidal Mudflats, Sandy beaches and Rocky Shores	To monitor change and subsequent recovery of biota of sandy and rocky shoreline habitats from hydrocarbon exposure
SMP 4	Mangroves	To monitor change to mangrove extent and health due to hydrocarbon exposure
SMP 5	Benthic habitats	To evaluate change in cover and composition of benthic habitats due to hydrocarbon exposure.
SMP 6	Marine Fauna	To monitor short and long-term environmental effects on marine fauna that may have resulted from the hydrocarbon spill and

		associated response.
SMP 7	Seafood Quality, Fisheries and Aquaculture	To identify potential health risks due to the presence of hydrocarbons in the flesh of targeted fisheries/aquaculture species
SMP 8	Fish, Invertebrates (Crustaceans and Cephalopods)	To monitor the abundance and distribution of fish assemblages in areas contacted by hydrocarbon spill.

Further detail is provided for each SMP in Appendix 2.

3.2 Scientific Monitoring Plans – Information Provided per SMP

For each SMP, common information is provided in a standardised template (refer Table 3.2).

Table 3.2: Information Provided per SMP

SMP detailed item	Description
Rationale	Importance of receptor, possible impact and importance of monitoring program.
Aim	A statement of what the program intends to achieve.
Baseline	No baseline data required. It is assumed marine waters of the environment that may be affected will not be polluted with hydrocarbons over the spatial extents considered for spill scenarios.
Contact	Contact is defined as occurring where any aerial, visual or fluorescence observation reports submitted to the IMT show presence, or spill fate modelling predicts oil at sensitive receptors of > 1 g/m^2 for surface oil, and >100 ppb and 50 ppb for entrained and dissolved oil respectively. [1]
Initiation criteria	Triggers to activate the program
Termination criteria	Triggers to terminate the program. Termination criteria will be aligned and agreed with key stakeholders. Where there is a Protected Area Management plan in place, management targets will guide termination criteria (Appendix 1), and be determined in conulstation with relevant stakeholders. Termination criteria form to be signed off by relevant stakeholders to make sure their interests have been met
Receptor impact	Measured states and pressures according to the State-Pressure-Response model.
Methodology	Descriptions of sampling methods to carry out scientific monitoring, including reference to methods described in an appendix. Where relevant, measurement criteria will align with Protected Area Management Plan or recovery plans where relevant.
Scope of works.	Timeline for scope of works (SoW) development.
Statistically significant	The basis of the significance is determined by the methodological approach as outlined in the relevant SMP.
Resources	List of some of the required resources.
Implementation	Mobilisation requirements for service provider(s).
Analysis and reporting	Summary of analysis, data management and reporting.

[1] For noting, the concentration thresholds set in this table are deliberately lower than the contact thresholds used for impact assessment in the Environment Plan. The intended lower contact threshold concentrations set here are to be used by spill fate modelling in a spill response scenario. The lower concentrations will allow the response team to identify sensitive receptor locations at risk of contact by oil fractions prior to contact.

3.3 Baseline and Reference Information

No pre-collected baseline or reference data are required to assess impacts to the marine environment due to a hydrocarbon release. It is assumed marine waters of the environment that may be affected will not be polluted with hydrocarbons in the areas considered for spill scenarios relevant to this activity.

Many relevant datasets that help establish baseline or reference data are available, including those held by other operators, government authorities and research agencies. IGEM (Industry-Government Environmental Meta-database) is a collaboration between the oil and gas Industry and government-funded organisations. Its primary goal is to enable the sharing of marine-based studies between government, industry and other stakeholders in a metadatabase format. It provides members the ability to enter, view and filter metadata and export results to a report. Where environmental knowledge gaps are identified, in the event of a spill, appropriate bio-statistical design of the fieldwork, data analysis and reporting would be incorporated into the post-spill event monitoring activities in place of full baseline datasets.

While baseline data can be used to evaluate ecological changes at a location, baseline data is not required to measure changes due to exposure to a pollutant over time (e.g. Underwood 1992 and references cited therein). The ideal that baseline data will make clear when an ecosystem has returned to pre-exposure conditions is difficult to achieve in reality due to natural perturbations that the marine environment is expected to experience (e.g. cyclones, El Niño events, climate change, etc.). In fact, the use of reference sites that allow a measure of ecological function as well as features (e.g. assemblages, coverage) that are also experiencing common natural perturbations is a more desirable approach to measuring impact and recovery so changes due to additional drivers are also incorporated into the assessment.

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Appendix 1: Management Plans and Key Performance Indicators / Key Values for Protected Areas

Table A.1

Note for all CMRs there are no current Management Plans - Until new management plans come into effect, transitional management arrangements are in place for marine reserves in the South-west, North-west, North, Temperate East and Coral Sea. Under these transitional arrangements, there are no changes “on the water” for users of the reserves. - See more at: https://parksaustralia.gov.au/marine/faq.html#sthash.gLaohh8v.dpuf

Appendix 2: Scientific Monitoring Plans

Table A1-1 SMP1 Water Quality

Strategy Component	Description – SMP1 Water quality
Rationale	Release of hydrocarbon to the marine environment will cause pollution of marine waters.
Aim	To determine the presence and spatial extent of hydrocarbon in marine waters.
Baseline	No baseline data required. It is assumed marine waters of the environment affected will not be polluted with hydrocarbons over the spatial extents considered for spill response.
Initiation criteria	Upon notification of a tier 2/3 spill event.
Termination criteria	When hydrocarbon pollution is no longer detectable within the environment affected by the spill.
Receptor impact	All environmental and social resources supported by marine waters within the environment affected by the spill.
Methodology	Water sampling and laboratory processing will follow the methods provided in CSIRO (2016) and McAlpine et al. (2010). Where relevant, measurement critieria will align with Protected Areas Management Plans.
Scope of works	Prepared for issue within 48 hours from activation of SMP1.
Resources	2 x water quality technicians 1 x Geographic Information Systems (GIS) personnel National Association of Testing Authorities (NATA) accredited laboratory for sample analysis Vessel and tender in operation Refueling facilities Decontamination/ washing facilities Safety aircraft/ rescue vessel on standby Submersible hydrocarbon fluorometers Water quality profilers Water samplers Booms and absorbent pads Cleaning agent Coolers (including ice bricks) Sample containers Preservative Hand held GPS unit Field laptop Hard drives
Implementation	Service provider to mobilise within 3 days from SMP1 being activated (this time allowing for preparation scope of work, equipment and disposables and travel to site).
Analysis and reporting	Chemical analysis will be carried out by NATA-accredited Laboratories. Data will be entered into an appropriate database which includes spatial information. Data will be statistically analysed. Data and conclusions will be summarised in a data report. Final report will be technically reviewed (peer review).

Table A1-2 SMP2 Sediment Quality

Strategy Component	Description – SMP2 Sediment quality
Rationale	Hydrocarbons released during a spill may contact and accumulate in marine sediments.
Aim	To determine the presence and extent of hydrocarbon compounds in marine sediments.
Baseline	No baseline data required. It is assumed marine sediments of the environment affected will not be polluted with hydrocarbons over the spatial extents considered for spill response.
Initiation criteria	Upon notification of a tier 2/3 spill event.
Termination Criteria	When hydrocarbon pollution is no longer detectable in the environment affected by the spill.
Receptor impact	All environmental and social resources supported by sediments within the environment affected by the spill.
Methodology	Sediment sampling and laboratory processing will follow the methods provided in AMSA (2003) and McAlpine et al. (2010). Where relevant, measurement critieria will align with Protected Areas Management Plans.
Scope of works	Prepared for issue within 48 hours from activation of SMP2.
Resources	2 Sediment quality technicians (field-based) 1 Geographic Information Systems (GIS) personnel (office based) National Association of Testing Authorities (NATA) accredited laboratory for sample analysis Vessel and tender in operation Refueling facilities Decontamination/washing facilities Safety aircraft/rescue vessel on standby Box corer Van veen sampler Sample drums 10% formalin 1L 5mm dyneema rope Flat spade Laser level and staff Nally tubs Sieve (1mm) Sampling containers Consumables (Decon 90, cleaning agents) Eskies and freezer blocks Glass mixing bowl and plastic spoons Non-powdered gloves
Implementation	Service provider to mobilise within 3 days from SMP2 being activated (this time allowing for preparation of scope of work, equipment and disposables and travel to site).
Analysis and reporting	Sediment samples analysed by NATA-accredited laboratories Data will be entered into an appropriate database which includes spatial information. Data will be statistically analysed. Data and conclusions will be summarised in a data report. Final report will be technically reviewed (peer review).

Table A1-3 SMP3 Intertidal Mudflats, Sandy Beaches and Rocky Shores

Strategy Component	Description – SMP3 Intertidal mudflats, sandy beaches and rocky shores
Rationale	Intertidal mudflats, rocky shores and sandy beaches may be loaded during a hydrocarbon spill with the stranding of floating and entrained oil. Intervertable faunal assemblages in turn may be affected due to hydrocarbon pollution.
Aim	To monitor change and subsequent recovery of biota of intertidal mudflats, sandy beaches and rocky shoreline habitats from hydrocarbon exposure.
Baseline	No baseline data required. It is assumed invertebrate assemblages of intertidal mudflats, sandy beaches and rocky shorelines will not be experiencing perturbations due to pollution immediately prior to, or at the time of commencement of the spill.
Initiation Criteria	Following information provided by operational monitoring (spill tracking buoys, spill modelling, surveillance), SMP1 or SMP2 that floating oil will, or has, stranded along intertidal mudflats/ sandy beaches/ rocky shores.
Termination Criteria	Shoreline invertebrate assemblages (abundance, species diversity/ composition) are not significantly different with assemblages at comparable reference sites not impacted by the spill. Once shoreline invertebrate assemblages have demonstrated no significant difference between areas affected and areas unaffected, recovery has been achieved.
Receptor Impacts	Hydrocarbon contact with intertidal mudflats, sandy beaches and rocky shores may result in changes to invertebrate assemblages including: • Species diversity; • Assemblage composition; and • Abundance of indicator taxa.
Methodology	Overall design will be in accordance with the following principles: • A comparison of invertebrate assemblages will be made between sites contacted and not contacted (reference) by floating oil. Where applicable (e.g. where whole expanses of shoreline have not been contacted by oil) a gradient approach may be applied along/ up the tidal face to assess impact and recovery. • Wherever possible, common sampling sites will be used with SMP2 sediment measurement sites to allow multivariate analysis of physico-chemical parameters of the sediment in combination with the invertebrate assemblage. • Where relevant, measurement criteria align with Protected Area management plans. • Intertidal mudflat invertebrate assemblages will be evaluated as per the Monitoring Roebuck Bay Benthos program as described in de Goeij *et al.* (2003). Rocky shorelines will be evaluated using quadrats as per Cadee et al. (2008). Invertebrate sampling associated with sandy shores will follow the methodology of Kohn (2003).
Scope of works	Prepared for issue within 72 hours from activation of SMP3.
Resources	1 Senior Scientist (experience with shoreline macroinvertebrates) (field based) 3 Field Assistants GIS personnel (office based) Quadrats, marking stakes and tape (50 m) Metric tape measure Sieve (1mm) Plastic corers Shovels, trowels, spoons Shore levelling equipment (theodolite, dumpy level, staffs) Sampling containers preservative

Strategy Component	Description – SMP3 Intertidal mudflats, sandy beaches and rocky shores
	Eskies and freezer blocks Waders, wetsuit boots Latex gloves Decon 90, deionised water Plastic bags Laboratory facilities for sorting and processing specimens Safety aircraft/rescue vessel on standby Refueling facilities
Implementation	Service provider to mobilise within 5 days of SMP3 being activated (this time allowing for preparation of scope of works, equipment and disposables and travel to site).
Analysis and reporting	Taxa from quadrats or sediment samples will be described to at least a family level and to species level where possible. Data will be entered into an appropriate database which includes spatial information and sediment quality information. Data will be analysed to determine statistical differences among spatially and temporally replicated sites. Where appropriate (e.g. for assemblage composition data) both univariate and multivariate analyses will be used. Data and conclusions will be summarised in an environmental report. Sediment quality data (SMP2) collected concurrently will be used to inform conclusions on impacts where data is relevant. Final report will be technically reviewed (peer review).

Table A1-4 SMP4 Mangroves

Strategy Component	Description – SMP4 Mangroves
Rationale	Mangroves may be contacted by floating and/ or entrained oil. Mangrove health may be directly affected by hydrocarbons due to coating, or indirectly via hydrocarbon contaminants within sediments. Exposure and contact to hydrocarbons can lead to leaf loss, mortality and reduction in aerial extent of mangrove habitat
Aim	To evaluate change in mangrove health and extent due to hydrocarbon exposure.
Baseline	Baseline data including the extent and health of mangroves is available for the north-west region as remotely sensed imagery (Landsat and Worldview) (Kuenzer et al. 2011). As the impacts to mangroves that may occur due to hydrocarbon exposure are not instantaneous, the need for pre-exposure data is reduced.
Initiation criteria	Following information provided by operational monitoring (spill tracking buoys, spill modelling, surveillance), SMP1 or SMP2 that floating or entrained oil will, or has, made contact with mangrove habitat.
Termination criteria	The diversity, health and extent of mangrove areas are not significantly different from from pre-exposure state, or are not significantly different from comparable non-contacted reference mangrove habitats. Once mangroves have demonstrated no significant difference between areas affected and areas unaffected, recovery has been achieved.
Receptor impact	Impact to mangroves from contact with hydrocarbons may be measured through change in: • Species diversity; • Tree health; • Aerial extent.
Methodology	Remote sensing data will be accessed from Landsat and/or Worldview datasets in mangrove areas of interest and analysed using a Normalised Difference Vegetation Index (NDVI), an index of plant health, and a control chart (time series) approach. Remote sensing of mangrove canopy cover and spatial extent of mangrove habitat has been used effectively elsewhere in Australia and has sufficient sensitivity to detect changes in canopy cover. Remote sensing allows larger areas to be monitored and will provide more informative long-term and broad-scale monitoring of mangrove habitats. In-field monitoring design will be in accordance with the following principles: • A comparison of mangrove habitat will be made between sites contacted and not contacted by oil. • Wherever possible, data generated by SMP1 water quality and and SMP2 sediment quality will be used in combination with assessment of impacts to mangrove habitat. • Where relevant, mangrove measurement criteria will align with Protected Area management plans.
Scope of works	Prepared for issue within 96 hours from activation of SMP4.
Resources	1 Senior Scientist (experience in mangrove condition assessment) (field based) 1 Field Assistant 1 GIS personnel (office based) Available vessel in operation Satellite imagery Quadrat marking stakes and tape Metric tape measure Laser distance measurer/ optical reading clinometer/ hypsometer/ 2m measuring pole Densiometer

Strategy Component	Description – SMP4 Mangroves
	Compass Box core and / or van veen grab and accessories Sieve (1mm) Hi-resolution binoculars Torches
Implementation	Service provider to mobilise within 7 days from SMP4 being activated (this time allowing for costing, preparation of scope of work, equipment and disposables and travel to site).
Analysis and reporting	Remote sensing data will be accessed from Landsat and/or Worldview datasets where hydrocarbons have contacted known mangrove areas and analysed using a Normalised Difference Vegetation Index (NDVI), an index of plant health, and a control chart (time series) approach. Data will be entered into an appropriate database which includes spatial information. Data will be analysed to determine statistical differences among spatially and temporally replicated sites. Water quality and sediment quality data (SMP1, SMP2) where relevant will be used to inform conclusions on impacts to mangrove habitats. Final report will be technically reviewed (peer review).

Table A1-5 SMP5 Benthic Habitats

Strategy Component	Description – SMP5 Benthic habitats
Rationale	Coral reefs, macroalgae, seagrass and benthic invertebrate (e.g. sponge gardens) communities are benthic habitats at risk of contact from floating oil (intertidal) and entrained hydrocarbons (subtidal). Impacts to benthic habitats include chronic (e.g. reduced productivity) and acute (e.g. death/ loss of habitat) effects.
Aim	To evaluate change in cover and composition of benthic habitats due to hydrocarbon exposure.
Baseline	No baseline data required. It is assumed benthic habitats in the area of the environment that may be affected will not be experiencing perturbations due to pollution immediately prior to, or at the time of commencement of the spill event.
Initiation Criteria	Following information provided by operational monitoring (spill tracking buoys, spill modelling, surveillance), SMP1 or SMP2 that floating or entrained oil will, or has, made contact with benthic habitats populated with benthic communities.
Termination Criteria	Benthic habitat cover and composition is not significantly different from from pre-exposure state, or are not significantly different from comparable non-contacted benthic habitats (as measured at reference sites). Once benthic habitats have demonstrated no significant difference between areas affected and areas unaffected, recovery has been achieved.
Receptor impact	Impact to benthic habitats from hydrocarbon exposure will be measured through change in: • Species diversity • Assemblage composition • Percent cover
Methodology	Monitoring design will be in accordance with the following principles: • A comparison of benthic habitats will be made between sites contacted (impact) and not contacted (reference) by oil. • Wherever possible, data generated by SMP1 water quality and and SMP2 sediment quality will be used in combination with assessment of impacts to benthic habitats. • Where relevant, measurement criteria for benthic habitats will align with Protected Area management plans. • Fixed transect monitoring approach of benthic habitats is the preferred method allowing greater power for temporal changes to be evaluated.
Scope of works	Prepared for issue within 96 hours from activation of SMP5.
Resources	1 Senior Scientist (experience in benthic habitat assessment) (field based) 1 Field Assistant GIS personnel (office based) 2 ROV Pilot/ towed camera technicians (sourced externally with equipment) (field based) Safety aircraft/rescue vessel on standby Available vessel in operation Decontamination/ washing facilities Satellite imagery ROV spread with mounted video and still camera, lighting and laser scaling Towed video equipment with lighting, laser scaling Drop down camera and housing Field Laptop Hard drives

Strategy Component	Description – SMP5 Benthic habitats
	Digital cameras Hand held GPS unit
Implementation	Service provider to mobilise within 7 days from SMP5 being activated (this time allowing for costing, preparation of scope of work, equipment and disposables and travel to site).
Analysis and reporting	Image analysis software will be used and data recorded into a database. Data will be analysed to determine statistical differences among spatially and temporally replicated sites. Where appropriate (e.g. for assemblage composition data) both univariate and multivariate analyses will be employed. Results and conclusions will be summarised in an environmental report. Water quality and sediment quality data (SMP1 and SMP2) collected where relevant will be used to inform conclusions on impacts. Final report will be technically reviewed (peer review).

Table A1-6 SMP6 Marine fauna

Strategy Component	Description – SMP6 Marine fauna
Rationale	For the purposes of this SMP, marine fauna are defined as: • Shorebirds – those birds that inhabit and feed in the intertidal zone and adjacent areas and are resident or migratory, using the area principally during the austral summer; • Seabirds – those birds associated with the sea and deriving most of their food from it; • Marine megafauna – cetaceans (whales and dolphins), sirenians (dugong) and whale sharks (*Rhincodon typus*); • Marine reptiles – turtles, seasnakes and estuarine crocodiles Marine fauna are at risk of contact from floating oil (on-water roosting/ swimming) and entrained hydrocarbons (diving/ sub-surface movement).
Aim	To monitor short and long-term environmental effects on marine fauna that may have resulted from the hydrocarbon spill and associated response.
Baseline	No baseline data required to quantify the number of individuals affected by a spill event.
Initiation Criteria	Upon notification of spill event.
Termination Criteria	When, in consultation with NOPSEMA, state agencies and DOEE: ○ Impacts to populations from hydrocarbon exposure have been quantified; ○ Recovery of populations has been demonstrated; ○ Agreement with relevant stakeholders based on the nature and scale of the spill, that observed impacts can no longer be attributed to the spill.
Receptor impact	Marine fauna are at risk of contact from floating oil (on-water roosting/ swimming) and entrained hydrocarbons (diving/ sub-surface movement). Impacts to marine fauna include smothering, ingestion, hypothermia, death.
Methodology	Marine fauna monitoring will include opportunistic aerial, vessel and shore-based surveys.
Scope of works	Prepared for issue within 72 hours from activation of SMP6.
Resources	<u>Aerial Survey</u> 1 Senior Marine Scientist 2 Trained Marine Wildlife Observers Pilots and fixed wing aircraft <u>Vessel and shore-based Surveys</u> 1 Senior Marine Scientist 2 Trained Marine Wildlife Observers <u>Equipment</u> Available vessel and tender in operation Refueling facilities for aircraft and vessel NATA accredited laboratory for sample analysis and necropsy Decontamination/ washing facilities Safety aircraft/ rescue vessels on standby Stretchers Hi-resolution binoculars Temperature loggers Torches Latex gloves, garbage bags, plastic aprons Disposable biopsy tools, forceps, scissors

Strategy Component	Description – SMP6 Marine fauna
	Battery operated clippers Haul nets Freezer Digital cameras Hard drives Field laptop Satellite phone and radios Handheld GPS units
Implementation	Service provider to mobilise within 3 days from SMP6 being activated (this time allowing for costing, preparation of equipment and disposables and travel to site).
Analysis and reporting	Data will be entered into an appropriate database and analysed. Data collected from oiled wildlife response documenting numbers of animals affected (e.g. oiled) or dead (necroscopy) are to be included in reporting and analysis. Results and conclusions will be summarised in a data report. Final report will be technically reviewed (peer review).

Table A1-7 SMP7 Seafood Quality, Fisheries and Aquaculture

Strategy Component	Description – SMP7 Seafood quality, fisheries and aquaculture
Rationale	Exposure of commercial and recreationally targeted fish and aquaculture species to entrained and dissolved aromatic hydrocarbons can cause sub-lethal or lethal effects and result in flesh tainting and levels of toxicants above human consumption guidelines. This scope includes finfish, sharks and invertebrates (principally crustacea).
Aim	To identify potential health risks due to the presence of hydrocarbons in the flesh of targeted fish/ fisheries/ aquaculture species.
Baseline	Representative baseline data will be obtained from pre-contact samples or samples from non-contacted (reference) sites as available.
Initiation criteria	Following indication from operational monitoring and SMP1 that marine waters have been contacted by entrained hydrocarbons and/ or dissolved aromatic hydrocarbons such that there may be subsequent impacts to fish.
Termination criteria	Hydrocarbon concentrations and taint in target species tissue samples are not significantly different from comparable non-impacted (reference) samples, where available. Hydrocarbon concentrations must meet statutory specification for residues and taints in food products (see Yender et al., 2002) indicating that the resource is once again commercially available.
Receptor impact	Impact to seafood quality from hydrocarbons is measured through change in toxicity indicators and olfactory taint.
Methodology	Target fish species (indicator species) will be determined from initial data from SMP8 and relevant commercially and recreationally fished species which are sufficiently abundant. Sampling method will be determined by habitat, target species and spill location and will use commercial or recreational techniques as appropriate. Commercial samples for market will be sampled where available. Implementation of this monitoring activity is to be undertaken in conjunction with commercial and recreational fishers as part of the stakeholder communication and consultation activities. Analysis of seafood tissue will follow Gagnon and Rawson (2012); with the addition of muscle (tail) samples of crustacea. Olfactory testing will follow Rawson et al. (2011), following the duo-trio method (Standards Australia 2005).
Scope of works	Prepared for issue within 96 hours from activation of SMP7.
Resources	1 Field Lead 2 Fish Assistants 1 commercial fisherman and vessel (desirable) Commercial fishing equipment Recreational fishing equipment Freezer Liquid nitrogen Glutaraldehyde (preservative) Eskies and freezer blocks Large heavy duty plastic bags Aluminium foil Latex gloves Balance Calipers, rulers, tape measure

Strategy Component	Description – SMP7 Seafood quality, fisheries and aquaculture
	Centrifuge
Implementation	Service provider to mobilise within 7 days from SMP7 being activated (this time allowing for costing, preparation of equipment and disposables and travel to site).
Analysis and reporting	Laboratories NATA-accredited for food standards analyses. Data recorded in an appropriate database and analysed to test for significant differences between impacted and non-impacted seafood. Hydrocarbon concentrations must meet statutory specification for residues and taints in food products (Yender et al. 2002). Final report will be technically reviewed (peer review).

Table A1-8 SMP8 Fish, Invertebrates (Crustaceans and Cephalopods)

Strategy Component	Description – SMP8 Fish, invertebrates (crustaceans and cephalopods)
Rationale	The region consists of a high diversity of fish and benthic motile invertebrate species, comprising an Indo-West Pacific assemblage and the region provides spawning and nursery grounds for several fisheries species. Fish, pelagic and benthic motile invertebrates (together referred to as 'fish') may be affected by entrained hydrocarbon and dissolved aromatic hydrocarbons.
Aim	To monitor the abundance and distribution of fish assemblages in areas contacted by hydrocarbon spill.
Baseline	No baseline data required. It is assumed fish assemblages in the area of the environment that may be affected will not be experiencing perturbations due to pollution immediately prior to, or at the time of commencement of the spill event.
Initiation criteria	Following indication from operational monitoring and SMP1 water quality that marine waters have been contacted by entrained hydrocarbons and/ or dissolved aromatic hydrocarbons such that there may be subsequent impacts to fish.
Termination criteria	Fish assemblages not significantly different from pre-exposure state, or are not significantly different from comparable non-contacted (reference) sites. Once fish assemblages have demonstrated no significant difference between areas affected and areas unaffected, recovery has been achieved.
Receptor impact	Potential impacts from hydrocarbon exposure include effects on the respiratory process through coating of gills and irritation and damage to epidermal surfaces through exposure.
Methodology	Fish assemblages will be assessed using the stereo-baited remote underwater video (BRUVs) following Shortis *et al.* (2009). Fish assemblages will be sampled within discrete habitats at cross-shelf impact areas and non-impact areas. Fish assemblage data will also be collected during assessment of benthic habitats along transects as per SMP5. Fisheries data, where relevant, collected before and after the spill, will be assessed in consultation with Department of Fisheries. Monitoring design will be in accordance with the following principles: • A comparison of fish assemblages will be made between sites contacted (impact) and not contacted (reference) by oil. • Wherever possible, data generated by SMP1 water quality will be used in combination with assessment of impacts to fish assemblages. • Where relevant, measurement criteria for fish assemblages will align with Protected Area management plans.
Scope of works	Prepared for issue within 96 hours from activation of SMP8.
Resources	1 Senior Marine Scientist Lead 1 Marine Scientist trained in fish identification and necropsy 2 BRUVS technicians (sourced externally with equipment) BRUVS spreads Bait for BRUVS Field laptop Digital camera NATA accredited laboratory for sample analysis Available vessel and tender in operation Decontamination/washing facilities

Strategy Component	Description – SMP8 Fish, invertebrates (crustaceans and cephalopods)
	Safety aircraft/rescue vessels on standby Resources to analyse BRUV data Freezers
Implementation	Service provider to mobilise within 7 days from SMP7 being activated (this time allowing for costing, preparation of equipment and disposables and travel to site).
Analysis and reporting	BRUV imagery will be processed using appropriate software (for example 'Event Measure' Software, www.seagis.com.au.). Data collected from BRUVS or from SMP5 will be entered into appropriate database and analysed to test for statistically significant differences between non-contacted and contacted assemblages. Use of fisheries data and statistical analyses will be informed through consultation with Department of Fisheries. NATA-accredited Laboratories will be employed for health analyses. Data and conclusions will be summarised in an environmental report. Final report will be technically reviewed (peer review).

Sea Eagle-1 and Tahbilk-1 Vessel Based Activity Environment Plan

TM-50-PLN-I-00004

Rev 2

APPENDIX J - TIMEFRAME TO RESPOND TO MINOR LEAK FROM WELLHEAD

	Week Duration	Justification
Notification and Evaluation		
Mobilise helicopter for arial survey	1	First available resource, anticipate 1-2 days after notification.
Mobilise vessel for sea surface survey	1	First available resource, anticipate 1-2 days after notification.
Contract ROV for subsea survey	1	Need to identify available resource and put contract in place. *
Mobilise ROV vessel and perform subsea survey	2	Assumes either using an asset between activities or mobilising an ROV with sampling capability to another type of vessel.
Response Vessel		
Contract MODU or Subsea Intervention Vessel	2	Aggressive timing, assumes working with a known contractor where key terms and conditions are established.
Prepare VSCR	4	Time to update with project specific information, risk assess, prepare and review. Cannot commence until response vessel is known. For expediency, this assumes a vessel with existing safety case is taken up.
Undertake engineering and fabrication of equipment to interface response vessel with well	8	Cannot start on this activity until the response vessel is known.
Mobilise response vessel	12	Based on past market query experience where response vessels are either working in Australia on a campaign or would need to be mobilised from abroad.
Complete well operations	4	Estimate. Includes time to mobilise, position vessel, connect to well and perform the activity.
Engineering & Planning		
Perform detailed well engineering	6	Activity can start immediately after site survey information is gathered. This activity will include risk management processes.
Risk management processes	1	Following JSE risk management processes, time for HAZID, HAZOP workshops, write up and follow on assurance activities.
DP3 assurance activities	1	JSE project management and assurance activities.
Implement service agreements	6	Can commence shortly after initial engineering assessment to verify required services and after the response vessel has been confirmed.
Prepare and review WOMP	2	Time taken to prepare and review the WOMP for submission.
Prepare detailed operations procedures	3	Time to prepare and review procedures.
Mobilise bulks, materials and other tooling	3	Not critical path, time with response vessel availability.
Permissioning		
Submit VSCR for approval	4	Based on experience
Submit WOMP for approval	2	Based on experience

* Assumes that this is not treated as a Loss of Well Control Event and no Safety Case Revision is required. NOPSEMA Information Paper A787102 advises that for a Loss of Well Control Event, that ROV monitoring will require a Safety Case.