Santos

Yoorn-1 Exploration Drilling Environment Plan

SO-91-BI-20003.01

PROJECT / FACILITY	Yoorn-1
REVIEW INTERVAL (MONTHS)	No Review Required
SAFETY CRITICAL DOCUMENT	NO

Rev	Owner	Reviewer/s *Managerial / Technical / Site*	Approver
	Drilling Superintendent	Team Lead - Environment	Manager - Offshore Drilling and Completions
1			

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A	18/08/2021	Consultant / Santos	Santos Internal Review
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1	04/04/2022	Consultant / Santos	Response to NOPSEMA RFWI

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Abbreviations

Abbreviation	Description
°C	Degrees Celsius
µ	Micron
3D	Three-dimensional
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ACN	Australian company number
AFZ	Australian Fishing Zone
AHO	Australian Hydrographic Office
AHS	Australian Hydrographic Service
AIS	Automatic identification system
ALARP	As low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park (Commonwealth)
AMSA	Australian Maritime Safety Authority
API	American Petroleum Institute
APPEA	Australian Petroleum Production and Exploration Association
bbl	Standard barrels
BIAs	Biologically important areas
BOD	Biochemical Oxygen Demand
BOP	Blowout preventer
BTEX	benzene, toluene, ethylbenzene, and xylene
CAC	Critical Acceptance Criteria
CAES	Catch and Effort System
CAMRIS	Coastal and Marine Resource Information System
CEO	Chief Executive Officer
CH_4	Methane
CHARM	Chemical hazard and risk management
CO_2	Carbon dioxide
cu in	Cubic inch
DAHs	Dissolved aromatic hydrocarbons
DAWE	Department of Agriculture, Water and the Environment
dB	Decibels
DBCA	Department of Biodiversity, Conservation and Attractions (Western Australia)

DEC	Department of Environment and Conservation (Western Australia)
DEWHA	Department of the Environment, Water, Heritage and the Arts
DMIRS	Department of Mines, Industry Regulation and Safety (Western Australia)
DoD	Department of Defence
DoE	Department of the Environment
DoEE	Department of the Environment and Energy
DoT	Department of Transport
DP	Dynamic positioning
DPaW	Department of Parks and Wildlife (Western Australia)
DPIRD	Department of Primary Industries and Regional Development (Western Australia)
DPLH	Department of Planning, Lands and Heritage
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DWER	Department of Water and Environmental Regulation (formerly DER)
E	East
EHS	Environment, Health & Safety
EMBA	Environment that may be affected
ENVID	Environmental hazard identification workshop
EP	Environment Plan
EPA	Environmental Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPO	Environmental performance outcome
EPS	Environmental performance standard
ESD	Ecologically Sustainable Development
g/cm^3	Gram per cubic centimetre
g/m^2	Grams per square metre
GHG	Greenhouse gas
ha	Hectare
HAZID	Hazard Identification
hDVS	Heterodyne distributed vibration sensing
HEV	High Environmental Value
HEVA	High Exposure Value Area
HSE	Health, safety and environment
HYCOM	Hybrid Coordinate Ocean Model
Hz	Hertz

IAPP	International air pollution prevention
IBC	Intermediate bulk container
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMDG	International maritime dangerous goods
IMP	Interface Management Plan
IMS	Invasive marine species
IMSMP	Invasive Marine Species Management Plan
IMT	Incident Management Team
IOPP	International oil pollution prevention
ISPP	International sewage pollution prevention
ITOPF	International Tanker Owners Pollution Federation Ltd
IUCN	International Union for Conservation of Nature
JRCC	Joint Rescue Coordination Centre
KCl	Potassium chloride
KEF	Key ecological feature
kHz	Kilo hertz
km	Kilometre
km/hr	Kilometres per hour
km^2	Square kilometres
KPIs	Key performance indicators
L	Litre
LCM	Lost circulation material
LMS	Listed Migratory Species
LOWC	Loss of well control
LTS	Listed Threatened Species
m	Metres
m/s	Metres per second
m^2	Square metres
m^3	Cubic metres
MAFMF	Marine Aquarium Fish Managed Fishery
MAH	Monoaromatic Hydrocarbons
MARPOL	International Convention for the Prevention of Pollution from Ships
MCS	Maximum Credible Scenario
MDO	Marine diesel oil

MDRT	Measured depth from rotary table
MEE	Maritime Environmental Emergencies
MEG	Mono Ethylene Glycol
MEVA	Moderate exposure value area
mg/L	Milligrams per litre
mm	Millimetres
MNES	Matters of National Environmental Significance
MoC	Management of change
MODU	Mobile offshore drilling unit
MoU	Memorandum of Understanding
MSDS	Material safety data sheet
N	North
N_2O	Nitrous oxide
NAFF	Non-aqueous fluid
NBPMF	Nicol Bay Prawn Managed Fishery
NCAR	National Centre for Atmospherics Research
NCEP	National Centre for Environmental Protection
NEBA	Net environmental benefit analysis
nm	Nautical mile
NMFS	National Marine Fisheries Service (US)
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NOx	Oxides of nitrogen
NWA	North West Alliance
NWS	North west shelf
OCNS	Offshore Chemical Notification Scheme
ODS	Ozone-depleting substance
OIM	Offshore Installation Manager
OPEP	Oil Pollution Emergency Plan
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OPMF	Onslow Prawn Managed Fishery
OSCAR	Oil Spill Contingency and Response
OSPAR	Convention for the Protection of the Marine Environment of the Northeast Atlantic
OSRL	Oil Spill Response Limited

OWM	Oil Weathering Model
OWR	Oiled Wildlife Response
P&A	Plug and abandon
Pa	Pascal
PAH	Polycyclic aromatic hydrocarbons
PAM	Passive acoustic monitoring
PFTIMF	Pilbara Fish Trawl Interim Managed Fishery
PHG	Pre-hydrated gel
PHPA	Partially hydrolysed polyacrylamide
PLMF	Pilbara Line Managed Fishery
PLONOR	Pose little or no risk to the environment
PMST	Protected Matters Search Tool
PNEC	Predicted No Effect Concentration
ppb	Parts per billion
ppm	Parts per million
ppt	Parts per thousand
PROWRP	Pilbara Regional Oiled Wildlife Response Plan
PSZ	Petroleum Safety Zone
PTMF	Pilbara Trap Managed Fishery
PTS	Permanent threshold shift
RAMSAR	Convention on Wetlands of International Importance Especially as Waterfowl Habitat
ROV	Remotely operated vehicle
S	South
Scf	Standard cubic foot (of gas)
SDS	Safety data sheet
SEL	Sound exposure level measured as dB re 1 $\mu Pa^2 \cdot s$
SFRT	Subsea First Response Toolkit
SINTEF	The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology
SMPEP	Shipboard Marine Pollution Emergency Plan
SOLAS	Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SOx	Oxides of sulphur
SSDI	Subsea dispersant injection
t	tonnes

TD	Total depth
TSSC	Threatened Species Scientific Committee
TTS	Temporary threshold shift
TVDRT	True vertical depth from rotary table
UK	United Kingdom
VOO	Vessel of opportunity
VSP	Vertical seismic profiling
W	West
WA	Western Australia
WAF	Water Accommodated Fraction
WAOWRP	WA Oiled Wildlife Response Plan
WBM	Water-based mud
WDAS	Well Design Automation System
WDCS	Whale and Dolphin Conservation Society
WOMP	Well Operations Management Plan

1 Introduction

1.1 Environment Plan Summary

OPGGS(E)R 2009 Requirements
Regulation 11(3)
Within 10 days after receiving notice that the Regulator has accepted an Environment Plan (EP) (whether in full, in part or subject to limitations or conditions), the titleholder must submit a summary of the accepted plan to the Regulator for public disclosure.
Regulation 11(4)
The summary: a) must include the following material from the environment plan: (i) the location of the activity (ii) a description of the receiving environment (iii) a description of the activity (iv) details of environmental impacts and risks (v) a summary of the control measures for the activity (vi) a summary of the arrangements for ongoing monitoring of the titleholder's environmental performance (vii) a summary of the response arrangements in the oil pollution emergency plan (viii) details of consultation already undertaken, and plans for ongoing consultation (ix) details of the titleholder's nominated liaison person for the activity b) must be to the satisfaction of the Regulator.

This Yoorn-1 Exploration Drilling Environment Plan (EP) summary has been prepared from material provided in this EP. 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 C**
A description of the activity	**Section 2**
Details of the environmental impacts and risks	**Sections 6** and **7**
The control measures for the activity	**Sections 6** and **7**
The arrangements for ongoing monitoring of the titleholder's environmental performance	**Section 8**
Response arrangements in the oil pollution emergency plan	**Sections 6.8, 7.2** and **7.3** See OPEP

Consultation already undertaken and plans for ongoing consultation	**Section 4**
Details of the titleholders nominated liaison person for the activity	**Section 1.4.1**

1.2 Activity Overview

Santos WA Northwest Pty Ltd (Santos) proposes to drill an exploration well in petroleum exploration permit WA-499-P, known as Yoorn-1. The permit is in Commonwealth waters; with the proposed well location approximately 102 km offshore from Dampier in Western Australia (WA).

This Environment Plan (EP) covers drilling activities and all MODU, vessel, ROV and helicopter operations within the operational area (the Activity).

1.3 Purpose of this Environment Plan

The EP has been prepared in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R) for assessment and acceptance by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). This EP details the environmental impacts and risks associated with the Activity and demonstrates how these are reduced to As Low As Reasonably Practicable (ALARP) and to an acceptable level.

The EP provides an implementation strategy used to measure and report on environmental performance during planned activities and unplanned events. The environmental management of the Activity described in the EP complies with the Santos Environmental Management Policy (QE-91-IQ-00047_REV 5) and with all relevant legislation. This EP documents relevant stakeholder consultation performed during the planning of the Activity. This EP is valid from the date that it is accepted by NOPSEMA, until submission and acceptance of Regulation 25A end-of-operation of EP notification.

1.4 Titleholder

OPGGS(E)R 2009 Requirements
Regulation 15. Details of titleholder and liaison person.
(1) The environment plan must include the following details for the titleholder: a) name b) business address c) telephone number (if any) d) fax number (if any) e) email address (if any) f) if the titleholder is a body corporate that has an Australian Company Number (ACN) (within the meaning of the *Corporations Act 2001*). (2) The environment plan must also include the following details for the titleholder's nominated liaison person: a) name b) business address c) telephone number (if any) d) fax number (if any) e) email address (if any).

1.4.1 Details of Titleholder

Santos WA Northwest Pty Ltd is the titleholder undertaking the Activity within Permit WA-499-P. Titleholder details are provided in **Table 1-1**.

Table 1-1: Titleholder Details

Title	Titleholder	ACN / ABN	Permit % Interest	Address
WA-499-P	Santos WA Northwest Pty Ltd Santos Offshore Pty Ltd	58 009 140 854 (ACN: 009 140 854)	55%	Business Address: Level 7, 100 St Georges Terrace, Perth, Western Australia 6000 Telephone number: (08) 6218 7100 Fax number: (08) 6218 7200 Email address: offshore.environment.admin@santos.com
		38 005 475 589 (ACN: 005 475 589)	45%	

1.4.2 Details for Santos' Nominated Liaison Person

Details for Santos' Nominated Liaison Person for the Activity are as follows:

Name: Jason J Young

Business address: Level 7, 100 St Georges Terrace, Perth, WA 6000

Telephone number: (08) 6218 7100

Email address: offshore.environment.admin@santos.com

Additional information about Santos and its operations can be obtained from the website at: www.santos.com

1.4.3 Notification Procedure in the Event of Changed Details

If there is a change in the titleholder, the titleholder's nominated liaison person or a change in the contact details for the titleholder or liaison person, Santos will notify NOPSEMA in writing and provide the updated details.

1.5 Environmental Management Framework

OPGGS(E)R 2009 Requirements
Regulation 13. Environmental assessment.
Requirements (4) The environment plan must: a) describe the requirements, including legislative requirements, that apply to the Activity and are relevant to the environmental management of the Activity b) demonstrate how those requirements will be met.
Regulation 16. Other information in the environment plan.
The environment plan must contain the following: a) a statement of the operator's corporate environmental policy.

1.5.1 Environmental Health and Safety Policy

The activity will be conducted in accordance with the Santos Environment, Health & Safety (EHS) Policy (**Appendix A** – Santos EHS Policy) and relevant legislative requirements presented within **Appendix B** – Legislative Requirements Relevant to the Activity, inclusive of references to the relevant EP sections where the legislation may prescribe or control how the activity is undertaken. **Sections 6, 7** and **8** of this EP details and evaluates impacts and risks from planned activities and unplanned events, provide control measures, set environmental performance outcomes and standards, and provide the strategy for ensuring environmental performance is achieved, as outlined within the EP.

1.5.2 International Legislation

Australia is signatory to numerous international conventions and agreements that obligate the Commonwealth government to prevent pollution and protect specified habitats, flora and fauna. Those that are relevant to the Activity are detailed in **Appendix B** – Legislative Requirements Relevant to the Activity.

1.5.3 Commonwealth Legislation

All activities conducted under the EP will comply with legislative requirements established under relevant Commonwealth legislation, and in line with applicable best practice guidelines and management procedures. These are further detailed in **Appendix B** – Legislative Requirements Relevant to the Activity.

2 Activity Description

OPGGS(E)R 2009 Requirements
Regulation 13. Environmental assessment.
Description of the Activity: 13 (1) The environment plan must contain a comprehensive description of the Activity including the following: a) the location or locations of the Activity b) general details of the construction and layout of any facility c) an outline of the operational details of the Activity (for example, seismic surveys, exploration drilling or production) and proposed timetables d) any additional information relevant to consideration of environmental impacts and risks of the Activity. Note: An environment plan will not be capable of being accepted by the Regulator if an Activity or part of the Activity, other than arrangements for environmental monitoring or for responding to an emergency, will be undertaken in any part of a declared World Heritage property – see regulation 10A.

2.1 Activity Location

2.1.1 Well Location

This EP provides for exploration drilling and associated activities (as described in **Section 2**) for one exploration well at Yoorn-1 permit WA-499-P. Water depth range for this well is from approximately 45 m.

At the well location, a Petroleum Safety Zone (PSZ) of 500m radius will be established around the MODU. Coordinates for the proposed well location is provided in **Table 2-1**; and shown in **Figure 2-1**.

In the event of a re-spud, the new well location would remain within the operational area, although is likely to be within 50 m of the original well location.

Table 2-1: Exploration Well Indicative Coordinates

Well	Permit	Easting	Northing	Latitude	Longitude
Yoorn-1	WA-499-P	373,358.7m	7,750,037.0m	20° 20' 36.70" S	115° 47' 12.30" E

Source: Datum GDA 94, UTM Zone 50

2.1.2 Operational Area

The Operational Area (OA) covered under this EP is the area within which all planned activities will occur (i.e. exploration drilling).

The Operational Area for Yoorn-1 is defined as a 2 km x 2 km square centred around the proposed well location. The Yoorn-1 well location, OA and PSZ are shown in **Figure 2-1**.

The OA is defined by the coordinates provided in **Table 2-2**.

Table 2-2: Yoorn-1 Operational Area Coordinates

Operational Area	Point	Easting	Northing	Latitude	Longitude
Yoorn-1 (WA-499-P)	1	374,358.1	7,751,037.0	20° 20' 04.41" S	115° 47' 47.03" E
	2	374,358.1	7,749,037.0	20° 21' 09.46" S	115° 47' 46.52" E
	3	372,358.1	7,749,037.0	20° 21' 08.98" S	115° 46' 37.56" E
	4	372,358.1	7,751,037.0	20° 20' 03.93" S	115° 46' 38.07" E

Source: Datum GDA 94, UTM Zone 50

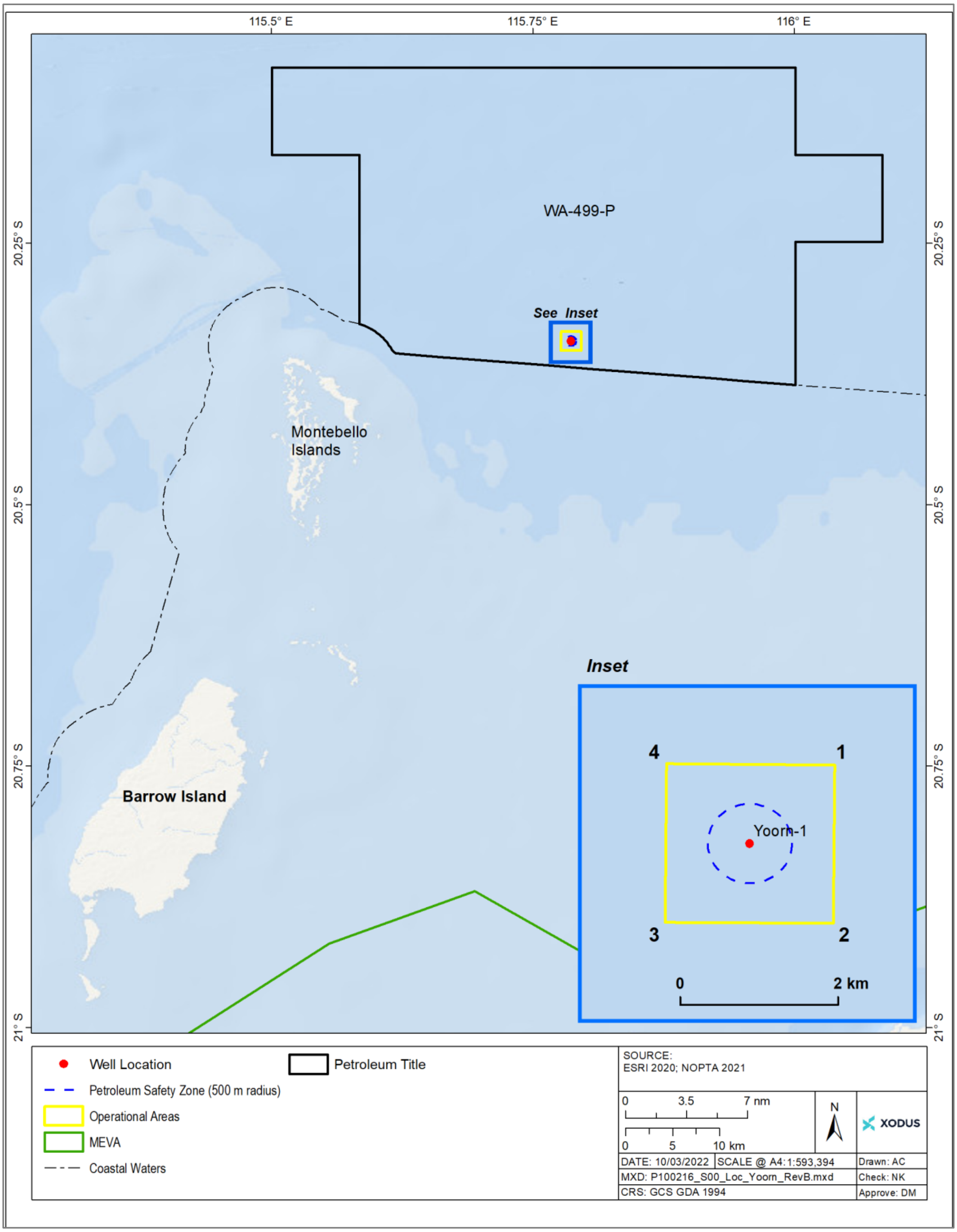

Figure 2-1: Yoorn-1 Well Location, PSZ and Operational Area

The distances of key islands and mainland points from the proposed well locations are provided in **Table 2-3**.

Table 2-3: Distances of Key Islands / Mainland Points from Yoorn-1

Island / Mainland	Relative Distance and Direction from Yoorn-1
Montebello Islands (Trimouille Island)	22.1 km WSW
Lowendal Island	40.2 km SW
Barrow Island	49.9 km SW
Dampier Archipelago: Enderby Island Rosemary Island Legendre Island	 76.5 km SE 82.9 km ESE 108.9 km E
Dampier	102.6 km SE
Onslow	159.8 km SSW

2.2 Activity Duration and Timings

2.2.1 Exploration Drilling

The planned drilling activity duration for the Yoorn-1 well is estimated to be up to 100 days (which includes an expected duration of 70 days, an allows for an additional contingency of 30 days). Durations are dependent on operational down time, contingency operations (e.g. sidetrack or re-spud if required) and delays due to unfavourable weather. The drilling duration may be subject to change based on geological conditions and potential for operational challenges.

Drilling is planned to take place between Q2 – Q4 2022.

Activities for the well will be conducted 24 hours per day, seven days per week.

Well Objectives

The well objectives include:

+ Drilling is planned to total depth with an allowance for re-spud and sidetrack contingencies if necessary. A re-spud contingency (if required) would be within 1km of the original well, but most likely within 50 m. A re-spud with potential abandonment of non-recoverable drilling tools and surface casing is not considered a new stage of the petroleum activity.
+ The well will be drilled and then permanently plugged and abandoned (P&A).
+ The reservoir target for the well is gas, although condensate may also be encountered.

2.3 Drilling Activities

The primary reservoir target of Yoorn-1 is the Biggada formation. The expected reservoir fluid is wet gas (gas and condensate). There are no secondary target formations.

2.3.1 Drilling Phases

The following high-level phases describe the planned drilling activity:

- Move the MODU to location within the permit area, position and pin MODU, pre-load and jack-up to operational elevation
- Drill top hole section riserless
- Run and cement conductor casing
- Drill surface hole section riserless
- Run and cement surface casings and install surface wellhead
- Install Blowout Preventer (BOP)
- Pressure test BOP
- Drill intermediate hole section(s)
- Run and cement intermediate liner or casing
- Drill remaining sections to well total depth (TD)
- Run formation evaluation program (e.g. wireline logging, cores, VSP)
- Plug and abandon (P&A) the well, leaving no part of the casing or conductor above the mudline
- Move MODU off location.

2.3.2 Move In and Rig Up

The MODU will be moved into position using one or more support vessels. The legs are jacked up during rig positioning to avoid contact with the seabed. Once at the desired location and with the MODU stationary, the legs are lowered to be fully in contact with the seabed and the MODU raises itself approximately 20 m above the sea surface and the cantilever will be skidded out.

2.3.3 Well Design and Drilling Operations

An indicative overview of the exploration drilling design and process is described in this section. This process is subject to change, depending on individual well design requirements and location of the well. Well schematics are provided in the Well Operations Management Plan (WOMP) submitted to NOPSEMA for assessment prior to drilling.

The well design includes drilling top hole and running conductor, then drilling the surface hole section and running surface casing. The surface wellhead and BOP will be installed and pressure tested before drilling to total depth (TD). The directional profiles and planned TD of the well is summarised below in **Table 2-4**. Note that the well TD may be less or more depending on the geology and operational issues encountered.

Table 2-4: Yoorn-1 Estimated Total Depth and Trajectory

Well	Approximate Total Depth	Trajectory
Yoorn-1	3,520 mTVDss +/-225m	Near-vertical

2.3.4 Drilling Fluids and Cuttings

Only water-based drilling fluids will be used for the Yoorn-1 well.

The top-hole section (or interval) for the well will be drilled using seawater and pre-hydrated gel (PHG) sweeps to clean the hole. This fluid and associated drilled formation cuttings will exit the well at seabed while drilling the hole section to install the conductor casing.

The surface hole section (or interval) for the well will also be drilled using seawater and PHG sweeps to clean the hole. This fluid and associated drilled formation cuttings will exit the well at the top of the conductor and be discharged to the sea while drilling the hole to install the surface casing.

Once surface casing, wellhead and BOP are installed, a closed circulating system will be established, and the remainder of the well will be drilled with a weighted brine/shale-inhibitive (e.g. potassium chloride (KCl)/partially-hydrolysed polyacrylamide (PHPA) or KCl/Kla-Stop) water-based mud (WBM). The WBM will be recycled and reused while drilling. The only WBM discharged from the MODU will be to the sea surface either on formation cuttings or from surface storage tanks/mud pits when no longer required.

Aqueous-based lost circulation material (LCM) will be available to pump should downhole losses occur.

Formation cuttings generated while drilling the top hole section for the conductor will exit the wellbore at the seabed. Formation cuttings generated while drilling the surface hole section for the surface casing will exit the wellbore at the top of the conductor.

Formation cuttings for the remaining hole sections to TD will be discharged to sea surface after being removed from the WBM drilling fluid through the MODU's solids control system. The solids control system comprises shale shakers and, if required to remove ultra-fine solids in the recovered drilling fluid, centrifuges.

2.3.5 Cement Operations

Cement is used to seal the casing following drilling of each section.

A primary cement job is planned for cementing the conductor in place. This cement job will provide a structural base for the well and is critical to well integrity. Any cement returns during the conductor cement job would be discharged at the seabed.

Primary cement jobs are planned for cementing the surface casing and intermediate casing strings in place on the well. These cement jobs will provide structural integrity to the casing strings and also ensure pressure containment capacity is provided for the subsequent hole sections. No cement returns are planned to surface in these cement jobs with all cement remaining downhole. In the unlikely event that cement is returned to surface then it will be discharged from the top of the conductor for the surface casing cement job and to the sea surface via the MODU solids control equipment for intermediate casing cement jobs.

Permanent abandonment cement plugs are planned to safely plug and abandon the well; the final abandonment program will ensure moveable hydrocarbons identified while drilling are isolated per the NOPSEMA-accepted WOMP.

During cementing operations, surface cementing equipment and lines will need to be flushed, washed and cleaned with water to prevent hard setting. Residual surface tank volumes will also be discharged to sea during cementing operations.

Once a closed circulating system is established, any casing shoe drilled out will return cement spacer and minor hard cement to surface. This will be discharged to sea surface via the MODU solids control system. The same process would be conducted for drilling out any contingency cement plugs (e.g. sidetracking plugs).

2.3.6 Well Evaluation

Well evaluation involves the collection of data on the well and surrounding formation. No well testing to surface (i.e. flowing hydrocarbon to surface and flaring) is planned under this EP. Downhole formation evaluation will be performed which may include wireline logging, Vertical Seismic Profiling (VSP) and coring. Radioactive sources used in downhole tools for logging purposes will be managed in accordance with the MODU Safety Case so that occupational health and safety risks to people are managed to an acceptable and ALARP level.

VSP is a routine activity conducted as part of drilling activities to provide detailed information regarding geological structures and stratigraphy in the vicinity of the well. VSP is planned to be undertaken over a 12 to 18-hour period, using a source array of three x 250 cubic inches (cu.in).

2.3.7 Plug and Abandonment

After completion of the drilling activity, the well will be plugged and abandoned (P&A). Plugging and abandonment procedures are designed to isolate the well and mitigate the risk of a potential release of wellbore fluids to the marine environment.

Plugging and abandonment operations involve setting a series of cement and mechanical plugs within the wellbore, including plugs above and between any hydrocarbon bearing intervals, at appropriate barrier depths in the well. These plugs are verified to confirm their integrity.

During P&A the casing will be cut below the seabed and recovered. No equipment will be left above the seabed.

All plugging and abandonment operations will be conducted in accordance with the NOPSEMA-accepted WOMP.

2.3.8 Contingency Activities

Should drilling difficulties be experienced and the well cannot progress, contingency options exist to recover and progress drilling operations. This includes but is not limited to:

- Cementing up the existing hole above the trouble zone and sidetrack the well around the problem. This troubleshooting contingency step is most likely to allow well operations to progress again and does not involve moving the MODU.
- In extreme circumstances, operations can only move forward if the existing wellbore is permanently plugged and abandoned and the well is re-spudded and started again from the seabed. This option may require moving the MODU (but MODU will remain within the operational area).

These activities would require additional time on location and an increase in the drilled rock volume (i.e. cuttings), drilling fluid usage and cement consumed compared to the planned activity.

Time required to undertake these activities is included in the maximum activity duration –up to 100 days for Yoorn-1 (which includes an expected duration of 70 days, an allows for an additional contingency of 30 days).

A re-spud and/or side-track drilling would only be exercised should drilling difficulties be experienced and are not considered new stages of the petroleum activity. If required, the well location for a re-spud would be within the operational area.

2.3.9 Cyclone Response

Cyclone activity may occur on the North West Shelf. Standard well suspension equipment will be available offshore to safely install temporary barriers in the well should the MODU require emergency evacuation in response to a cyclone. In the event the MODU is down-manned for a cyclone, the well will be suspended with two verified independent barriers to flow. The integrity of these barriers will be independent of any cyclonic metocean conditions and is verified within the NOPSEMA-accepted WOMP for the activity where the plan for well suspension in the event of a cyclone is assessed.

2.3.10 End of Activity

Activities end when the well has been plugged and abandoned and the MODU and all support vessels have departed the operational area.

The surface wellhead will be removed, and no equipment will be left above the seabed.

2.4 Support Operations

2.4.1 Mobile Offshore Drilling Unit (MODU) Operations

The Yoorn-1 exploration well will be drilled with a jack-up MODU. A MODU is a vessel capable of engaging in drilling or well intervention operations.

The MODU will be towed into position at the well location by one or more support vessels.

The MODU is fitted with various equipment to support operations including:

- power generation systems
- fuel oil storage

+ cooling water and freshwater systems
+ drainage, effluent and waste systems
+ solids control equipment used in drilling to separate the solids and drilling fluids (this may include shale shakers, centrifuging systems and cuttings driers).

MODU refuelling in the operational area may occur during the activity.

Whilst on position, a 500 m PSZ will be maintained around the MODU at all times, as required under the OPGGS Act.

2.4.2 Support Vessel Operations

The MODU will be typically supported by two vessels, with a maximum of four accounted for in this EP. The support vessels are yet to be confirmed but are usually offshore multiple purpose or anchor handling vessels. The vessels will be either stationary or operating at slow speeds while undertaking activities within the operational areas including:

+ Towing the MODU
+ Holding MODU position temporarily over the drilling location while pinning the rig
+ Standing-by at close proximity to the MODU during critical operations
+ Standing-by outside the 500 m PSZ from the MODU
+ Delivering food, potable water, drill water, fuel, dry bulk, drilling fluids, chemicals, equipment and other supplies from shore
+ Back loading surplus chemicals, equipment and waste for delivery to shore.

Equipment and material transfers may include, but are not limited to, crew supplies, hydrocarbons (diesel, engine oil, hydraulic fluids, grease etc.), bulk drilling products, MODU and drilling equipment/parts and waste. MODU cranes will be used for transfers between the MODU and support vessels.

Bulk products will also be transferred via hose from the support vessels and MODU. Such products include drilling fluids and solids, brine, drilling water, cement and fuel oil (diesel).

At least one support vessel will remain on standby to the MODU within the distance defined in the Safety Case (nominally three nautical miles). Support vessels will not anchor in the OA during the activity.

Support vessels are considered part of the petroleum activity when within the OA. The transit of vessels outside the OA is outside the scope of this EP and is managed under the Commonwealth *Navigation Act 2012*.

2.4.3 Remotely Operated Vehicle (ROV) Operations

A ROV is a tethered underwater vehicle deployed from a vessel or from the MODU. ROVs are unoccupied, highly manoeuvrable and operated by a crew aboard a vessel or MODU. They are linked by either a neutrally buoyant tether or often when working in rough conditions or in deeper water a load carrying umbilical cable is used along with a tether management system. Most ROVs are equipped with at least a video camera and lights. Additional equipment may include sonars, magnetometers, a still camera, a manipulator or cutting arm, water samplers, and instruments that measure water clarity, water temperature, water density, sound velocity, light penetration and temperature.

Observation-class and work-class ROVs will be used. It is likely that the work-class ROV will be operated from the MODU; however, it could also be operated from a support vessel.

2.4.4 Helicopter Operations

Helicopters will be used primarily for crew change and medevac, and occasionally for equipment and material transfers. Helicopter flights will occur a minimum of three times a week, dependent on the progress of the drilling program and logistical constraints.

2.5 Chemical Assessment

A risk-based approach to select chemical products ranked under the Offshore Chemical Notification Scheme (OCNS) is applied for those chemicals used and discharged to the marine environment. This scheme lists and ranks all chemicals used in the exploration, exploitation, and associated offshore processing of petroleum on the UK Continental Shelf.

Chemicals are ranked according to their calculated Hazard Quotients (HQ) by the CHARM (Chemical Hazard Assessment and Risk Management) mathematical model, which uses aquatic toxicity, biodegradation and bioaccumulation data. The HQ is converted to a colour banding with Gold and Silver colour bands representing the least environmentally hazardous chemicals. Chemicals not amenable to the CHARM model (i.e. inorganic substances, hydraulic fluids or chemicals used only in pipelines) are assigned an OCNS grouping based on the worst-case ecotoxicity data with Group E and D representing the least hazard potential.

The Santos Operations Chemical Selection, Evaluation and Approval Procedure (EA-91-II-10001) and Santos Drilling Fluid and Chemical Selection in Drilling Activities Procedure (EA-91-II-00007) accept CHARM ranked Gold/Silver, or non-CHARM ranked E/D chemicals for use and discharge without a detailed environmental risk assessment. The same applies to chemicals that are OSPAR Pose Little or No Risk to the Environment (PLONOR) List. The PLONOR Listed, agreed upon by the OSPAR Convention (Convention for the Protection of the Marine Environment of the North-East Atlantic), contains a list of substances that will pose little or no risk to the environment in offshore waters. If chemicals are ranked lower than Gold, Silver, E or D (i.e. CHARM ranked purple, orange, blue or white, or non-CHARM A, B or C ranked chemicals) and no alternatives are available, a risk assessment is conducted providing technical justification for their use and showing that their use and associated risk is acceptable and ALARP.

As described above, investigation of potential alternative chemicals is completed when chemicals are ranked lower than CHARM Gold, Silver, E or D (i.e. CHARM ranked purple, orange, blue or white, or non-CHARM A, B or C ranked chemicals). There is a preference for chemical options that are CHARM ranked Gold/Silver, or non-CHARM ranked E/D chemicals and / or chemical that have a low aquatic toxicity, are readily biodegradable and do not bioaccumulate (discussed below).

Any chemicals that may be discharged to the marine environment and not OCNS CHARM or non-CHARM ranked are risk assessed using the OCNS CHARM or non-CHARM models. The chemical is assigned a pseudo-ranking based on the available aquatic toxicity, biodegradation and bioaccumulation data (discussed below) and assessed for environmental acceptability for discharge to the marine environment.

2.5.1 Ecotoxicity Assessment

Table 2-5 and **Table 2-6** act as guidance in assessing the ecotoxicity of chemicals during the investigation of potential alternatives. **Table 2-5** is used by Cefas to group a chemical based on ecotoxicity results, 'A' representing highest toxicity/risk to environment and 'E' lowest. **Table 2-6** shows classifications/categories of toxicity against aquatic toxicity results.

Table 2-5: Initial OCNS Grouping

Initial grouping	A	B	C	D	E
Result for aquatic-toxicity data (ppm)	<1	≥1-10	>10-100	>100-1,000	>1,000
Result for sediment-toxicity data (ppm)	<10	≥10-100	>100-1,000	>1,000-10,000	>10,000

Note: Aquatic toxicity refers to the *Skeletonema costatum* EC50, *Acartia tonsa* LC50, and *Scophthalmus maximus* (juvenile turbot) LC50 toxicity tests. Sediment toxicity refers to the *Corophium volutator* LC50 test.

Source: Cefas Standard Procedure 2019, OCNS 011 NL Protocol PART 1: Core Elements

Table 2-6: Aquatic Species Toxicity Grouping

Category	Species	LC_{50} and EC_{50} criteria
Category Acute 1 Hazard statement - Very toxic to aquatic life	Fish	LC_{50} (96hr) of ≤1 mg/L
	Crustacea	EC_{50} (48hr) of ≤1 mg/L
	Algae / other aquatic plant species	ErC_{50} (72 or 96hr) of ≤1 mg/L
Category Acute 2 – Hazard statement – Toxic to aquatic life	Fish	LC_{50} (96hr) of >1 mg/L to ≤10 mg/L
	Crustacea	EC_{50} (48hr) of >1 mg/L to ≤10 mg/L
	Algae / other aquatic plant species	ErC_{50} (72 or 96hr) of >1 mg/L to ≤10 mg/L
Category Acute 3 – Hazard statement – Harmful to aquatic life	Fish	LC_{50} (96hr) of >10 mg/L to ≤100 mg/L
	Crustacea	EC_{50} (48hr) of >10 mg/L to ≤100 mg/L
	Algae / other aquatic plant species	ErC_{50} (72 or 96hr) of >10 mg/L to ≤100 mg/L

Source: United Nations (2019) Globally Harmonized System of Classification and Labelling of Chemicals (GHS), Eight Revised Edition

2.5.2 Biodegradation Assessment

The biodegradation of chemicals is assessed using the Cefas biodegradation criteria, which aligns with the categorisation outlined in the United Nations GHS Annex 9 Guidance on Hazards to the

Aquatic Environment (2019). The below is used as a guide during the investigation of potential chemical alternatives. Preference is to select readily biodegradable chemicals.

Cefas categorises biodegradation into the following groups:

a. Readily biodegradable: results of >X% biodegradation in 28 days to an OSPAR harmonised offshore chemical notification format (HOCNF) accepted ready biodegradation protocol.
b. Moderately biodegradable: results >20% and less than X% to an OSPAR HOCNF accepted ready biodegradation protocol.
c. Poorly biodegradable: results from OSPAR HOCNF accepted ready biodegradation protocol

Where X is equal to:

+ 60% in 28 days in OECD 306, Marine BODIS or any other acceptable marine protocols, or in the absence of valid results for such tests.
+ 60% in 28 days (OECD 301B, 301C, 301D, 301F, Freshwater BODIS) OR
+ 70% in 28 days (OECD 301A, 301E).

2.5.3 Bioaccumulation Assessment

The bioaccumulation of chemicals is assessed using the Cefas bioaccumulation criteria, which aligns with the categorisation outlined in the United Nations GHS Annex 9 Guidance on Hazards to the Aquatic Environment (2019). Preference is to select non bioaccumulative chemicals.

The following guidance is used by Cefas:

a. Non-bioaccumulative/non-bioaccumulating: Log Pow less than 3, or results from a bioaccumulation test (preferably using Mytilus edulis) demonstrates a satisfactory rate of uptake and depuration, and the molecular mass is ≥700.
b. Bioaccumulative/Bioaccumulates: Log Pow ≥3, or results from a bioaccumulation test (preferably using Mytilus edulis) demonstrates an unsatisfactory rate of uptake and depuration, and the molecular mass is less than 700.

All chemicals will be selected in accordance with the Santos Operations Chemical Selection, Evaluation and Approval Procedure (EA-91-II-10001) and Santos Drilling Fluid and Chemical Selection in Drilling Activities Procedure (EA-91-II-00007), as applicable.

3 Description of the Environment

OPGGS(E)R 2009 Requirements
Regulation 13. Environmental assessment.
Description of the environment 13(2) The environment plan must — a) describe the existing environment that may be affected by the petroleum activity; and b) include details of the particular relevant values and sensitivities (if any) of that environment. Note: The definition of environment in regulation 4 includes its social, economic and cultural features. 13(3) Without limiting paragraph (2)(b), particular relevant values and sensitivities may include the following: a) the world heritage values of a declared World Heritage property within the meaning of the EPBC Act b) the national heritage values of a National Heritage place within the meaning of that Act c) the ecological character of a declared Ramsar wetland within the meaning of that Act d) the presence of a listed threatened species or listed threatened ecological community within the meaning of that Act e) the presence of a listed migratory species within the meaning of that Act f) any values and sensitivities that exist in, or in relation to, part or all of: (i) a Commonwealth marine area within the meaning of that Act (ii) Commonwealth land within the meaning of that Act

3.1 Environment that May Be Affected (EMBA)

This section summarises the key physical, biological, socio-economic and cultural characteristics of the existing environment that may be affected (EMBA) by the activity, both from planned and unplanned events associated with the activity.

The potential area impacted by planned activities is expected to be within the defined Operational Area (OA) **(Section 2.1.2)**. The OA for Yoorn-1 is defined as a 2 km x 2 km square centred around the proposed well location (referred to as the Yoorn OA).

For the purposes of impact assessment, the following spatial areas are also considered:

+ a light emissions assessment boundary area of up to 20 km from the OA, which is recommended by the National Light Pollution Guidelines (CoA, 2020) (refer **Section 6.3**)
+ a noise emissions assessment boundary area of up to 20 km from the OA (refer **Section 6.4).**

No activity will occur within this 20 km boundary. It is described purely for environmental impact assessment purposes only in the relevant impact sections.

The EMBA encompasses the full range of environmental receptors that might be contacted by hydrocarbons in the highly unlikely event of a worst-case hydrocarbon spill, as shown in **Figure 3-1**.

A detailed and comprehensive description of the environment (required by OPGGS(E)R 2009, Section 13(3)) in the operational areas and EMBA is provided in **Section 3** and within the Values and Sensitivities of the Western Australian Marine Environment (EA-00-RI-10062, **Appendix C**).

Copies of the Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) outputs for the operational areas and the EMBA are also available in **Appendix D** – EPBC Protected Matters Search Tool Results.

The EMBA encompasses the environment that may be affected by planned and unplanned events (i.e. where a change in ambient environmental conditions may potentially occur). Most planned and unplanned events associated with the activity may affect the environment up to a few kilometres from the operational areas, e.g. from noise impacts (as identified in **Section 6**). A large unplanned hydrocarbon spill would extend substantially beyond this (**Section 7**).

3.1.1 Determining the Environment that May Be Affected

The outer extent of the EMBA for this EP is based on the results of stochastic oil spill modelling of a Loss of Well Control (LOWC) scenario, as this represented the largest spatial extent of potential changes to ambient environment conditions from an aspect. Stochastic hydrocarbon dispersion and fate modelling, applied to the worst-case spill scenario identified as relevant to the activity (**Section 7**), was undertaken to inform the EMBA. Stochastic modelling is created by overlaying hundreds of individual hypothetical oil spill simulations from an oil spill into a single map, with each simulation subject to a different set of metocean conditions drawn from historical records. Stochastic modelling is completed to reduce uncertainty in risk assessment and spill response planning.

The modelling considered four key physical or chemical phases of hydrocarbons that pose differing environmental and socioeconomic risks: surface, entrained, dissolved aromatic and shoreline accumulated hydrocarbons. The modelling used defined hydrocarbon exposure values, as relevant, to identifying an area that might be contacted by hydrocarbons, environment risk assessment and oil spill response planning, for the various hydrocarbon phases. Refer to **Table 3-1** for the exposure values used and to **Section 7.1** to **7.2** for further information on the reasons why these exposure values have been selected and how they relate to the risk assessment.

The EMBA is based on stochastic modelling, using the low exposure values (**Table 3-1**). The EMBA encompasses the outer most boundary of the overlaid worst-case spatial extent of the four hydrocarbon phases listed above for the credible spill scenario. The EMBA is illustrated in **Figure 3-1**.

The low exposure values are used as a predictive tool to set the outer boundaries of an EMBA and may not necessarily result in ecologically significant impacts. To inform the evaluation of potential environmental consequences of a hydrocarbon release (impact assessment), modelling is undertaken using higher exposure values (i.e. the concentrations at which environmental consequences may result). The higher exposure values are known as ‘moderate’ and ‘high’ are described and explained within **Section 7.1.6**. Applying the same method used to determine the EMBA, spatial areas were derived for moderate and high exposure values as illustrated on figures throughout **Section 3**.

A low exposure threshold, which represents a visible oil (rainbow) sheen, has been used to provide an indication of the extent to which stakeholders may visually observe oil on the sear surface. This is considered to provide a conservative extent of potential impacts to visual amenity. Biological impacts are expected to occur within the moderate and high exposure values which represent a subset of the

EMBA. Refer to **Section 7.1.3** for further information on the spill trajectory modelling thresholds that have been selected.

While the EMBA represents the largest possible spatial extent that could be affected by the worst-case hydrocarbon spill event, it is important to understand that the stochastic modelling considers 120 different simulations for any one spill event. Simplistically, each simulation considers a different combination of metocean conditions over time. An actual spill event is more likely to be represented by only one of the simulations and hence, have a much smaller spatial footprint.

The moderate value exposure area (MEVA) has been identified by the outer extent of the ‘moderate’ exposure areas predicted for both modelled scenarios (**Section 7.1**).

Table 3-1: Hydrocarbon Exposure Values

Hydrocarbon Phase	Exposure Value		
	Low	Moderate	High
Surface (g/m^2)	1	10	50
Shoreline accumulation (g/m^2)	10	100	1,000
Dissolved aromatics (ppb)	10	50	400
Entrained (ppb)	10	100	-

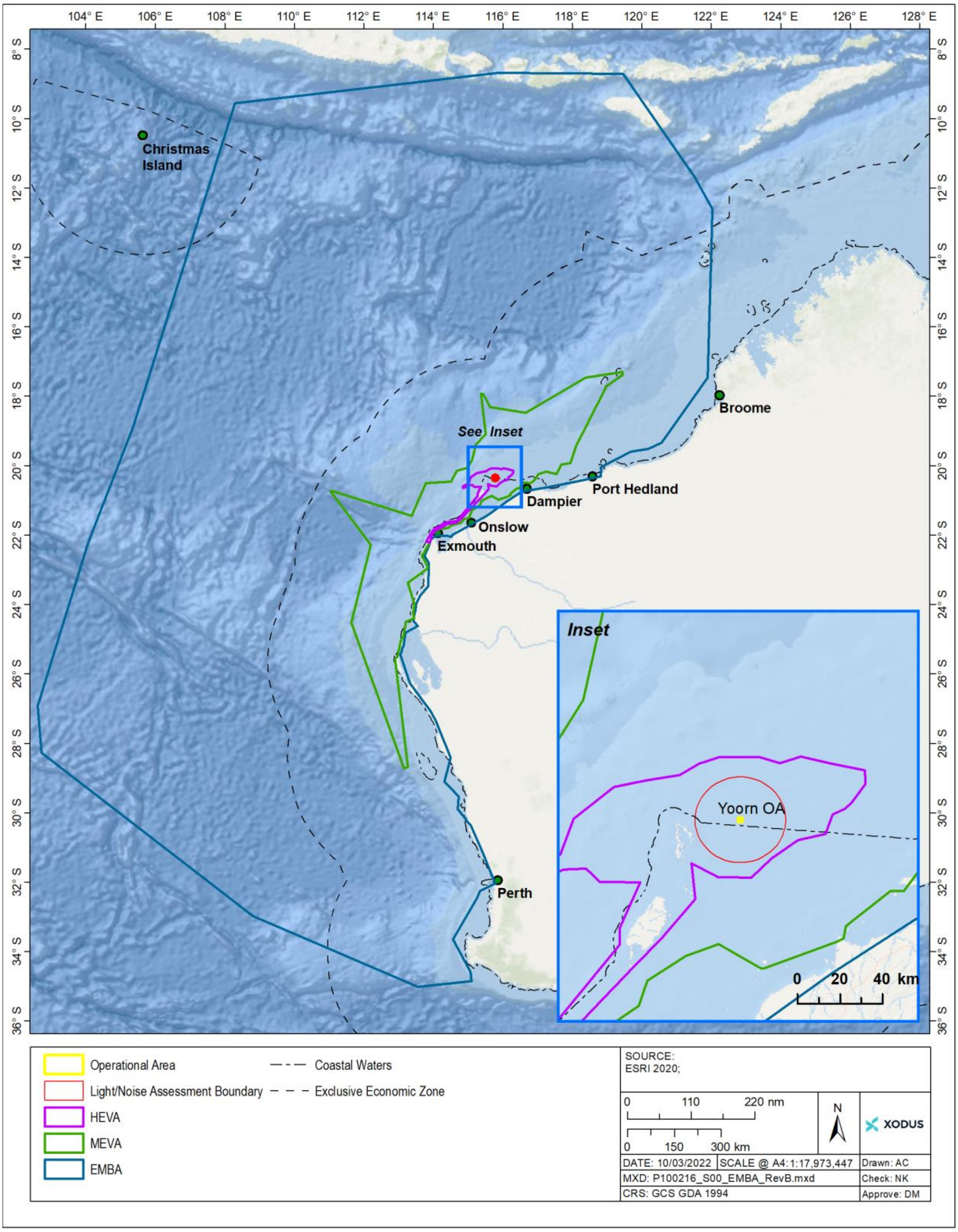

Figure 3-1: Operational Areas, Light/Noise Boundary, HEVA, MEVA and EMBA

3.2 Environmental Values and Sensitivities

This section summarises environmental values and sensitivities, including physical, biological, socio-economic and cultural features in the marine and coastal environment that are relevant to the OA and the EMBA.

A comprehensive description of the environmental values and sensitivities of the existing environment within the EMBA (as required by Regulation 13(3) of the OPGGS(E)R), is provided for in Santos' Values and Sensitivities of the Western Australian Marine Environment (EA-00-RI-10062). It is a compilation of environmental values and sensitivities including physical, biological, social, economic and cultural features within the marine and coastal environment that are relevant to all of Santos' activities, not specifically to this EP. A copy of the document is provided in **Appendix C**.

Specific to this EP, the DAWE PMST associated with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was used to determine potential receptors such as Matters of National Environmental Significance (MNES) within the operational areas and the EMBA. The results of these searches are provided in **Appendix D**.

A summary of the information derived from the Protected Matters Search, Bioregional Plans and the identified fauna Recovery Plans of relevance to the operational areas and the EMBA is provided in this section.

3.2.1 Bioregions

The OA is situated within Commonwealth waters of the North West Marine Region.

Based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4.0, the OA is within the Northwest Shelf Province and the EMBA overlaps the North-west Marine Region and South-west Marine Region (**Figure 3-2**).

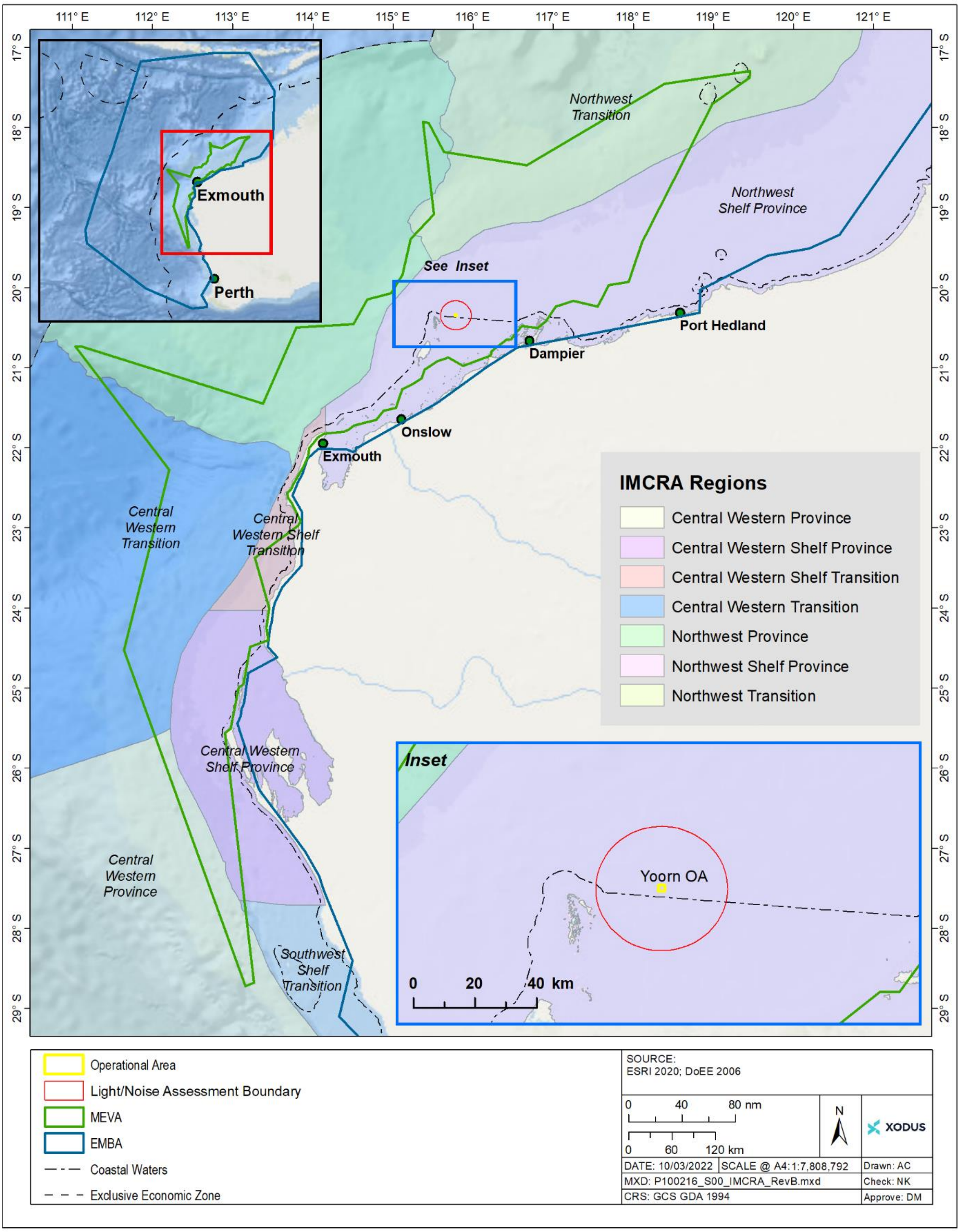

Figure 3-2: IMCRA 4.0 Provincial Bioregions within the EMBA and Operational Areas

3.2.1.1 Benthic Habitats

The presence of marine, coastal and terrestrial habitats within the operational areas and EMBA are shown in **Figure 3-3**. The presence of marine and coastal habitats within the OA and EMBA is summarised in **Table 3-2** and a detailed description of these habitats with reference to the IMCRA provincial bioregions is provided in *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062), **Appendix C**.

A geophysical site survey was conducted at the Yoorn-1 site in October 2021 (MMA Offshore, 2021). Results state the seabed is flat with an area of high-density depressions observed in the southern corner of the survey area. These depressions have been interpreted to represent coarse sediments (shell fragments) that have been transported by seabed currents. Based on side scan sonar reflectivity and three grab samples collected within the Yoorn-1 survey area, seabed sediments are expected to comprise of unconsolidated very fine to fine carbonate sand with varying sizes of shell fragments. Shadows, interpreted as boulders, were also identified with the closest being 165 m to the south-west of the well location and measuring 0.7 m in length x 0.5 m in width and 0.3 m in height.

3.2.1.2 Operational Area

The OA does not contain any shoreline habitat. The nearest land from Yoorn-1 is Trimouille, Lowendal and Barrow Islands located approximately 22.1 km, 40.2 km and 49.9 km away, respectively.

The marine and coastal habitats within the EMBA are summarised with reference to the IMCRA provincial bioregions are described further in *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062, **Appendix C**).

3.2.1.3 EMBA

Benthic habitats that could potentially be impacted in a major spill event are shown in **Figure 3-3** and further detailed in **Table 3-2**: Habitats Associated with Receptors Identified within the MEVA and EMBA.

Benthic habitats identified from the EMBA include benthic primary producers (coral reefs, macroalgae, seagrasses and mangroves), soft sediments, rocky substrates, intertidal mud/sandflats, rocky shorelines and sandy beaches.

Within the EMBA, habitat diversity is highest in shallower waters (<30 m) associated with the mainland and offshore islands/shoals where light availability promotes the occurrence of benthic primary producers, and in areas where hard substrate provides attachment points for a greater diversity of habitat forming organisms. The closest offshore islands to the operational area is in the Dampier Archipelago, approximately 76 km to the south-south east.

Benthic primary producers are important components of ecosystems as they provide the source of energy driving food webs and provide shelter for a diverse array of organisms. Further information on benthic primary producers, identified as being present within EMBA, or identified from predictions of hydrocarbon shoreline contact, is presented under subheadings below.

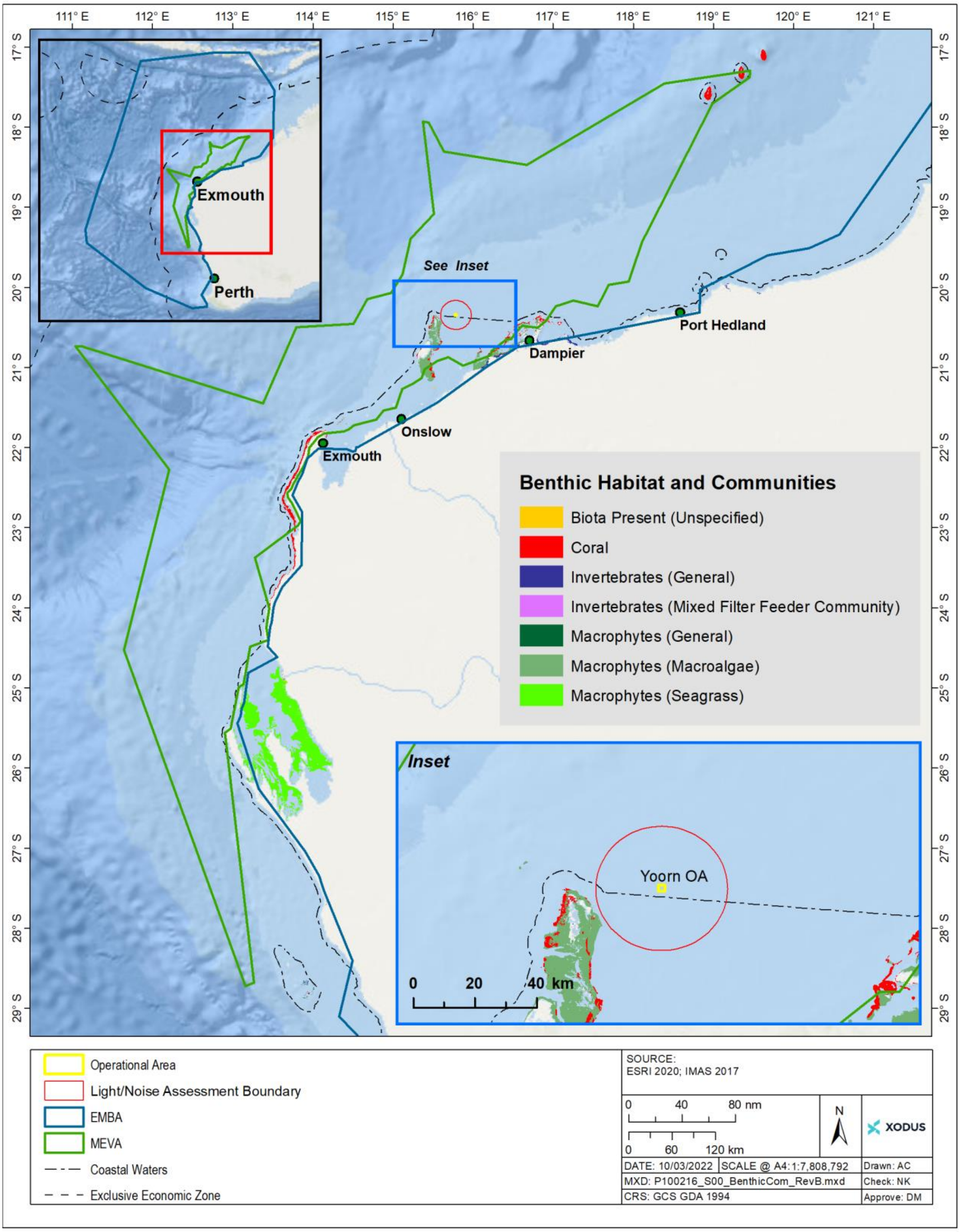

Figure 3-3: Benthic Habitats within the MEVA and EMBA

Table 3-2: Habitats Associated with Receptors Identified within the MEVA and EMBA

Category	Receptor	Presence in both OAs	EMBA Presence												Relevant Events That May Impact on the Receptors
			MEVA Presence												
			Northwest Province	Northwest Shelf Province	Northwest Transition	Central Western Transition	Central Western Shelf Transition	Central Western Shelf Province	Central Western Province	Southwest Shelf Transition	Southwest Shelf Province	Southwest Transition	Timor Province	Christmas Island Province	
Benthic Habitats	Coral reefs			✓	✓		✓	✓		✓	✓		✓	✓	<u>Unplanned</u> LOWC MDO
	Seagrass			✓	✓		✓	✓		✓	✓		✓	✓	
	Macroalgae			✓	✓		✓	✓		✓	✓		✓	✓	
	Non-coral benthic invertebrates	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	<u>Planned</u> Seabed disturbance. Planned operational discharges. <u>Unplanned</u> LOWC MDO Unplanned release of solids.

Category	Receptor	Presence in both OAs	EMBA Presence												Relevant Events That May Impact on the Receptors
			MEVA Presence								Southwest Shelf Province	Southwest Transition	Timor Province	Christmas Island Province	
			Northwest Province	Northwest Shelf Province	Northwest Transition	Central Western Transition	Central Western Shelf Transition	Central Western Shelf Province	Central Western Province	Southwest Shelf Transition					
Shoreline Habitats	Mangroves			✓			✓	✓							<u>Unplanned</u> LOWC MDO
	Intertidal platforms			✓			✓	✓		✓	✓			✓	
	Sandy beaches			✓	✓		✓	✓		✓	✓		✓	✓	
	Rocky shorelines			✓			✓	✓		✓	✓			✓	

3.2.2 Protected / Significant Areas

There are a number of areas protected under the EPBC Act that lie within the OA and EMBA; these are listed in **Table 3-3** and shown in **Figure 3-5** and **Figure 3-6**. These areas are further described in *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062, **Appendix C**).

The OA and light and noise boundary areas intersects the Montebello Australian Marine Park (AMP), within the Special Use Zone (**Figure 3-5**). There are no additional protected areas identified for the light and noise boundary areas.

Four World Heritage Areas (WHA) were identified from the EPBC Protected Matters database as occurring within the EMBA, they are the Ningaloo Coast WHA and Shark Bay, Western Australia WHA; and Australian Convict Sites (Fremantle Prison Buffer Zone), Australian Convict Sites (Fremantle Prison) (which are both onshore). The values of these sites have been described in *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062, **Appendix C**).

There are no Ramsar sites that are located within the OA or EMBA.

Seven National Heritage Properties, ranging from Natural, Indigenous and Historic, were identified from the EPBC Protected Matters database as occurring within the EMBA. Shark Bay, Western Australia and the Ningaloo Coast were identified as the two natural National Heritage Properties; the single indigenous National Heritage Property is the Dampier Archipelago (including Burrup Peninsula); and the four historic National Heritage Properties were the Batavia Shipwreck Site and Survivor Camps Area 1629- Houtman Abrolhos, Dirk Hartog Landing Site 1616 – Cape Inscription Area, Fremantle Prison (former) and HMAS Sydney II and HSK Kormoran Shipwreck Sites (**Table 3-3**). The values of these sites have been described in the in *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062, **Appendix C**).

The EMBA overlaps a number of Australian Marine Parks (AMPs) as well as State Marine Parks and Marine Management Areas (**Table 3-6**).

AMPs are recognised under the EPBC Act for protecting and maintaining biological diversity and contributing to a national representative network of marine protected areas. Management plans for AMPs have been developed and came into force on 1 July 2018. Under these plans AMPs are allocated conservation objectives (IUCN Protected Area Category) based on the Australian IUCN reserve management principles in Schedule 8 of the EPBC Regulations 2000. The management zones, associated with the AMPs identified within the EMBA, and the relevant objectives are detailed in **Table 3-4** and **Table 3-5**.

Key ecological features (KEFs) which are components of the marine ecosystem that are considered to be important for biodiversity or ecosystem function and integrity of the Commonwealth Marine Area are also included in the EPBC Act Protected Matters Database results (**Appendix D** – EPBC Protected Matters Search Tool Results). The OA does not overlap any KEFs (**Figure 3-4**). However, the EMBA overlaps a number of KEFs. **Table 3-3** lists the KEFs within the EMBA, together with their distance from the OA. Further detail on these KEFs is provided in the values of these sites have been described in the in *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062, **Appendix C).**

Table 3-7 summarises the EPBC Act protected matters that may be affected by planned and unplanned events within the OA and EMBA. For each protected matter the table provides links to relevant planned and unplanned events within **Section 6** and **7** that may create an impact.

There are no Wetlands of International Importance identified in the OA or in the EMBA.

Table 3-3: Protected Areas, Key Ecological Features and Threatened Ecological Communities within the Operational Areas and EMBA

Value/sensitivity		Name	IUCN Classification	Yoorn OA	EMBA
World Heritage Properties (WHA)		Shark Bay	-	-	✓
		Ningaloo Reef	-	-	✓
		Australian Convict Sites (Fremantle Prison Buffer Zone)	-	-	✓
		Australian Convict Sites (Fremantle Prison)	-	-	✓
Commonwealth Heritage Places		Mermaid Reef – Rowley Shoals	-	-	✓
		Ningaloo Marine Area	-	-	✓
		Learmonth Air Weapons Range Facility	-	-	✓
		Lancelin Defence Training Area	-	-	✓
		Scott Reef and Surrounds – Commonwealth Area	-	-	✓
National Heritage Properties	Natural	Shark Bay	-	-	✓
		The Ningaloo Coast	-	-	✓
	Indigenous	Dampier Archipelago (including Burrup Peninsula)	-	-	✓
	Historic	Batavia Shipwreck Site and Survivor Camps Area 1629 – Houtman Abrolhos	-	-	✓
		Dirk Hartog Landing Site 1616 – Cape Inscription Area	-	-	✓

Value/sensitivity		Name	IUCN Classification	Yoorn OA	EMBA
		Fremantle Prison (former)	-	-	✓
		HMAS Sydney II and HSK Kormoran Shipwreck Sites	-	-	✓
Australian Marine Parks		Montebello Australian Marine Park	Multiple Use Zone (IUCN VI)	✓	✓
		Mermaid Reef Australian Marine Park	National Park Zone (IUCN II)	-	✓
		Argo-Rowley Terrace Australian Marine Park	Multiple Use Zone (IUCN VI) National Park Zone (IUCN II) Special Purpose Zone (Trawl) (IUCN VI)	-	✓
		Kimberley Australian Marine Park	Multiple Use Zone (IUCN VI)	-	✓
		Eighty Mile Beach Australian Marine Park	Multiple Use Zone (IUCN VI)	-	✓
		Dampier Australian Marine Park	Multiple Use Zone (IUCN VI) Habitat Protection Zone (IUCN IV) National Park Zone (IUCN II)	-	✓
		Gascoyne Australian Marine Park	Multiple Use Zone (IUCN VI) National Park Zone (IUCN II) Habitat Protection Zone (IUCN IV)	-	✓
		Ningaloo Australian Marine Park	Recreational Use Zone (IUCN IV) National Park Zone (IUCN II)	-	✓
		Perth Canyon Australian Marine Park	Habitat Protection Zone (IUCN IV) Multiple Use Zone (IUCN VI) National Park Zone (IUCN II)	-	✓

Value/sensitivity	Name	IUCN Classification	Yoorn OA	EMBA
	South-west Corner Australian Marine Park	Multiple Use Zone (IUCN VI) National Park Zone (IUCN II) Special Purpose Zone (Mining)	-	✓
	Two Rocks Australian Marine Park	Multiple Use Zone (IUCN VI) National Park Zone (IUCN II)	-	✓
	Carnarvon Canyon Australian Marine Park	Habitat Protection Zone (IUCN IV)	-	✓
	Shark Bay Australian Marine Park	Multiple Use Zone (IUCN VI)	-	✓
	Abrolhos Australian Marine Park	Habitat Protection Zone (IUCN IV) Multiple Use Zone (IUCN VI) National Park Zone (IUCN II) Special Purpose Zone (IUCN VI)	-	✓
	Jurien Australian Marine Park	National Park Zone (IUCN II) Special Purpose Zone (IUCN VI)	-	✓
State Marine Parks and Marine Management Areas	Rowley Shoals Marine Park	Sanctuary Zone Recreation Zone General Use Zone	-	✓
	Montebello Islands Marine Park	National Park (IUCN II) Sanctuary Zone	-	✓
	Barrow Island Marine Park	Sanctuary Zone	-	✓
	Barrow Island Marine Management Area	Conservation Area Unzoned Area	-	✓
	Ningaloo Marine Park	National Park (IUCN II) Sanctuary Zone	-	✓

Value/sensitivity	Name	IUCN Classification	Yoorn OA	EMBA
		Special Purpose Zone Recreation Zone General Use Zone		
	Muiron Islands Marine Management Area	Sanctuary Zone Special Purpose Zone Recreation Zone General Use Zone	-	✓
	Shark Bay Marine Park	Multiple Use Zone (IUNC VI) Sanctuary Zone	-	✓
	Jurien Bay Marine Park	General Use Zone	-	✓
	Marmion Marine Park	Multiple Use Zone (IUCN VI)	-	✓
Key Ecological Features	Glomar shoals	-	-	✓
	Ancient coastline at 125 m depth contour	-	-	✓
	Continental slope demersal fish communities	-	-	✓
	Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	-	-	✓
	Exmouth Plateau	-	-	✓
	Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	-	-	✓
	Canyons linking the Argo Abyssal Plain with the Scott Plateau	-	-	✓

Value/sensitivity	Name	IUCN Classification	Yoorn OA	EMBA
	Western demersal slope and associated fish communities	-	-	✓
	Wallaby Saddle	-	-	✓
	Seringapatam Reef and Commonwealth waters in the Scott Reef Complex	-	-	✓
	Western rock lobster	-	-	✓
	Ancient coastline at 90-120m depth	-	-	✓
	Commonwealth waters adjacent to Ningaloo Reef	-	-	✓
	Commonwealth marine environment surrounding the Houtman Abrolhos Islands	-	-	✓
	Perth Canyon and adjacent shelf break, and other west coast canyons	-	-	✓
	Cape Mentelle upwelling	-	-	✓
	Commonwealth marine environment within and adjacent to the west-coast inshore lagoons	-	-	✓
	Naturaliste Plateau	-	-	✓

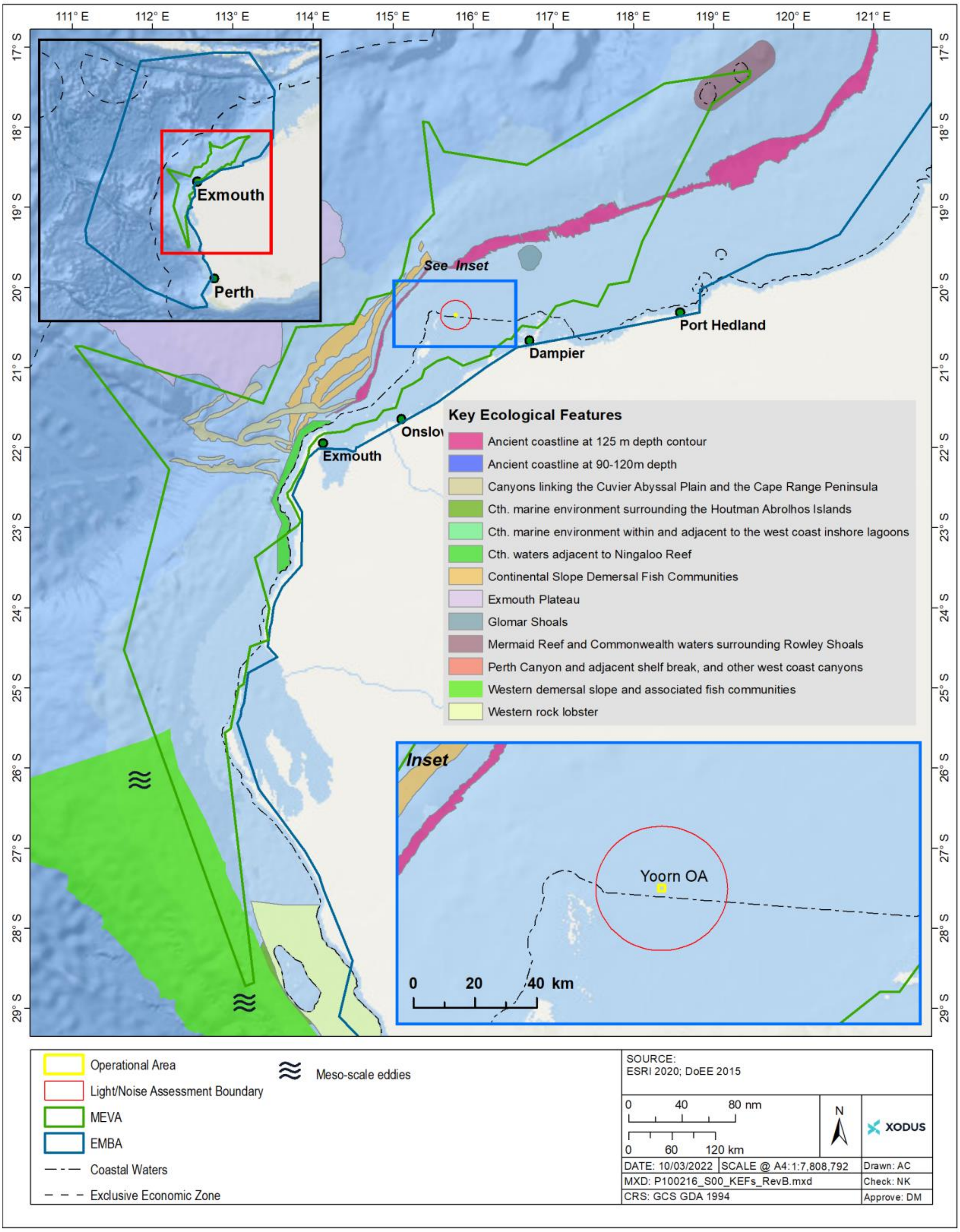

Figure 3-4: Key Ecological Features within the EMBA, MEVA and OAs

Table 3-4: Australian IUCN Reserve Management Principles (Schedule 8 of the EPBC Regulations 2000)

Applicable Marine Park	IUCN Principles[1]	IUCN Objectives [2]
	Strict Nature Reserve (IUCN Ia)	**Sanctuary Zone (IUCN Ia)**
Ashmore Reef AMP, Cartier Island AMP	The reserve or zone should be managed primarily for scientific research or environmental monitoring based on the following principles.	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.
	Habitats, ecosystems and native species should be preserved in as undisturbed a state as possible.	
	Genetic resources should be maintained in a dynamic and evolutionary state.	
	Established ecological processes should be maintained.	
	Structural landscape features or rock exposures should be safeguarded.	
	Examples of the natural environment should be secured for scientific studies, environmental monitoring and education, including baseline areas from which all avoidable access is excluded	
	Disturbance should be minimised by careful planning and execution of research and other approved activities.	
	Public access should be limited to the extent it is consistent with these principles.	
	National Park (IUCN II)	**National Park Zone (IUCN II)**
Abrolhos AMP, Argo-Rowley Terrace AMP, Dampier AMP, Gascoyne AMP, Mermaid Reef AMP, Ningaloo AMP, Perth Canyon AMP, Two Rocks AMP, Jurien AMP	The reserve or zone should be protected and managed to conserve its natural condition according to the following principles.	Managed to protect and conserve ecosystems, habitats and native species in as natural a state as possible. The zone only allows non-extractive activities unless authorised for research and monitoring.
	Natural and scenic areas of national and international significance should be protected for spiritual, scientific, educational, recreational or tourist purposes.	
	Representative examples of physiographic regions, biotic	

Applicable Marine Park	IUCN Principles[1]	IUCN Objectives [2]
	communities, genetic resources, and native species should be perpetuated in as natural a state as possible to provide ecological stability and diversity.	
	Visitor use should be managed for inspirational, educational, cultural and recreational purposes at a level that will maintain the reserve or zone in a natural or near natural state.	
	Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur.	
	Respect should be maintained for the ecological, geomorphologic, sacred and aesthetic attributes for which the reserve or zone was assigned to this category.	
	The needs of indigenous people should be taken into account, including subsistence resource use, to the extent that they do not conflict with these principles.	
	The aspirations of traditional owners of land within the reserve or zone, their continuing land management practices, the protection and maintenance of cultural heritage and the benefit the traditional owners derive from enterprises, established in the reserve or zone, consistent with these principles should be recognised and taken into account.	
	Habitat/species Management Area (IUCN IV)	**Habitat Protection Zone (IUCN IV)**
Abrolhos AMP, Carnarvon Canyon AMP, Dampier AMP, Gascoyne AMP, Ningaloo AMP, Perth Canyon AMP	The reserve or zone should be managed primarily, including (if necessary) through active intervention, to ensure the maintenance of habitats or to meet the requirements of collections or specific species based on the following principles.	Managed to allow activities that do not harm or cause destruction to seafloor habitats, while conserving ecosystems, habitats and native species in as natural a state as possible.
	Habitat conditions necessary to protect significant species, groups or	

Applicable Marine Park	IUCN Principles[1]	IUCN Objectives [2]
	collections of species, biotic communities or physical features of the environment should be secured and maintained, if necessary, through specific human manipulation.	
	Scientific research and environmental monitoring that contribute to reserve management should be facilitated as primary activities associated with sustainable resource management.	
	The reserve or zone may be developed for public education and appreciation of the characteristics of habitats, species or collections and of the work of wildlife management.	
	Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur.	
	People with rights or interests in the reserve or zone should be entitled to benefits derived from activities in the reserve or zone that are consistent with these principles.	
	If the reserve or zone is declared for the purpose of a botanic garden, it should also be managed for the increase of knowledge, appreciation and enjoyment of Australia's plant heritage by establishing, as an integrated resource, a collection of living and herbarium specimens of Australian and related plants for study, interpretation, conservation and display.	
Ningaloo AMP, Ashmore Reef AMP	NA	Managed to allow recreational use, while conserving ecosystems, habitats and native species in as natural a state as possible. The zone allows for recreational fishing, but not commercial fishing.
	Managed Resource Protected Area (IUCN VI)	**Multiple Use Zone (IUCN VI)**

Applicable Marine Park	IUCN Principles[1]	IUCN Objectives [2]
Abrolhos AMP, Argo-Rowley Terrace, Dampier AMP, Gascoyne AMP, Jurien AMP, Kimberley AMP, Montebello AMP, Shark Bay AMP	The reserve or zone should be managed mainly for the ecologically sustainable use of natural ecosystems based on the following principles.	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 values.
	The biological diversity and other natural values of the reserve or zone should be protected and maintained in the long term.	
	Management practices should be applied to ensure ecologically sustainable use of the reserve or zone.	
	Management of the reserve or zone should contribute to regional and national development to the extent that this is consistent with these principles.	
		Special Purpose Zone (IUCN VI)
South-west Corner AMP, Abrolhos AMP, Argo-Rowley Terrace	N/A	Managed to allow specific activities though special purpose management arrangements while conserving ecosystems, habitats and native species. The zone allows or prohibits specific activities.

[1]Australian IUCN Reserve Management Principles for Commonwealth Marine Protected Areas (Environment Australia, 2002)

[2]North-west Marine Parks Network Management Plan (Director of National Parks, 2018a); South- west Marine Parks Network Management Plan (Director of National Parks, 2018b)

3.2.2.1 Australian Marine Parks

The OA and light and noise boundary overlaps with the Montebello AMP (**Figure 3-5**). There are no additional protected areas identified for the light and noise boundary areas. The broader EMBA overlaps 31 AMPs. Values for these AMPs are described below (**Table 3-5**) and further in *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062, **Appendix C**).

Management plans for AMPs have been developed and came into force on 1 July 2018. Under these plans AMPs are allocated conservation objectives (International Union for Conservation of Nature (IUCN) Protected Area Category) (**Table 3-4**) based on the Australian IUCN reserve management principles in Schedule 8 of the EPBC Regulations 2000. These principles determine what activities are acceptable within the different zones of the AMP network. The Activity will be undertaken in compliance with the AMP network zone rules. In the event of spill response operations being required within an AMP, emergency spill response activities are allowed in accordance with the

Australian National Plan for Maritime Environmental Emergencies (MEE) without the need for a permit, class approval or Activity license or lease issued by the Director of National Parks.

The proposed Yoorn-1 well is within the Multiple Use Zone (IUCN VI) of the Montebello AMP. Offshore petroleum activities authorised under the OPGGS Act are considered 'mining operations'; which are permitted within a Multiple Use Zone (VI) (DNP, 2018).

Table 3-5: Values of Australian Marine Parks overlapping the EMBA

Australian Marine Park	Management Zone/s	Values
Abrolhos Australian Marine Park	+ Habitat Protection Zone (IUCN IV) + Multiple Use Zone (IUCN VI) + National Park Zone (IUCN II) + Special Purpose Zone (IUCN VI)	The Abrolhos Marine Park protected the following conservation values: + Contains habitats, species and ecological communities associated with four bioregions: Central Western Province; Central Western Shelf Province; Central Western Transition; and South-west Shelf Transition. + Seven key ecological features: the Commonwealth marine environment surrounding the Houtman Abrolhos Islands (valued for high levels of biodiversity and endemism); demersal slope and associated fish communities of the Central Western Province (valued as a species group that are nationally or regionally important to biodiversity); mesoscale eddies (valued for high productivity and aggregations of marine life); Perth Canyon and adjacent shelf break, and other west-coast canyons (valued for high biological productivity and aggregations of marine life, and unique seafloor features with ecological properties of regional significance); western rock lobster (valued as a species that plays a regionally important ecological role); ancient coastline between 90 m and 120 m depth (valued for relatively high productivity, aggregations of marine life and high levels of biodiversity and endemism); and Wallaby Saddle (valued for high productivity and aggregations of marine life). + Tourism, commercial fishing, mining, recreation including fishing, are important activities in the Marine Park
Argo-Rowley Terrace Australian Marine Park	+ Multiple Use Zone (IUCN VI) + National Park Zone (IUCN II) + Special Purpose Zone (IUCN VI)	The Argo-Rowley Marine Park protected the following conservation values: + Contains habitats, species and ecological communities associated with the Northwest Transition and Timor Province. + Two key ecological features: canyons linking the Argo Abyssal Plain with the Scott Plateau (valued for high productivity and aggregations of marine life); and Mermaid Reef and Commonwealth waters surrounding Rowley Shoals (valued for enhanced productivity, aggregations of marine life and high species richness). + The Marine Park is situated in the deeper waters of the region and a range of seafloor features such as canyons on the slope between the Argo Abyssal Plain, Rowley Terrace and Scott

Australian Marine Park	Management Zone/s	Values
		Plateau. These are believed to be up to 50 million years old and are associated with small, periodic upwellings that results in localised higher levels of biological productivity + Biologically important areas within the Marine Park include resting and breeding habitat for seabirds and a migratory pathway for the pygmy blue whale. + Commercial fishing and mining are important activities in the Marine Park.
Carnarvon Canyon Australian Marine Park	+ Habitat Protection Zone (IUCN IV)	The Carnarvon Canyon Marine Park protected the following conservation values: + Significant because it contains habitats, species and ecological communities associated with the Central Western Transition. This includes deep-water ecosystems associated with the Carnarvon Canyon. + The Marine Park lies within a transition zone between tropical and temperate species and is an area of high biotic productivity. + A bioregion characterised by large areas of continental slope, a range of topographic features such as terraces, rises and canyons, seasonal and sporadic upwelling, and benthic slope communities comprising tropical and temperate species. + Commercial fishing is an important activity in the Marine Park.
Dampier Australian Marine Park	+ Habitat Protection Zone (IUCN IV) + Multiple Use Zone (IUCN VI) + National Park Zone (IUCN II)	The Dampier Marine Park protected the following conservation values: + Significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province. + The Marine Park provides protection for offshore shelf habitats adjacent to the Dampier Archipelago, and the area between Dampier and Port Hedland, and is a hotspot for sponge biodiversity + The Marine Park includes several submerged coral reefs and shoals including Delambre Reef and Tessa Shoals + Biologically important areas within the Marine Park include breeding and foraging habitat for seabirds, internesting habitat for marine turtles and a migratory pathway for humpback whales. + Port activities, commercial fishing and recreation, including fishing, are important activities in the Marine Park.
Eighty Mile Beach Australian Marine Park	+ Multiple Use Zone (IUCN VI)	The Eighty Mile Beach Marine Park protected the following conservation values: + Significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province and consists of shallow shelf habitats, including terrace, banks and shoals.

Australian Marine Park	Management Zone/s	Values
		+ most important areas for migratory shorebirds in Australia; and the Western Australian Eighty Mile Beach Marine Park, providing connectivity between offshore and inshore coastal waters of Eighty Mile Beach. + The bioregion includes diverse benthic and pelagic fish communities, and ancient coastline thought to be an important seafloor feature and migratory pathway for humpback whales. + Biologically important areas within the Marine Park include breeding, foraging and resting habitat for seabirds, internesting and nesting habitat for marine turtles, foraging, nursing and pupping habitat for sawfish and a migratory pathway for humpback whales. + Tourism, commercial fishing, pearling and recreation are important activities in the Marine Park.
Gascoyne Australian Marine Park	+ Multiple Use Zone (VI) + Habitat Protection Zone (IV) + National Park Zone (II)	The Gascoyne Marine Park protects the following conservation values: + Important foraging areas for migratory seabirds threatened and migratory hawksbill 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; + 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 WA coastal waters; + Ecosystem examples from the surrounding provinces; + Four key ecological features: Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula, Commonwealth waters adjacent to Ningaloo Reef, Continental slope demersal fish communities and Exmouth Plateau; + The canyons in the 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 canyon heads; and + The reserve therefore provides connectivity between the inshore waters of the existing Ningaloo Commonwealth Marine Park and the deeper waters of the area.
Jurien Australian Marine Park	+ National Park Zone (IUCN II) + Special Purpose Zone (IUCN VI)	The Jurien Marine Park protects the following conservation values: + Significant because it includes habitats, species and ecological communities associated with two bioregions: South-west Shelf Transition; and Central Western Province.

Australian Marine Park	Management Zone/s	Values
		+ It includes three key ecological features: ancient coastline between 90 and 120 m depth (valued for relatively high productivity, aggregations of marine life and high levels of biodiversity and endemism); demersal slope and associated fish communities of the Central Western Province (valued as a species group that are nationally or regionally important to biodiversity); and western rock lobster (valued as a species that plays a regionally important ecological role). + The Marine Park contains a mixture of tropical species carried south by the Leeuwin Current, and temperate species carried north by the Capes Current. The Marine Park's shelf habitats are defined by distinct ridges of limestone reef with extensive beds of macroalgae. Inshore lagoons are inhabited by a diverse range of invertebrates and fish. Seagrass meadows occur in more sheltered areas as well as in the inter-reef lagoons along exposed sections of the coast. + Biologically important areas within the Marine Park include foraging habitat for seabirds, Australian sea lions and white sharks, and a migratory pathway for humpback and pygmy blue whales. + The Noongar people have responsibilities for sea country in the Marine Park. + The Marine Park contains two known shipwrecks listed under the Historic Shipwrecks Act 1976—SS Cambewarra (wrecked in 1914), Oleander (wrecked in 1884). + Tourism, commercial fishing, mining and recreation, including fishing, are important activities in the Marine Park. These activities contribute to the wellbeing of regional communities and the prosperity of the nation.
Kimberley Australian Marine Park	+ Multiple Use Zone (VI)	The Kimberley Marine Park protects the following conservation values: + Significant because it includes habitats, species ad ecological communities associated with the Northwest Shelf Province, Northwest Shelf Transition and Timor Province; + Two key ecological features: ancient coastline between 90 and 120 m depth (values for relatively high productivity, aggregations of marine life and high levels of biodiversity and endemism) and continental slope demersal fish communities (valued for high levels of endemism and diversity and the second richest area for demersal fish species in Australia); + Biologically important areas within the Marine Park include breeding and foraging habitat for seabirds, internesting and

Australian Marine Park	Management Zone/s	Values
		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 and foraging habitat for whale sharks; The national heritage listing for the West Kimberley recognises the following key cultural heritage values: + Wanjina Wunggurr Cultural Tradition which incorporates many sea country cultural sites + Log-raft maritime tradition, which involved using tides and currents to access warrurru (reefs) far offshore to fish + Interactions with Makassan traders around sea foods over hundreds of years + Important pearl resources that were used in traditional trade through the wunan and in contemporary commercial agreements + Tourism, commercial fishing, mining, recreation, including fishing, and traditional use are important activities in the Marine Park.
Mermaid Reef Australian Marine Park	+ National Park Zone (IUCN II)	The Mermaid Reef Marine Park protected the following conservation values: + Significant because it contains habitats, species and ecological communities associated with the Northwest Transition + One key ecological feature: Mermaid Reef and Commonwealth waters surrounding Rowley Shoals (valued for its high productivity, aggregations of marine life and high species richness) + Ecologically significant as they are considered the ecological steppingstones for reef species originating in Indonesian/Western Pacific waters + Biologically important areas include breeding habitat for seabirds and a migratory pathway for the pygmy blue whale + Tourism, recreation, and scientific research are important activities in the Marine Park.
Montebello Australian Marine Park	+ Multiple Use Zone (IUCN VI)	The Montebello Marine Park protected the following conservation values: + Significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province + One key ecological feature: the ancient coastline at the 125-m depth contour (valued as a unique seafloor feature with ecological properties of regional significance) + The bioregion includes diverse benthic and pelagic fish communities, and ancient coastline thought to be an important seafloor feature and migratory pathway for humpback whales

Australian Marine Park	Management Zone/s	Values
		+ Biologically important areas within the Marine Park include breeding habitat for seabirds, internesting, foraging, mating, and nesting habitat for marine turtles, a migratory pathway for humpback whales and foraging habitat for whale sharks + Tourism, commercial fishing, mining and recreation are important activities in the Marine Park.
Ningaloo Australian Marine Park	+ Recreational Use Zone (IUCN IV) + National Park Zone (IUCN II)	The Ningaloo Marine Park 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 key ecological features + The Ningaloo Coast World Heritage Property, the Ningaloo Coast National Heritage listing and Ningaloo Marine Area Commonwealth Heritage Listing.
Perth Canyon Australian Marine Park	+ Habitat Protection Zone (IUCN IV) + Multiple Use Zone (IUCN VI) + National Park Zone (IUCN II)	The Perth Canyon Marine Park protects the following conservation values: + Significant because it includes habitats, species and ecological communities associated with four bioregions: Central Western Province; South-west Shelf Province; Southwest Transition; and South-west Shelf Transition. + It includes four key ecological features: Perth Canyon and adjacent shelf break, and other west-coast canyons (valued for high biological productivity and aggregations of marine life, and unique seafloor features with ecological properties of regional significance); demersal slope and associated fish communities of the Central Western Province (valued as a species group that are nationally or regionally important to biodiversity); western rock lobster (valued as a species that plays a regionally important ecological role); and mesoscale eddies (valued for high productivity and aggregations of marine life). + The Marine Park includes the majority of the Perth Canyon, Australia's largest submarine canyon, which is home to the largest feeding aggregations of blue whales in Australia. This

Australian Marine Park	Management Zone/s	Values
		unique feature is also of particular significance because it cuts into the continental shelf at approximately 150 m depth west of Rottnest Island, linking the shelf with deeper ecosystems at depths of up to 5000 m. + Biologically important areas within the Marine Park include foraging habitat for seabirds, Antarctic blue, pygmy blue and sperm whales, a migratory pathway for humpback, Antarctic blue and pygmy blue whales, and a calving buffer area for southern right whales. + The Swan River traditional owners have responsibilities for sea country in the Marine Park. + Tourism, commercial shipping, commercial fishing, recreation, including fishing, and defence training are important activities in the Marine Park. These activities contribute to the wellbeing of regional communities and the prosperity of the nation.
Shark Bay Australian Marine Park	+ Multiple Use Zone (IUCN VI)	The Shark Bay Marine Park protected the following conservation values: + Significant because it contains habitats, species and ecological communities associated with the Central Western Shelf Province and Central Western Transition. + The Marine Park provides connectivity between deeper Commonwealth waters and the inshore waters of the Shark Bay world heritage property. + Biologically important areas within the Marine Park include breeding habitat for seabirds, internesting habitat for marine turtles, and a migratory pathway for humpback whales. + Tourism, commercial fishing, mining and recreation, including fishing, are important activities in the Marine Park.
South-west Corner Australian Marine Park	+ Multiple Use Zone (IUCN VI) + Natonal Park Zone (IUCN II) + Special Purpose Zone (Mining)	The South-west Corner Marine Park protects the following conservation values: + significant because it contains habitats, species and ecological communities associated with three bioregions: Southern Province; South-west Transition; and South-west Shelf Province. + It includes six key ecological features: Albany Canyon group and adjacent shelf break (valued for high productivity, aggregations of marine life and unique seafloor features with properties of regional significance); Cape Mentelle upwelling (valued for high productivity and aggregations of marine life); Diamantina Fracture Zone (valued as a unique seafloor feature with ecological properties of regional significance); Naturaliste Plateau (valued as a unique seafloor feature with ecological properties of regional significance); western rock lobster (valued

Australian Marine Park	Management Zone/s	Values
		as a species that plays a regionally important ecological role); and ancient coastline between 90 m and 120 m depth (valued for relatively high productivity, aggregations of marine life and high levels of biodiversity and endemism). + As the largest Marine Park in the South-west Network, it contains a wide range of important ecosystems in both shallow and deep water, reaching abyssal depths including the Diamantina Fracture Zone, Naturaliste Plateau and Donnelly Banks, along with many reefs and canyons. The Marine Park contributes to a transect that extends from coastal land (Leeuwin–Naturaliste and D'entrecasteaux National Parks), to coastal waters (Ngari Capes Marine Park) and the deep ocean. + Biologically important areas within the Marine Park include foraging habitat for seabirds, Australian sea lions, white sharks and sperm whales, a migratory pathway for Antarctic blue, pygmy blue and humpback whales, and a calving buffer area for southern right whales. + The Nyungar/Noongar people have responsibilities for sea country in the Marine Park. + The Marine Park contains 10 known shipwrecks listed under the Historic Shipwrecks Act 1976. + Tourism, commercial fishing, commercial shipping, and recreation, including fishing, are important activities in the Marine Park. These activities contribute to the wellbeing of regional communities and the prosperity of the nation.
Two Rocks Australian Marine Park	Multiple Use Zone (IUCN VI) National Park Zone (IUCN II)	The Two Rocks Marine Park protects the following conservation values: + Significant because it includes habitats, species and ecological communities associated with the South-west Shelf Transition. + It includes three key ecological features: the Commonwealth marine environment within and adjacent to the west-coast inshore lagoons (valued for high productivity and aggregations of marine life, and high levels of biodiversity and endemism); western rock lobster (valued as a species that plays a regionally important ecological role); and ancient coastline between 90 m and 120 m depth (valued for relatively high productivity, aggregations of marine life and high levels of biodiversity and endemism). + The Marine Park is shallow and provides connectivity between offshore waters and the west coast inshore lagoons, which are

Australian Marine Park	Management Zone/s	Values
		key areas for the recruitment of rock lobster and other commercially and recreationally important fish species. + Biologically important areas within the Marine Park include foraging habitat for seabirds and Australian sea lions, a migratory pathway for humpback and pygmy blue whales, and a calving buffer area for southern right whales. + The Swan River traditional owners have responsibilities for sea country in the Marine Park. + Tourism, commercial fishing, recreation, including fishing, 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.

Source: Director of National Parks (2018a and 2018b)

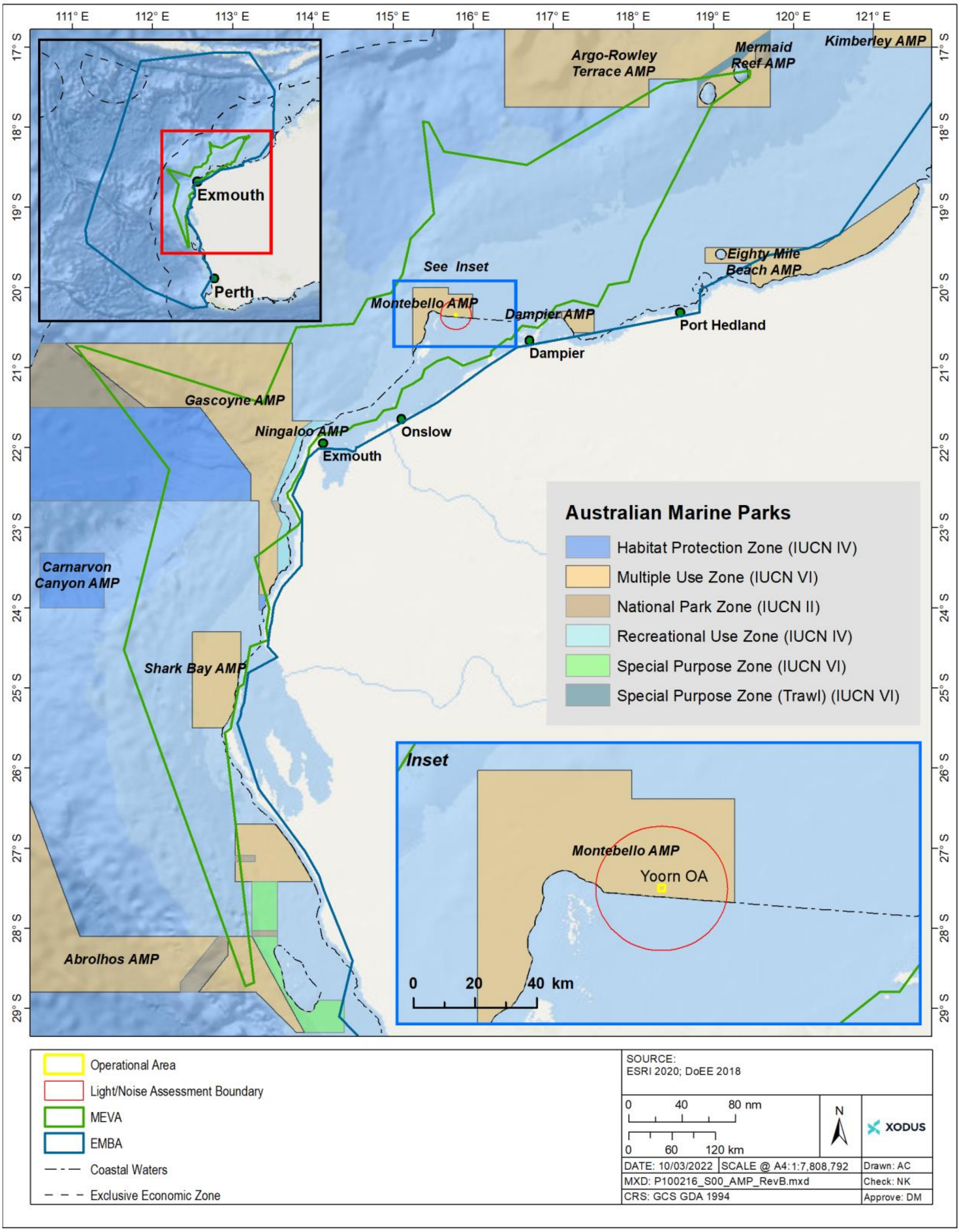

Figure 3-5: Australian Marine Parks within the EMBA and Operational Areas

3.2.2.2 State Marine Parks

There are nine State Marine Parks and two Marine Management Areas located in the EMBA:

+ Shark Bay Marine Park
+ Ningaloo Marine Park
+ Muiron Islands Marine Management Area
+ Barrow Island Marine Park
+ Barrow Island Marine Management Area
+ Marmion Marine Park
+ Jurien Bay Marine Park
+ Montebello Islands Marine Park
+ Rowley Shoals Marine Park.

The OA does not overlap any State Marine Parks. However, the Light and noise boundary intersects the Montebello Islands Marine Park. Values for the Marine Parks are outlined briefly in **Table 3-6** below and are described further in *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062, **Appendix C**).

Table 3-6: State Marine Parks overlapping the EMBA

State Marine Park	Values
Ningaloo Marine Park	The Ningaloo Marine Park covers an area of 263,343 km^2, including both State and Commonwealth waters, extending 25 km offshore. The park protects a large portion of Ningaloo Reef, which stretches over 300 km from North West Cape south to Red Bluff. It is the largest fringing coral reef in Australia, forming a discontinuous barrier that encloses a lagoon that varies in width from 200 m to 7 km. Gaps that regularly intercept the main reef line provide channels for water exchange with deeper, cooler waters (CALM 2005). The Ningaloo Marine Park forms the backbone of the nature-based tourism industry, and recreational activities in the Exmouth region. Seasonal aggregations of whale sharks, manta rays, sea turtles and whales, as well as the annual mass spawning of coral attract large numbers of visitors to Ningaloo each year (MPRA and CALM 2005).
Shark Bay Marine Park	The Shark Bay Marine Park covers an area of 7,443 km^2, extending from the WA state water boundary, and a water depth range between 15 m and 220 m. The marine park is located approximately 60 km offshore of Carnarvon, adjacent to Shark Bay world heritage property and national heritage place. The Shark Bay Marine Park is significant because it contains habitats, species and ecological communities associated with the Central Western Shelf Province and Central Western Transition. The marine park supports a breeding habitat for seabirds, internesting habitat for marine turtles and a migratory pathway for humpback whales.
Barrow Island Marine Park	Barrow Island Marine Park is a significant breeding and nesting area for threatened sea turtles and its waters support important coral reefs and a diversity of tropical marine animals.

State Marine Park	Values
	The marine park is 4,100 ha that supports large numbers of threatened green turtles on Turtle Bay. On the western side if Barrow Island, contains Biggada Reef that is only one of two significant fringing reefs in the Montebello/Barrow Island reserve system.
Barrow Island Marine Management Area	The Barrow Island Marine Management Area is offshore and relatively remote. It covers 114,500 hectares includes most of the waters around Barrow Island and the waters around the Lowendal Islands. The park is a significant breeding and nesting area for marine turtles and its waters support important coral reefs, unique mangrove communities and a diversity of tropical marine animals. Threatened green, hawksbill and flatback turtles regularly use the sandy beaches of Barrow Island for breeding and nesting.
Montebello Islands Marine Park	More than 58,000 hectares of ocean surrounding 265 low-lying islands and islets that are fringed by coral reefs populated with colourful tropical fish. The Montebello Islands Marine Park, with its natural land and seascapes, barrier and fringing coral reefs, wide variety of wildlife and rich maritime heritage.
Rowley Shoals Marine Park	The Rowley Shoals include the State managed Rowley Shoals Marine Park and nearby Mermaid Reef, Commonwealth managed Marine Park. The Rowley Shoals Marine Park and Mermaid Reef Marine Park protect a chain of three coral atolls at the edge of Australia's continental shelf. The atolls have shallow lagoons inhabited by diverse corals and abundant marine life. Corals form a spectacular chain of reef systems, each covering about 80 km^2. Shallow lagoons within the reefs provide sheltered waters that are inhabited by diverse and abundant tropical marine life. Further offshore, the seafloor slopes away to the abyssal plain, some 6000 metres below.
Jurien Bay Marine Park	The Jurien Bay Marine Park is a Class A marine park located on the central west coast of Western Australia about 200 km north of Perth and covers an area of 82,375 ha (CALM 2005b). Its western boundary is the seaward limit of Western Australian coastal waters. Its northern boundary is the northern point of Dynamite Bay at Green Head (30° 4' 7.9" South), and its southern boundary is located just south of Wedge (30° 50' 20" South) and is contiguous with the southern boundary of the Wanagarren Nature Reserve. Jurien Bay Marine Park is considered to be broadly representative of the Central West Coast limestone reef system, which is a major marine ecosystem within this bioregion. The marine biota of the area consists of an unusual mix of tropical and temperate species as well as many endemic species (Larkum & Hartog, 1989). The Marine Park is dominated by five major marine habitat types: seagrass meadows; bare or sparsely vegetated mobile sand; shoreline and offshore intertidal reef platforms; subtidal limestone reefs; and reef pavement (CALM 2005b). Marine wildlife includes 14 species of cetaceans, a variety of sea and shorebirds which nest on the islands and the Australian sea lion (North Fisherman Island to the north of Jurien Bay is one of the main breeding sites for sea lions in the Central West Coast region and it is believed this breeding population is genetically distinct from the southern coast population – Gales et al. 1992). Commercial fishing for western rock lobster as well as commercial wetlining, abalone, shark netting, beach seining for mullet and collecting of specimen shells and aquarium fish are carried out within the marine park.

State Marine Park	Values
Marmion Marine Park	Marmion Marine Park was Western Australia's first marine park, declared in 1987 and is a multi-use reserve (CALM 2002). Marmion Marine Park is located offshore from Perth's northern suburbs, between Trigg Island and Burns Beach. Habitats in the area include intertidal reef platforms, coastal sand beaches, a high limestone reef about 1 km from shore, Little Island and the Three Mile Reef system. Of note are complex assemblages of sea floor communities, including seagrass meadows, algal limestone pavement communities and crevice animal associations (CALM 2002). The marine park provides an important habitat for marine mammals, such as sea lions, dolphins and whales. The island nature reserves within Marmion Marine Park provide an important habitat for several species of seabirds and haul-out areas for Australian sea lions, especially at Little Island and Burns Rocks (CALM 2002).
Muiron Islands Management Area	The Ningaloo Marine Park Management Plan (CALM 2005) created a MMA for the Muiron Islands, immediately adjacent to the northern end of the Park. This 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. 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 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).

Source: DBCA (2020a)

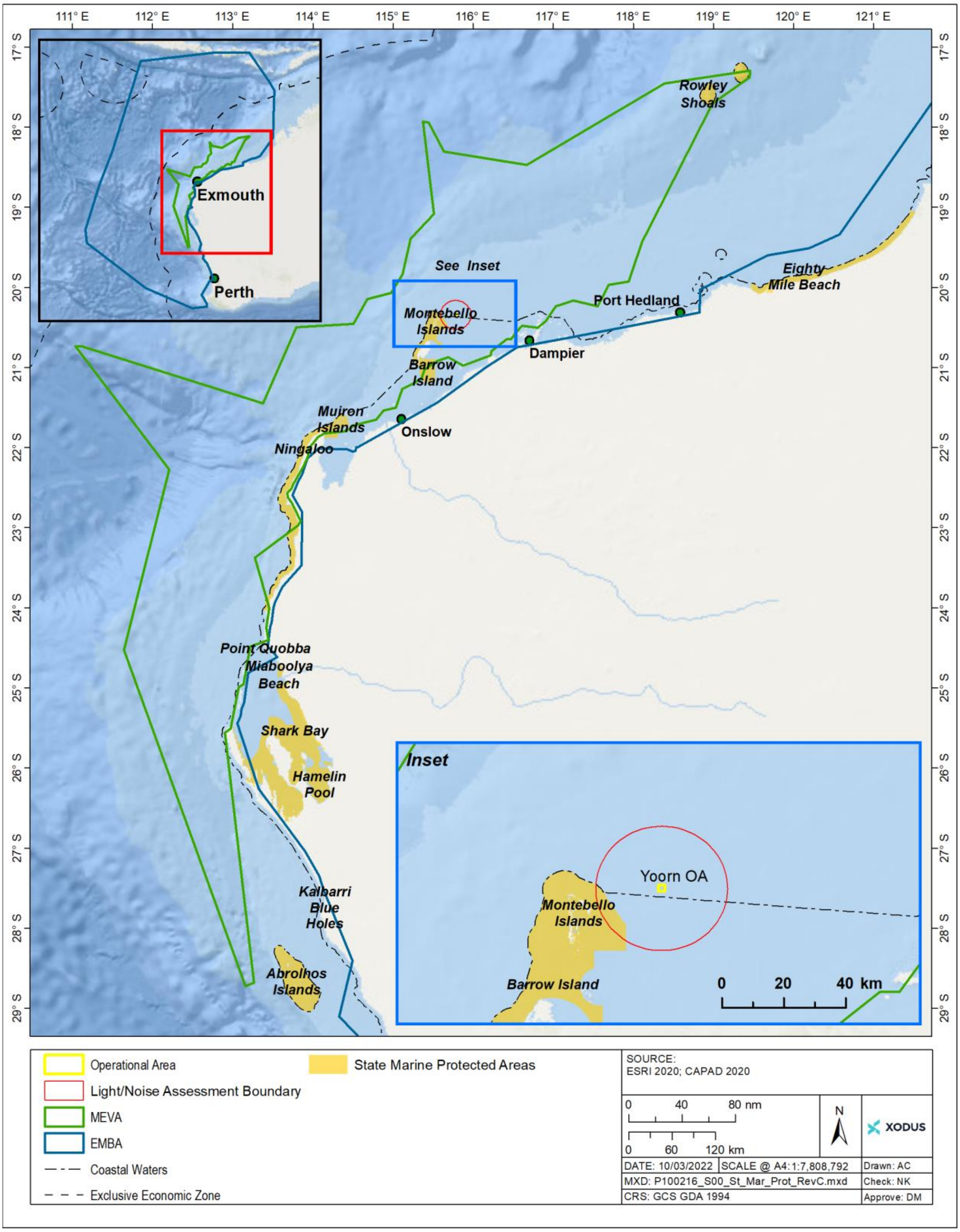

Figure 3-6: State Marine Protected Areas within the EMBA, MEVA and Operational Area

3.2.3 Marine Fauna

Table 3-7 presents the environmental values and sensitivities (threatened and migratory species) within the OA and EMBA. These include all relevant Matters of National Environmental Significance (MNES) protected under the EPBC Act 1999 as identified in the PMST search for the OA and EMBA (**Appendix D** – EPBC Protected Matters Search Tool Results). For each species identified, the extent of likely presence is provided. The BIAs and habitats critical to the survival of a species are described in the *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062, **Appendix C**) and overlap with designated Biologically Important Areas (BIAs) are shown in **Table 3-8**. BIAs such as an aggregation, breeding, resting, nesting or feeding areas or known migratory routes for these species are shown in **Figure 3-7** to **Figure 3-31**.

Note that terrestrial species (such as terrestrial mammals, reptiles and bird species) that appear in the EPBC search of the EMBA and do not have habitats along shorelines are not relevant to the activity impacts and risks have been excluded from **Table 3-7**.

The following environmental values and sensitivities have been identified as being relevant to the activity, with information provided in the following subsections to supplement the information available in *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062, **Appendix C**):

+ Humpback whale migration
+ Pygmy blue whale
+ Marine turtles
+ Whale shark
+ Breeding seabirds.

A PMST search was also undertaken for the 20 km boundary around the OA relevant to light and noise impact assessment. Of the species identified (in addition to those within the OA), five have a threatened species status; Northern Siberian Bar-tailed Godwit, Australian Painted Snipe, Short-nosed Seasnake, Leaf-scaled Seasnake, and Sei Whale.

Relevant conservation advices, recovery plans and management plans for marine fauna identified in the PMST for the OA, light and noise assessment boundaries and the EMBA are provided in **Table 3-7.**

Table 3-8 identifies the BIAs that intersect the OA, the 20 km light and noise assessment boundary, the MEVA and the EMBA.

DAWE may develop recovery plans for threatened fauna listed under the EPBC Act. The Act requires that 'habitat critical to the survival of the listed threatened species' is identified in recovery plans. Critical habitat within the EMBA relevant to for marine reptiles and is listed in **Table 3-8.**

Table 3-7: Environmental Values and Sensitivities within the EMBA, Light/Noise Boundary Areas and Operational Area – Threatened and Migratory Marine Fauna

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Fish and Sharks						
Southern Pygmy Pipehorse	*Acentronura australe*	Marine	-	-	MO	<u>Planned</u> + Light emissions + Noise emissions + Planned operational discharges + Planned drilling discharges + Spill response operations <u>Unplanned</u> + Hydrocarbon releases/spills + Interaction with marine fauna
Helen's Pygmy Pipehorse	*Acentronura larsonae*	Marine	MO	MO	MO	
Narrow sawfish, Knifetooth sawfish	*Anoxypristis cuspidata*	Migratory	MO	LO	KO	
Corrugated Pipefish, Barbed Pipefish	*Bhanotia fasciolata*	Marine	-	-	MO	
Braun's Pughead Pipefish, Pug-head Pipefish	*Bulbonaricus brauni*	Marine	MO	MO	MO	
Gale's Pipefish	*Campichthys galei*	Marine	-	-	MO	
Three-keel Pipefish	*Campichthys tricarinatus*	Marine	MO	MO	MO	
Grey nurse shark (west coast population)	*Carcharias taurus* (west coast population)	Vulnerable	LO	LO	KO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	**Scientific name**					
Oceanic whitetip shark	*Carcharhinus longimanus*	Migratory	LO	LO	LO	+ Introduction of invasive marine species (IMS)
White shark, Great white shark	*Carcharodon carcharias*	Vulnerable Migratory	MO	MO	FKO	
Pacific Short-bodied Pipefish, Shortboded Pipefish	*Choeroichthys brachysoma*	Marine	MO	MO	MO	
Muiron Island Pipefish	*Choeroichthys latispinosus*	Marine	MO	MO	MO	
Pig-snouted Pipefish	*Choeroichthys suillus*	Marine	MO	MO	MO	
Fijian Banded Pipefish	*Corythoichthys amplexus*	Marine	-	-	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish	*Corythoichthys falvofasciatus*	Marine	-	-	MO	
Australian Messmate Pipefish, Banded Pipefish	*Corythoichthys falvofasciatus*	Marine	-	-	MO	
Schultz's Pipefish	*Corythoichthys schultzi*	Marine	-	-	MO	
Roughridge Pipefish	*Cosmocampus banneri*	Marine	-	-	MO	
Banded Pipefish, Ringed Pipefish	*Doryrhamphus dactyliophorus*	Marine	MO	MO	MO	
Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Bluestripe Pipefish	*Doryrhamphus excisus*	Marine	-	-	MO	
Cleaner Pipefish, Janss' Pipefish	*Doryrhamphus janssi*	Marine	MO	MO	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Many-banded Pipefish	*Doryrhamphus multiannulatus*	Marine	MO	MO	MO	
Flagtail Pipefish	*Doryrhamphus negrosensis*	Marine	MO	MO	MO	
Ladder Pipefish	*Festucalex scalaris*	Marine	MO	MO	MO	
Tiger Pipefish	*Filicampus tigris*	Marine	MO	MO	MO	
Northern river shark, New Guinea river shark	*Glyphis garricki*	Endangered	-	-	MO	
Brock's Pipefish	*Halicampus brocki*	Marine	MO	MO	MO	
Red-hair Pipefish, Duncker's Pipefish	*Halicampus dunckeri*	Marine	-	-	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Mud Pipefish, Gray's Pipefish	*Halicampus grayi*	Marine	MO	MO	MO	
Glittering Pipefish	*Halicampus nitidus*	Marine	MO	MO	MO	
Spiny-snout Pipefish	*Halicampus spinirostris*	Marine	MO	MO	MO	
Ribboned Pipehorse, Ribboned Seadragon	*Haliichthys taeniophorus*	Marine	MO	MO	MO	
Upside-down Pipefish, Eastern Upside-down Pipefish	*Heraldia nocturna*	Marine	-	-	MO	
Beady Pipefish, Steep-nosed Pipefish	*Hippichthys penicillus*	Marine	MO	MO	MO	
Western Spiny Seahorse, Narrow-bellied Seahorse	*Hippocampus angustus*	Marine	MO	MO	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Short-head Seahorse, Short-snouted Seahorse	*Hippocampus breviceps*	Marine	-	-	MO	
Spiny Seahorse, Thorny Seahorse	*Hippocampus histrix*	Marine	MO	MO	MO	
Spotted Seahorse, Yellow Seahorse	*Hippocampus kuda*	Marine	MO	MO	MO	
Flat-face Seahorse	*Hippocampus planifrons*	Marine	MO	MO	MO	
Hedgehog Seahorse	*Hippocampus spinosissimus*	Marine	-	-	MO	
West Australian Seahorse	*Hippocampus subelongatus*	Marine	-	-	MO	
Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse	*Hippocampus trimaculatus*	Marine	MO	MO	MO	
Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish	*Histiogamphelus cristatus*	Marine	-	-	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Shortfin mako, mako shark	*Isurus oxyrinchus*	Migratory	-	LO	LO	
Longfin mako shark	*Isurus paucus*	Migratory	-	LO	LO	
Porbeagle, mackerel shark	*Lamna nasus*	Migratory	-	-	LO	
Australian Smooth Pipefish, Smooth Pipefish	*Lissocampus caudalis*	Marine	-	-	MO	
Prophet's Pipefish	*Lissocampus fatiloquus*	Marine	-	-	MO	
Javelin Pipefish	*Lissocampus runa*	Marine	-	-	MO	
Reef manta ray, coastal manta ray	*Manta alfredi*	Migratory	KO	KO	KO	
Giant manta ray, chevron manta ray, Pacific manta ray	*Manta birostris*	Migratory	LO	LO	KO	
Sawtooth Pipefish	*Maroubra perserrata*	Marine	-	-	MO	
Tidepool Pipefish	*Micrognathus micronotopterus*	Marine	MO	MO	MO	
Blind gudgeon	*Milyeringa veritas*	Vulnerable	-	-	KO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Western Crested Pipefish	*Mitotichthys meraculus*	Marine	-	-	MO	
Balston's Pygmy Perch	*Nannatherina balstoni*	Vulnerable	-	-	LO	
Bonyhead Pipefish, Bony-headed Pipefish	*Nannocampus subosseus*	Marine	-	-	MO	
Blind cave eel	*Ophisternon candidum*	Vulnerable	-	-	KO	
Black Rock Pipefish	*Phoxocampus belcheri*	Marine	MO	MO	MO	
Leafy Seadragon	*Phycodurus eques*	Marine	-	-	MO	
Common Seadragon	*Phyllopteryx taeniolatus*	Marine	-	-	MO	
Dwarf sawfish, Queensland sawfish	*Pristis clavata*	Vulnerable Migratory	KO	KO	KO	
Freshwater sawfish, largetooth sawfish, river sawfish,	*Pristis pristis*	Vulnerable Migratory	-	-	KO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Green sawfish, Dindagubba, narrowsnout sawfish	*Pristis zijsron*	Vulnerable Migratory	KO	KO	KO	
Pugnose Pipefish, Pug-nosed Pipefish	*Pugnaso curtirostris*	Marine	-	-	MO	
Whale shark	*Rhincodon typus*	Vulnerable Migratory	MO	FKO	FKO	
Pallid Pipehorse, Hardwick's Pipehorse	*Solegnathus hardwickii*	Marine	MO	MO	MO	
Gunther's Pipehorse, Indonesian Pipefish	*Solegnathus lettiensis*	Marine	MO	MO	MO	
Robust Ghostpipefish, Blue-finned Ghost Pipefish	*Solenostomus cyanopterus*	Marine	MO	MO	MO	
Spotted Pipefish, Gulf Pipefish, Peacock PIpefish	*Stigmatopora argus*	Marine	-	-	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish	*Stigmatopora nigra*	Marine	-	-	MO	
Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish	*Syngnathoides biaculeatus*	Marine	MO	MO	MO	
Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish	*Trachyrhamphus bicoarctatus*	Marine	MO	MO	MO	
Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish	*Trachyrhamphus longirostris*	Marine	MO	MO	MO	
Hairy Pipefish	*Urocampus carinirostris*	Marine	-	-	MO	
Mother-of-pearl Pipefish	*Vanacampus margaritifer*	Marine	-	-	MO	
Port Phillip Pipefish	*Vanacampus phillipi*	Marine	-	-	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish	*Vanacampus poecilolaemus*	Marine	-	-	MO	
Marine Mammals						
Minke Whale	*Balaenoptera acutorostrata*		MO	MO	MO	Planned + Noise emissions + Planned operational discharges + Planned drilling discharges + Spill response operations Unplanned + Hydrocarbon releases/spills + Marine fauna interaction
Long-nosed Fur-seal, New Zealand Fur-seal	*Arctocephalus forsteri*	Marine	-	-	LO	
Antarctic minke whale, dark-shoulder minke whale	*Balaenoptera bonaerensis*	Migratory	-	-	LO	
Sei whale	*Balaenoptera borealis*	Vulnerable, Migratory	-	MO	FLO	
Bryde's whale	*Balaenoptera edeni*	Migratory	MO	MO	LO	
Blue whale	*Balaenoptera musculus*	Endangered Migratory	LO	LO	FKO	
Fin whale	*Balaenoptera physalusk*	Vulnerable, Migratory	MO	MO	FLO	
Arnoux's Beaked Whale	*Berardius arnuxii*		-	-	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	**Scientific name**					
Pygmy Right Whale	*Caperea marginata*	Migratory	-	-	FLO	
Common Dolphin, Short-beaked Dolphin	*Delphinus delphis*		MO	MO	MO	
Dugong	*Dugong dugon*	Migratory Marine	-	KO	BKO	
Southern right whale	*Eubalaena australis*	Endangered Migratory	-	-	BKO	
Pygmy Killer Whale	*Feresa attenuata*		-	-	MO	
Short-finned Pilot Whale	*Globicephala macrorhynchus*		-	-	MO	
Long-finned Pilot Whale	*Globicephala melas*		-	-	MO	
Risso’s Dolphin, Grampus	*Grampus griseus*		MO	MO	MO	
Southern Bottlenose Whale	*Hyperoodon planifrons*		-	-	MO	
Longman’s Beaked Whale	*Indopacetus pacificus*		-	-	MO	
Pygmy Sperm Whale	*Kogia breviceps*		-	-	MO	
Dwarf Sperm Whale	*Kogia simus*		-	-	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Fraser's Dolphin, Sarawak Dolphin	*Lagenodelphis hosei*		-	-	MO	
Dusky Dolphin	*Lagenorhynchus obscurus*	Migratory	-	-	LO	
Southern Right Whale Dolphin	*Lissodelphis peronii*		-	-	MO	
Humpback whale	*Megaptera novaeangliae*	Migratory	BKO	BKO	BKO	
Andrew's Beaked Whale	*Mesoplodon bowdoini*		-	-	MO	
Blainville's Beaked Whale, Dense-beaked Whale	*Mesoplodon densirostris*		-	-	MO	
Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale	*Mesoplodon ginkgodens*		-	-	MO	
Gray's Beaked Whale, Scamperdown Whale	*Mesoplodon grayi*		-	-	MO	
Hector's Beaked Whale	*Mesoplodon hectori*		-	-	MO	
Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale	*Mesoplodon layardii*		-	-	MO	
True's Beaked Whale	*Mesoplodon mirus*		-	-	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Australian sea-lion, Australian sea lion	*Neophoca cinerea*	Vulnerable	-	-	BKO	
Irrawaddy	*Orcaella brevirostris*		-	-	MO	
Australian Snubfin Dolphin	*Orcaella heinsohni*	Migratory	-	-	MO	
Killer whale, Orca	*Orcinus orca*	Migratory	MO	MO	MO	
Melon-headed Whale	*Peponocephala electra*		-	-	MO	
Sperm whale	*Physeter macrocephalus*	Migratory	-	-	FKO	
False Killer Whale	*Pseudorca crassidens*		-	MO	LO	
Indo-Pacific humpback dolphin	*Sousa chinensis*	Migratory	MO	MO	KO	
Spotted Dolphin, Pantropical Spotted Dolphin	*Stenella attenuata*		MO	MO	MO	
Striped Dolphin, Euphrosyne Dolphin	*Stenella coeruleoalba*		-	-	MO	
Long-snouted Spinner Dolphin	*Stenella longirostris*		-	-	MO	
Rough-toothed Dolphin	*Steno bredanensis*		-	-	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Shepherd's Beaked Whale, Tasman Beaked Whale	*Tasmacetus shepherdi*		-	-	MO	
Indian Ocean Bottlenose Dolphin, Spotted bottlenose dolphin	*Tursiops aduncus (Arafura/Timor Sea populations)*	Migratory	LO	LO	KO	
Bottlenose Dolphin	*Tursiops truncates s. str.*		MO	MO	MO	
Cuvier's Beaked Whale, Goose-beaked Whale	*Ziphius cavirostris*		-	-	MO	
Marine Reptiles						
Horned Seasnake	*Acalyptophis peronii*	Marine	MO	MO	MO	<u>Planned</u> + Light emissions + Noise emissions + Planned operational discharges + Planned drilling discharges + Spill response operations <u>Unplanned</u>
Short-nosed seasnake	*Aipysurus apraefrontalis*	Critically Endangered Marine	-	LO	KO	
Leaf-scaled Seasnake	*Aipysurus foliosquama*	Critically Endangered Marine	-	KO	KO	
Dubois' Seasnake	*Aipysurus duboisii*	Marine	MO	MO	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	**Scientific name**					
Spine-tailed Seasnake	*Aipysurus eydouxii*	Marine	MO	MO	MO	+ Hydrocarbon releases/spills + Marine fauna interactions + Introduction of IMS
Dusky Seasnake	*Aipysurus fuscus*	Marine	-	-	KO	
Olive Seasnake	*Aipysurus laevis*	Marine	MO	MO	MO	
Shark Bay Seasnake	*Aipysurus pooleorum*	Marine	-	-	MO	
Brown-lined Seasnake	*Aipysurus tenuis*	Marine	MO	MO	MO	
Stokes' Seasnake	*Astrotia stokesii*	Marine	MO	MO	MO	
Loggerhead turtle	*Caretta caretta*	Endangered Migratory Marine	KO	FKO	BKO	
Green turtle	*Chelonia mydas*	Vulnerable Migratory Marine	KO	FKO	BKO	
Salt-water Crocodile, Estuarine Crocodile	*Crocodylus porosus*	Migratory Marine	-	-	LO	
Leatherback turtle	*Dermochelys coriacea*	Endangered	LO	LO	FKO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
		Migratory Marine				
Spectacled Seasnake	*Disteira kingii*	Marine	MO	MO	MO	
Olive-headed Seasnake	*Disteira major*	Marine	MO	MO	MO	
Turtle-headed Seasnake	*Emydocephalus annulatus*	Marine	-	MO	MO	
North-western Mangrove Seasnake	*Ephalophis greyi*	Marine	MO	MO	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Hawksbill turtle	*Eretmochelys imbricata*	Vulnerable Migratory Marine	KO	FKO	BKO	
Black-ringed Seasnake	*Hydrelaps darwiniensis*	Marine	-	-	MO	
Slender-necked Seasnake	*Hydrophis coggeri*	Marine	-	-	MO	
Fine-spined Seasnake	*Hydrophis czeblukovi*	Marine	MO	MO	MO	
Elegant Seasnake	*Hydrophis elegans*	Marine	MO	MO	MO	
Null	*Hydrophis mcdowelli*	Marine	-	-	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Spotted Seasnake, Ornate Reef Seasnake	*Hydrophis ornatus*	Marine	MO	MO	MO	
Spine-bellied Seasnake	*Lapemis hardwickii*	Marine	-	-	MO	
Olive Ridley Turtle, Pacific Ridley turtle	*Lepidochelys olivacea*	Endangered Migratory Marine	-	-	FLO	
Flatback turtle	*Natator depressus*	Vulnerable Migratory Marine	AKO	FKO	BKO	
Yellow-bellied Seasnake	*Pelamis platurus*	Marine	MO	MO	MO	
Birds						
Common sandpiper	*Actitis hypoleucos*	Migratory Marine	MO	KO	KO	Planned + Light emissions

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	**Scientific name**					
Common noddy	*Anous stolidus*	Migratory Marine	MO	LO	LO	+ Planned operational discharges + Spill response operations Unplanned + Hydrocarbon releases/spills
Australian lesser noddy	*Anous tenuirostris melanops*	Vulnerable	-	-	BKO	
Fork-tailed swift	*Apus pacificus*	Migratory Marine	-	-	LO	
Cattle Egret	*Ardea ibis*	Marine	-	-	MO	
Flesh-footed shearwater	*Ardenna carneipes (also Puffinus carneipes)*	Migratory Marine	-	-	FLO	
Sooty Shearwater	*Ardenna grisea (also Puffinus griseus)*	Migratory Marine (Puffinus griseus)	-	-	MO	
Wedge-tailed shearwater	*Ardenna pacifica (also Puffinus pacificus)*	Migratory Marine (*Puffinus pacificus*)	-	-	BKO	
Ruddy turnstone	*Arenaria interpres*	Migratory	-	-	RKO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Australasian Bittern	*Botaurus poiciloptilus*	Endangered	-	-	LO	
Sharp-tailed sandpiper	*Calidris acuminata*	Migratory Marine	MO	MO	RKO	
Sanderling	*Calidris alba*	Migratory Marine	-	-	RKO	
Red knot, knot	*Calidris canutus*	Endangered Migratory Marine	MO	MO	KO	
Curlew sandpiper	*Calidris ferruginea*	Critically Endangered Migratory Marine	MO	LO	KO	
Pectoral sandpiper	*Calidris melanotos*	Migratory Marine	MO	MO	KO	
Red-necked stint	*Calidris ruficollis*	Migratory	-	-	RKO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Long-toed Stint	*Calidris subminuta*	Migratory Marine	-	-	KO	
Great knot	*Calidris tenuirostris*	Critically Endangered	-	-	RKO	
Streaked shearwater	*Calonectris leucomelas (also Puffinus leucomelas)*	Migratory Marine	LO	LO	KO	
Forest Red-tailed Black-Cockatoo, Karrak	*Calyptorhynchus banksia naso*	Vulnerable	-	-	KO	
Carnaby's Cockatoo, Short-billed Black-Cockatoo	*Calyptorhynchus latirostris*	Endangered	-	-	KO	
Great Skua	*Catharacta skua*	Marine	-	-	MO	
Red-rumped Swallow	*Cecropis daurica*	Migratory Marine (Hirundo daurica)	-	-	MO	
Double-banded Plover	*Charadrius bicinctus*	Migratory Marine	-	-	RKO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Greater sand plover, large sand plover	*Charadrius leschenaultii*	Vulnerable Migratory Marine	-	-	KO	
Lesser Sand Plover, Mongolian Plover	*Charadrius mongolus*	Endangered Migratory Marine	-	-	RKO	
Red-capped Plover	*Charadrius mongolus*	Marine	-	-	RKO	
Oriental plover	*Charadrius veredus*	Migratory Marine	-	-	KO	
Black-eared Cuckoo	*Chrysococcyx osculans*	Marine	-	-	KO	
Oriental Cuckoo, Horsfield's Cuckoo	*Cuculus optatus*	Migratory	-	-	MO	
Amsterdam albatross	*Diomedea amsterdamensis*	Endangered Migratory marine	-	-	LO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Tristan Albatross	*Diomedea dabbenena*	Endangered Migratory Marine	-	-	LO	
Southern Royal albatross	*Diomedea epomophora*	Vulnerable Migratory Marine	-	-	FLO	
Wandering albatross	*Diomedea exulans*	Vulnerable Migratory Marine	-	-	FLO	
Northern Royal albatross	*Diomedea sanfordi*	Endangered Migratory Marine	-	-	FLO	
Grey falcon	*Falco hypoleucos*	Vulnerable	-	-	KO	
Christmas Island Frigatebird, Andrew's Frigatebird	*Fregata andrewsi*	Endangered Migratory	-	-	FKO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
		Marine				
Lesser frigatebird, Least Frigatebird	*Fregata ariel*	Migratory Marine	LO	LO	BKO	
Great frigatebird, Greater Frigatebird	*Fregata minor*	Migratory Marine	-	-	LO	
Swinhoe's Snipe	*Gallingo megala*	Migratory Marine	-	-	RLO	
Pin-tailed Snipe	*Gallingo stenura*	Migratory Marine	-	-	RLO	
Oriental pranticole	*Glareola maldivarum*	Migratory Marine	-	-	KO	
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Marine	-	LO	BKO	
Blue Petrel	*Halobaena caerulea*	Vulnerable Marine	-	-	MO	
Pied Stilt, Black-winged Stilt	*Himantopus himantopus*	Marine	-	-	RKO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Red-rumped Swallow	*Hirundo daurica*	Migratory (Cecropis daurica) Marine	-	-	MO	
Barn Swallow	*Hirundo rustica*	Migratory Marine	-	MO	KO	
Caspian tern	*Hydroprogne caspia (also Sterna caspia)*	Migratory Marine (Sterna caspia)	-	BKO	BKO	
Silver Gull	*Larus novaehollandiae*	Marine	-	BKO	BKO	
Pacific Gull	*Larus pacificus*	Marine	-	-	BKO	
Malleefowl	*Leipoa ocellata*	Vulnerable	-	-	KO	
Broad-billed Sandpiper	*Limicola falcinellus*	Migratory Marine	-	-	KO	
Asian Dowitcher	*Limnodromus semipalmatus*	Migratory Marine	-	-	KO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Bar-tailed godwit	*Limosa lapponica*	Migratory Marine	-	KO	KO	
Northern Siberian bar-tailed godwit, bar-tailed godwit (menzbieri)	*Limosa lapponica menzbieri*	Critically Endangered	-	KO	KO	
Black-tailed godwit	*Limosa limosa*	Migratory	-	-	RKO	
Southern Giant-Petrel, Southern giant petrel	*Macronectes giganteus*	Endangered Migratory Marine	MO	MO	MO	
Northern giant petrel	*Macronectes halli*	Vulnerable Migratory Marine	-	-	MO	
White-winged Fairy-wren (Barrow Island), Barrow Island Black-and-white Fairy-wren	*Malurus leucopterus edouardi*	Vulnerable	-	-	LO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
White-winged fairy-wren (Dirk Hartog Island), Dirk Hartog black-and-white fairy-wren	*Malurus leucopterus leucopterus*	Vulnerable	-	-	LO	
Rainbow Bee-eater	*Merops ornatus*	Marine	-	-	MO	
Grey Wagtail	*Motacilla cinereal*	Migratory Marine	-	MO	MO	
Yellow Wagtail	*Motacilla flava*	Migratory Marine	-	MO	KO	
Eastern Curlew, Far eastern curlew	*Numenius madagascariensis*	Critically Endangered Migratory Marine	MO	LO	KO	
Little Curlew, Little Whimbrel	*Numenius minutus*	Migratory Marine	-	-	KO	
Whimbrel	*Numenius phaeopus*	Migratory Marine	-	-	RKO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	**Scientific name**					
Bridled tern	*Onychoprion anaethetus (also Sterna anaethetus)*	Migratory Marine (*Sterna anaethetus*)	-	BKO	BKO	
Fairy Prion (southern)	*Pachyptila turtur subantarctica*	Vulnerable Marine	-	-	KO	
Osprey	*Pandion haliaetus*	Migratory Marine	MO	BKO	BKO	
Abbott's booby	*Papasula abbotti*	Endangered Marine	-	-	MO	
White-faced Storm-Petrel	*Pelagodroma marina*	Marine	-	-	BKO	
Night Parrot	*Pezoporus occidentalis*	Endangered	-	-	MO	
White-tailed tropicbird	*Phaethon lepturus*	Migratory Marine	-	-	BLO	
Red-tailed tropicbird	*Phaethon rubricauda*	Migratory Marine	-	-	BKO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Red-necked Phalarope	*Phalaropus lobatus*	Migratory Marine	-	-	RKO	
Sooty albatross	*Phoebetria fusca*	Vulnerable Migratory Marine	-	-	LO	
Pacific Golden Plover	*Pluvialis fulva*	Migratory Marine	-	-	RKO	
Grey plover	*Pluvialis squatarola*	Migratory Marine	-	-	RKO	
Great-winged Petrel	*Pterodroma macroptera*	Marine	-	-	FKO	
Soft-plumaged petrel	*Pterodroma mollis*	Vulnerable Marine	-	-	FKO	
Little Shearwater	*Puffinus assimilis*	Marine	-	-	BKO	
Hutton’s Shearwater	*Puffinus huttoni*	Marine	-	-	FKO	
Red-necked Avocet	*Recurvirostra novaehollandiae*	Marine	-	-	RKO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Australian painted snipe	*Rostratula australis (also Rostratula benghalensis)*	Endangered Marine (*Rostratula benghalensis*)	-	MO	LO	
Little tern	*Sterna albifrons*	Migratory Marine	-	-	AKO	
Lesser Crested Tern	*Sterna bengalensis*	Marine	-	BKO	BKO	
Roseate tern	*Sterna dougallii*	Migratory Marine	FLO	BKO	BKO	
Sooty Tern	*Sterna fuscata*	Marine	-	BKO	BKO	
Australian fairy tern	*Sternula nereis nereis*	Vulnerable	FLO	BKO	BKO	
Australian Pratincole	*Stiltia isabella*	Marine	-	-	KO	
Masked booby	*Sula dactylatra*	Migratory Marine	-	-	BKO	
Brown booby	*Sula leucogaster*	Migratory Marine	-	-	BKO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Greater Crested Tern	*Thalasseus bergii*	Migratory Marine (*Sterna bergii*)	-	BKO	BKO	
Indian yellow-nosed albatross	*Thalassarche carteri*	Vulnerable Migratory Marine	-	-	FMO	
Shy albatross	*Thalassarche cauta*	Endangered Migratory Marine	-	-	FLO	
Campbell albatross, Campbell Black-browed albatross	*Thalassarche impavida*	Vulnerable Migratory Marine	-	-	MO	
Black-browed albatross	*Thalassarche melanophris*	Vulnerable Migratory Marine	-	-	MO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	**Scientific name**					
White-capped albatross	*Thalassarche steadi*	Vulnerable Migratory Marine	-	-	FLO	
Crested tern	*Thalasseus bergii (also Sterna bergii)*	Marine (*Sterna bergii*) Migratory	-	BKO	BKO	
Hooded Plover	*Thinornis rubricollis*	Marine	-	-	KO	
Grey-tailed tattler	*Tringa brevipes (also Heteroscelus brevipes)*	Migratory Marine (*Heteroscelus brevipes*)	-	-	RKO	
Wood sandpiper	*Tringa glareola*	Migratory Marine	-	-	KO	
Common greenshank, greenshank	*Tringa nebularia*	Migratory Marine	-	-	KO	

Value/sensitivity		EPBC Act Status	OA	Light / Noise Boundary	EMBA Presence	Relevant aspects
Common name	Scientific name					
Marsh Sandpiper, Little Greenshank	*Tringa stagnatilis*	Migratory Marine	-	-	RKO	
Common Redshank, Redshank	*Tringa totanus*	Migratory Marine	-	-	RKO	
Painted button-quail (Houtman Abrolhos)	*Turnix varius scintillans*	Vulnerable	-	-	LO	
Terek sandpiper	*Xenus cinereus*	Migratory Marine	-	-	RKO	
<u>Type of Presence:</u> MO – Species or species habitat may occur within area LO – Species or species habitat may occur within area KO – species or species habitat known to occur within area AMO – Aggregation may occur within area ALO – Aggregation likely to occur within area AKO – Aggregation known to occur within area		BMO – Breeding may occur within the area BLO – Breeding likely to occur within the area BKO – Breeding known to occur within the area FMO – Foraging, feeding or related behaviour may occur within the area FLO – Foraging, feeding or related behaviour likely to occur within area FKO – Foraging, feeding or related behaviour known to occur within area			MMO – Migration may occur within area MLO – Migration likely to occur within area MKO – Migration known to occur within area RMO – Roosting may occur within the area RLO – Roosting likely to occur within the area RKO – Roosting known to occur within the area	

Table 3-8: Biologically Important Areas and Habitat Critical Identified in the Operational Area, Light/Noise Boundary Area, MEVA and EMBA

Species	BIA Area	OA	Light / Noise Boundary	Presence in MEVA	Presence in EMBA	Habitat Critical within EMBA[1]
Fish						
Whale shark	Foraging	-	✓	✓	✓	N/A
White shark	Foraging	-	-	-	✓	
Marine Mammals						
Blue whale	Foraging / Migration	-	-	-	✓	N/A
Pygmy blue whale	Foraging	-	-	✓	✓	
	Migration	-	-	✓	✓	
	Distribution	✓	✓	✓	✓	
Humpback whale	Resting	-	-	✓	✓	
	Migration (north and south)	✓	✓	✓	✓	
	Nursing	-	-	-	✓	
	Calving	-	-	-	✓	
Southern right whale	Seasonal calving habitat	-	-	-	✓	
	Calving buffer	-	-	-	✓	
Sperm whale	Foraging	-	-	-	✓	
Australian sea lion	Foraging (male and female)	-	-	-	✓	
Dugong	Breeding	-	-	✓	✓	
	Calving	-	-	✓	✓	
	Nursing	-	-	✓	✓	
	Foraging	-	-	✓	✓	
Marine Reptiles						
Green turtle	Aggregation	-	-	✓	✓	

Species	BIA Area	OA	Light / Noise Boundary	Presence in MEVA	Presence in EMBA	Habitat Critical within EMBA[1]
	Mating	-	✓	✓	✓	Scott Reef – 20 km internesting buffer 20 km internesting buffer: Adele Island, Barrow Island, Lacepede Islands, Montebello Islands (all with sandy beaches), Dampier Archipelago, Serrurier Island, Thevenard Island, Northwest Cape, Ningaloo coast; Ashmore Reef and Cartier Reef
	Nesting	-	✓	✓	✓	
	Internesting	-	✓	✓	✓	
	Internesting buffer (incl. critical habitat)	✓	✓	✓	✓	
	Foraging	-	✓	✓	✓	
	Basking	-	-	✓	✓	
Loggerhead turtle	Nesting	-	-	✓	✓	20 km internesting buffer: Muiron Islands, Ningaloo coast
	Internesting	-	-	✓	✓	
	Internesting buffer	-	✓	✓	✓	
	Foraging	-	-	-	✓	
Hawksbill turtle	Mating	-	-	✓	✓	20 km internesting buffer: Dampier Archipelago (including Rosemary Island and Delambre Island), Montebello Islands (including Ah Chong Island, South East Island and Trimouille Island), Lowendal Islands (including Varanus Island, Beacon Island and Bridled Island), Sholl Island
	Nesting	-	-	✓	✓	
	Internesting	-	-	✓	✓	
	Internesting buffer (incl. critical habitat)	✓	✓	✓	✓	
	Foraging	-	-	✓	✓	
	Migration corridor	-	-	✓	✓	
Flatback turtle	Mating	-	-	✓	✓	60 km internesting buffer:
	Nesting	-	-	✓	✓	
	Internesting	-	-	✓	✓	

Species	BIA Area	OA	Light / Noise Boundary	Presence in MEVA	Presence in EMBA	Habitat Critical within EMBA[1]
	Internesting buffer (incl. critical habitat)	✓	✓	✓	✓	Eighty Mile Beach, Eco Beach, Lacepede Islands; Montebello Islands, Mundabullangana Beach, Barrow Island, Cemetery Beach, Dampier Archipelago (including Delambre Island and Huay Island), coastal islands from Cape Preston to Locker Island
	Foraging	-	-	✓	✓	
	Aggregation	-	-	✓	✓	
	Migration corridor	-	-	✓	✓	
Birds						
Common noddy	Foraging	-	-	-	✓	N/A
	Foraging (provisioning young)	-	-	✓	✓	
Australian lesser noddy	Foraging (provisioning young)	-	-	✓	✓	
Flesh-footed shearwater	Aggregation	-	-	-	✓	
	Foraging	-	-	-	✓	
Wedge-tailed shearwater	Breeding/foraging	✓	✓	✓	✓	
Little penguin	Foraging (provisioning young)	-	-	-	✓	
Lesser frigatebird	Breeding/Foraging	-	-	✓	✓	
Caspian tern	Foraging (provisioning young)	-	-	-	✓	
Pacific gull	Foraging	-	-	-	✓	
Roseate tern	Breeding/foraging	✓	✓	✓	✓	

Species	BIA Area	OA	Light / Noise Boundary	Presence in MEVA	Presence in EMBA	Habitat Critical within EMBA[1]
	Foraging (provisioning young)	-	-	-	✓	
Bridled tern	Foraging	-	-	✓	✓	
Sooty tern	Foraging	-	-	✓	✓	
White-faced storm petrel	Foraging		-	✓	✓	
Great-winged petrel	Foraging (provisioning young)	-	-	-	✓	
Soft-plumaged petrel	Foraging	-	-	-	✓	
White-tailed tropicbird	Breeding/foraging	-	-	✓	✓	
Little shearwater	Foraging	-	-	✓	✓	
Fairy tern	Breeding/foraging	-	✓	✓	✓	
Little tern	Resting	-	-	✓	✓	
Brown booby	Breeding/foraging	-	-	-	✓	
Indian yellow-nosed albatross	Foraging	-	-	-	✓	
Lesser crested tern	Breeding/foraging	-	✓	✓	✓	

[1]Source: CoA, 2017

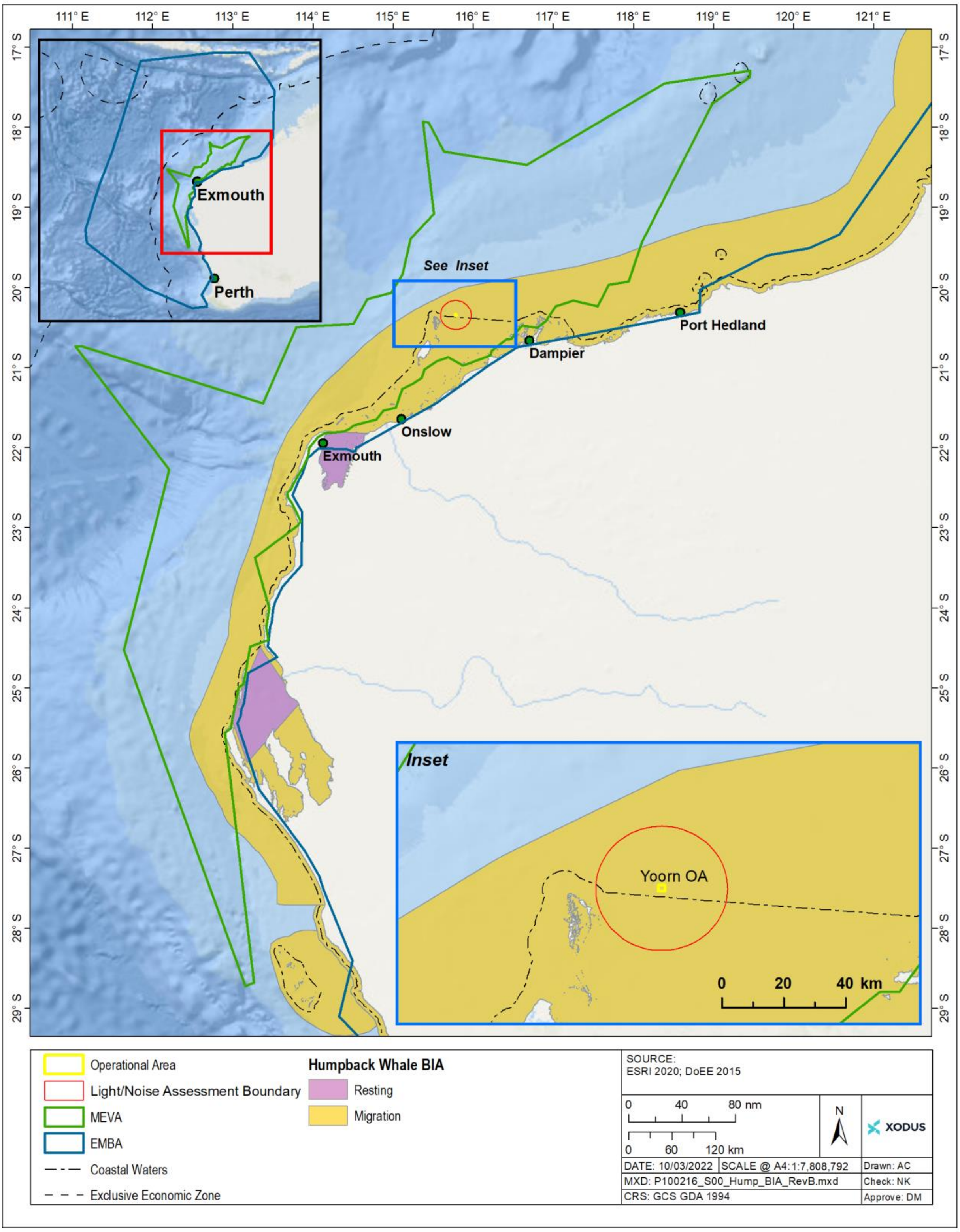

Figure 3-7: Biologically important areas for EPBC Protected Humpback Whale species within the vicinity of the EMBA and Operational Area

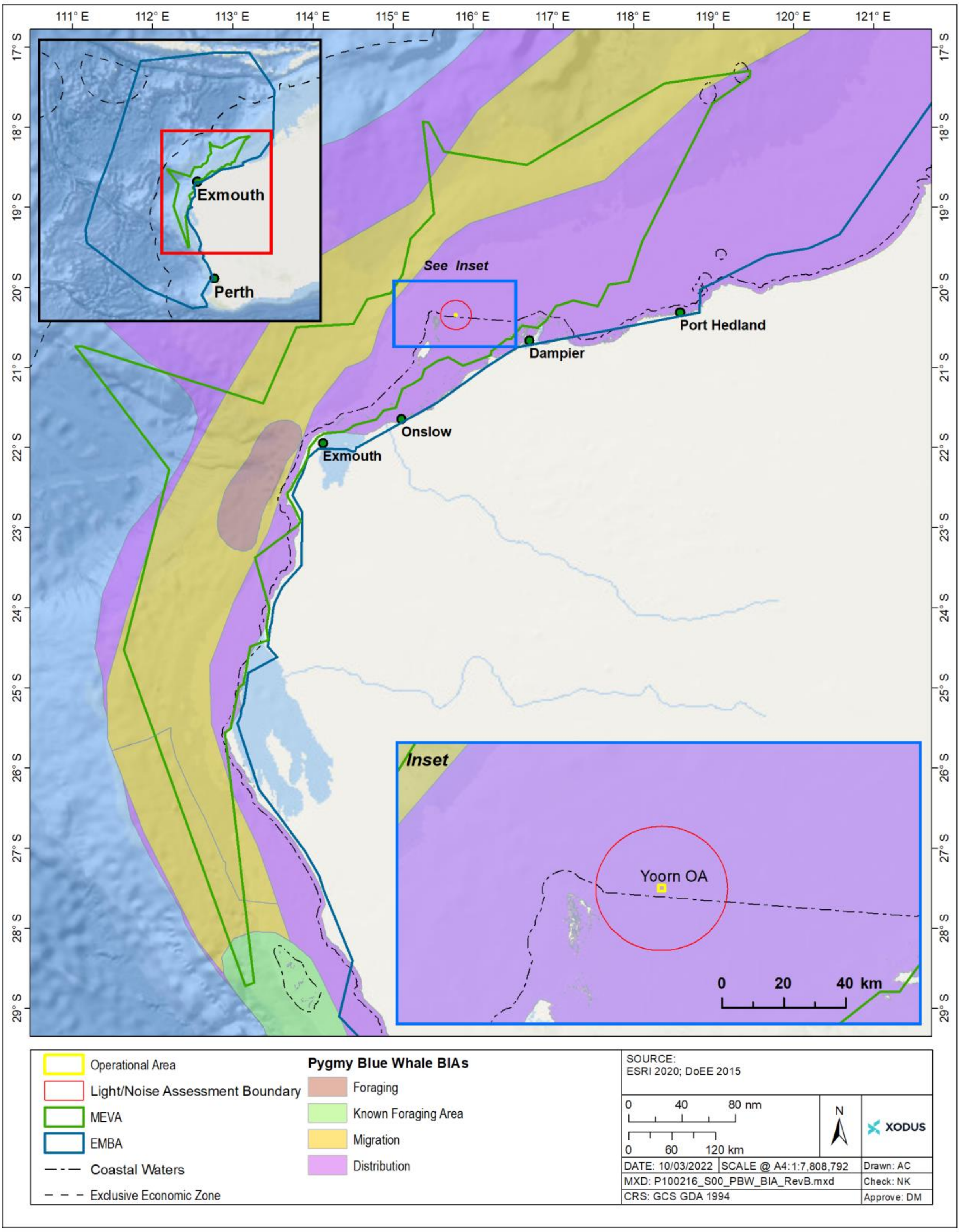

Figure 3-8: Biologically important areas for EPBC Protected Pygmy Blue Whale species within the EMBA and Operational Area

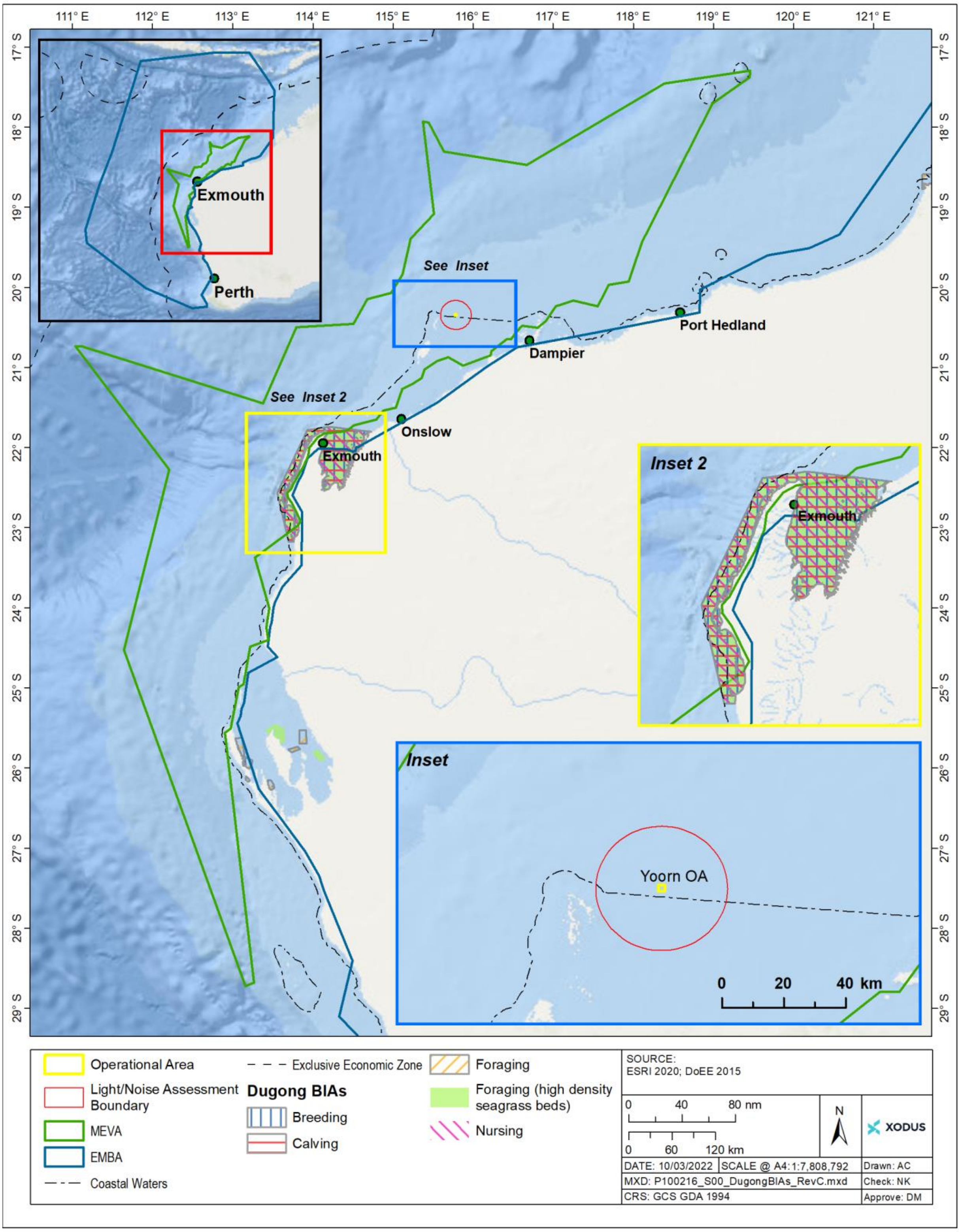

Figure 3-9: Biologically important areas for EPBC Protected Dugong within the EMBA and Operational Area

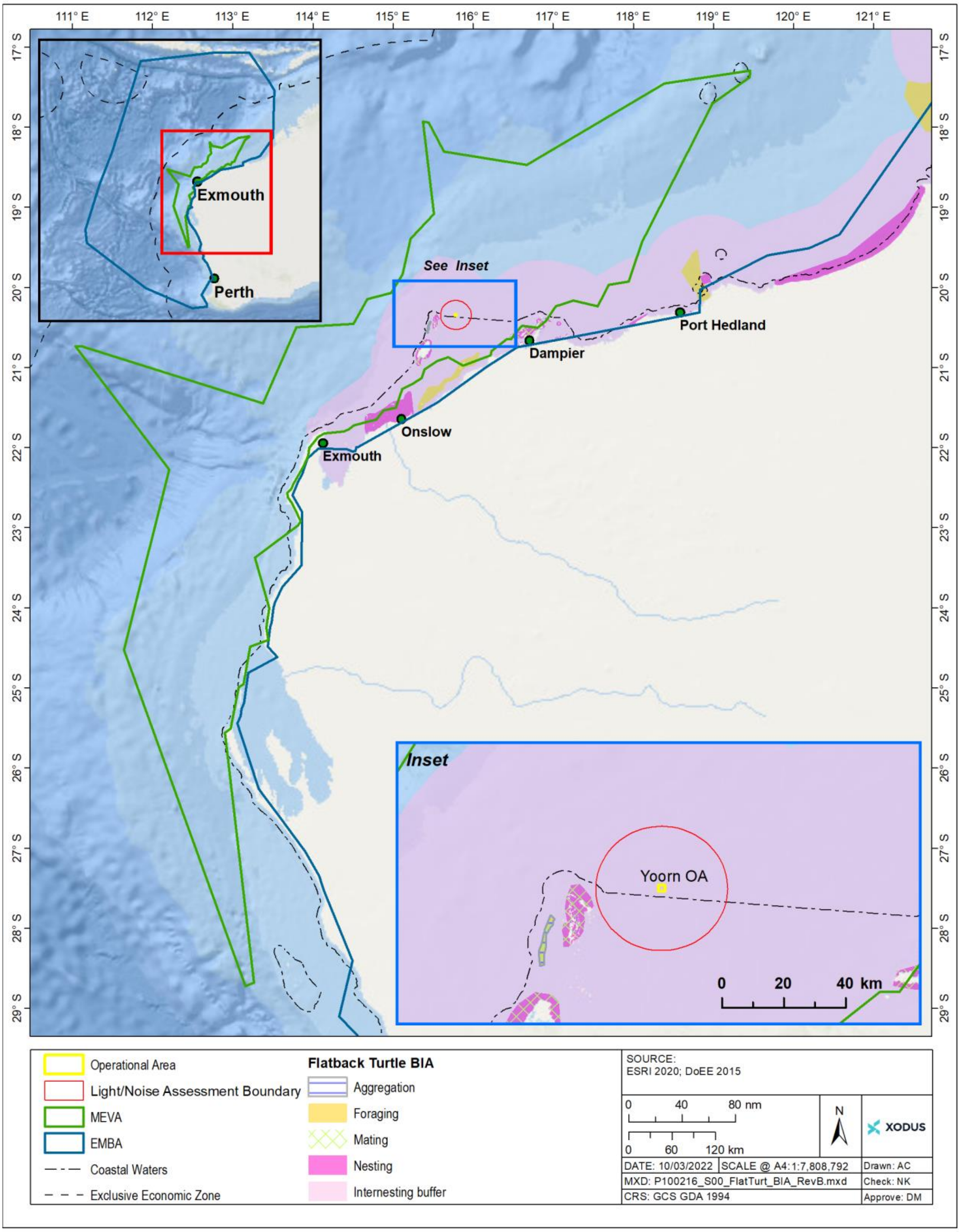

Figure 3-10: Biologically important areas for EPBC Protected Flatback Turtles within the vicinity of the EMBA and Operational Area

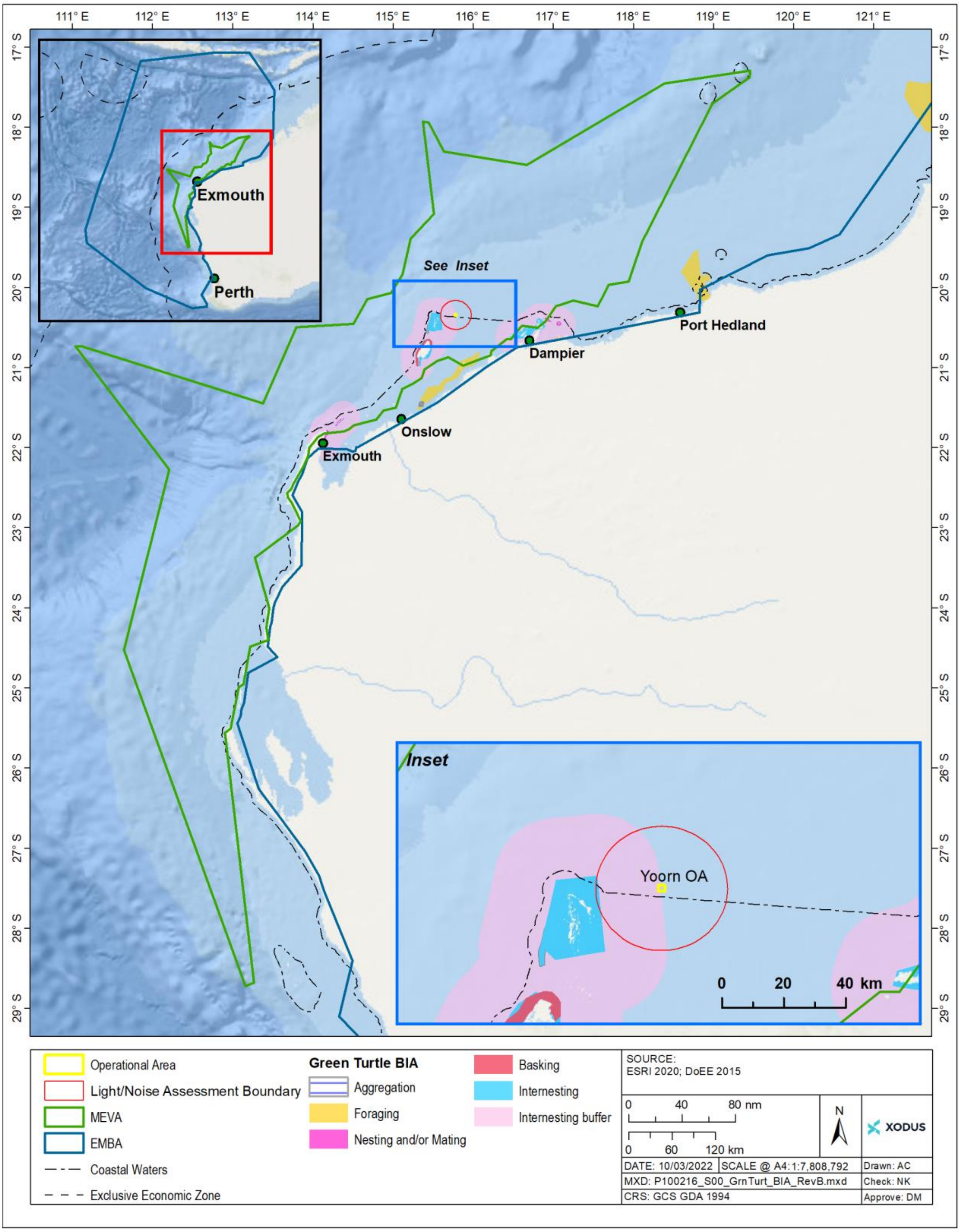

Figure 3-11: Biologically important areas for EPBC Protected Green Turtles within the vicinity of the EMBA and Operational Area

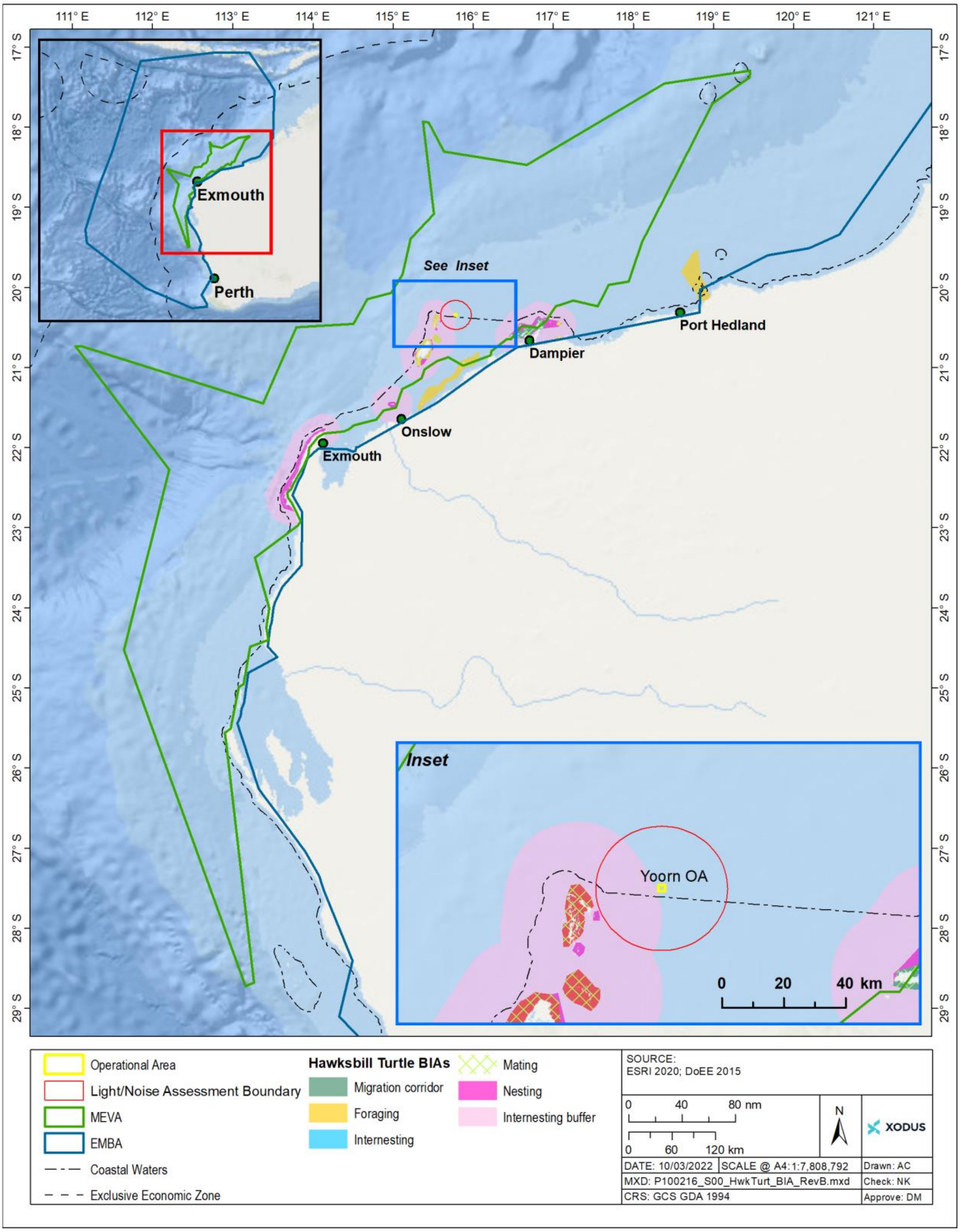

Figure 3-12: Biologically important areas for EPBC Protected Hawksbill Turtles within the vicinity of the EMBA and Operational Area

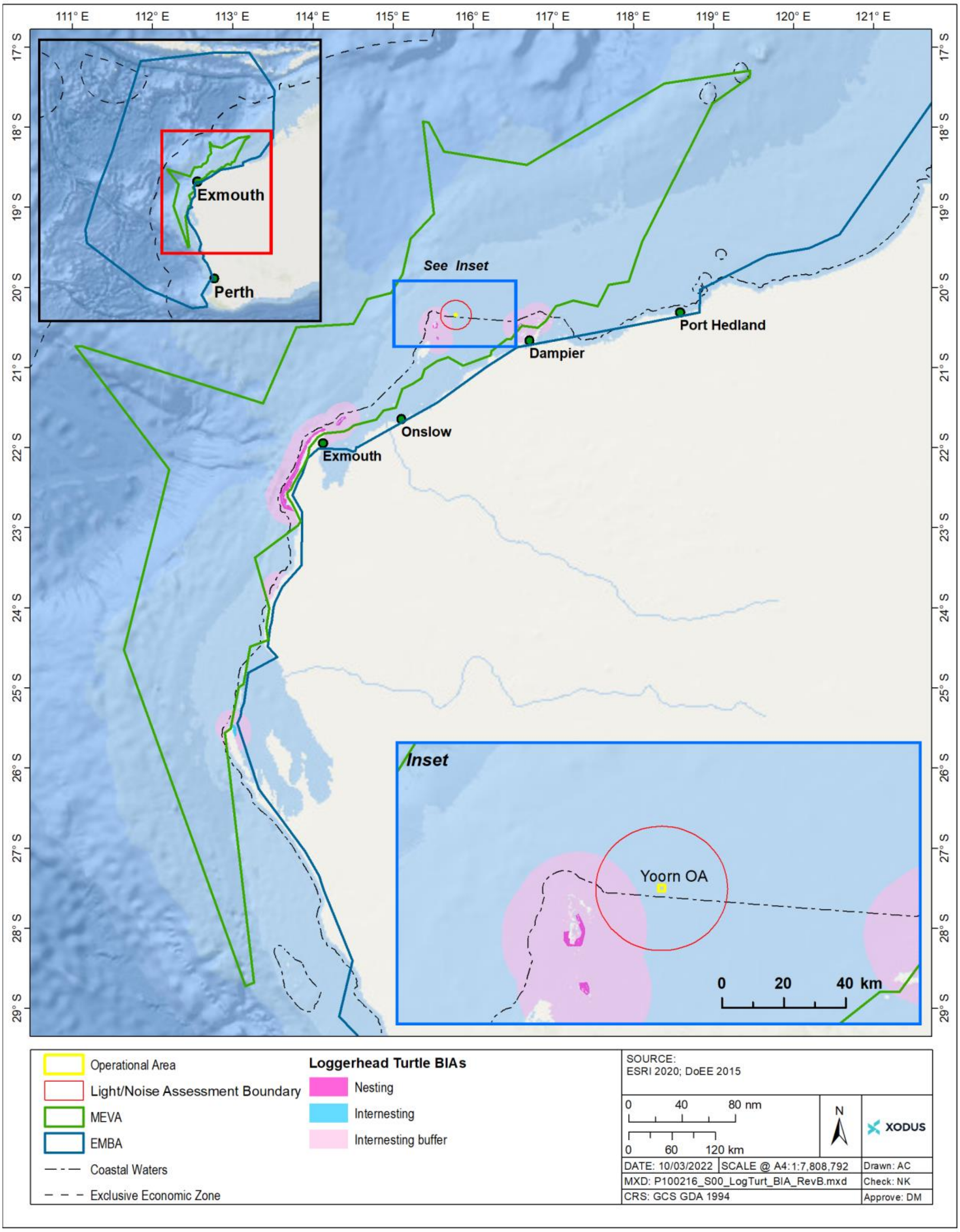

Figure 3-13: Biologically important areas for EPBC Protected loggerhead Turtles within the vicinity of the EMBA and Operational Area

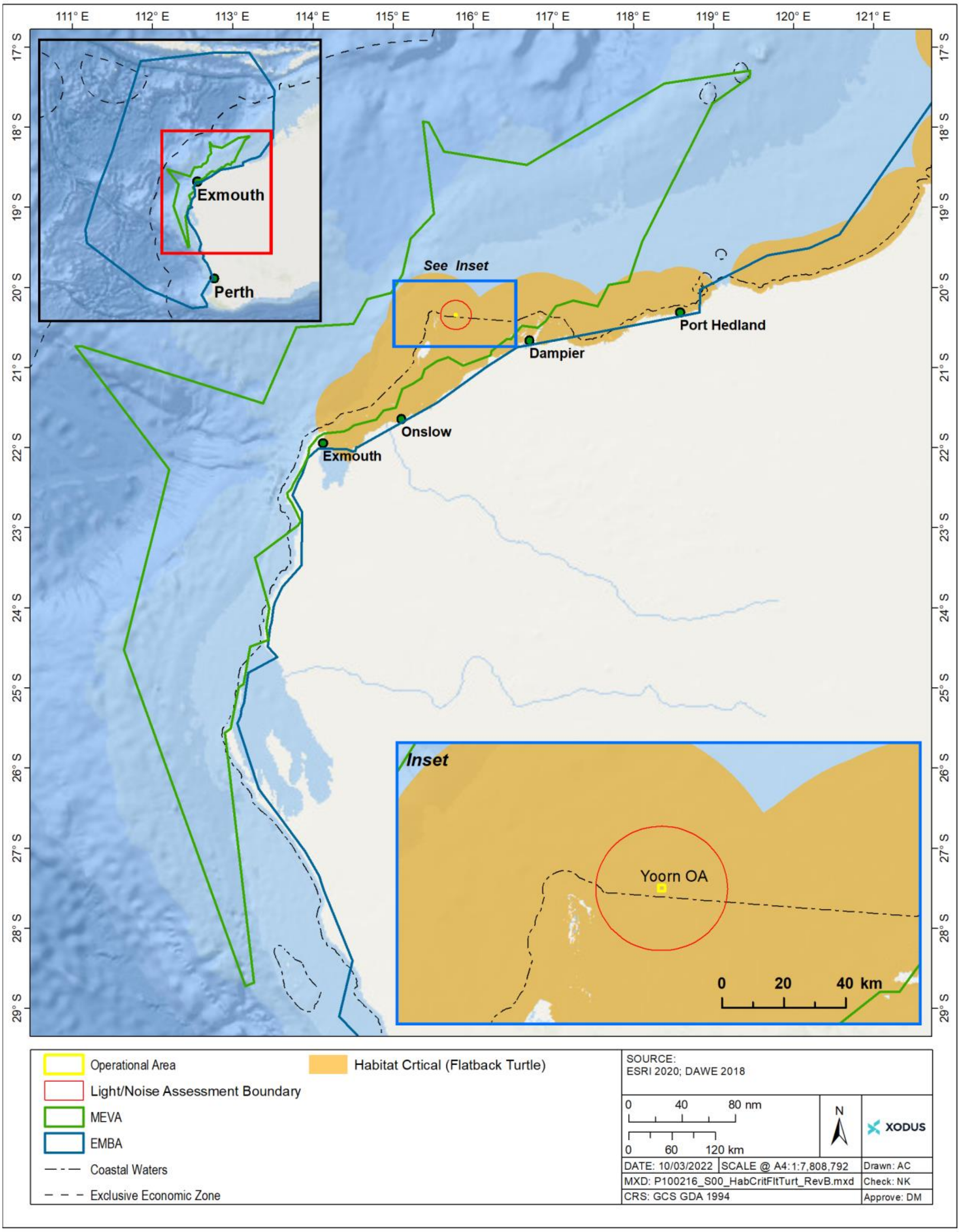

Figure 3-14: Habitat Critical areas for EPBC Protected Flatback Turtle within the vicinity of the EMBA and Operational Area

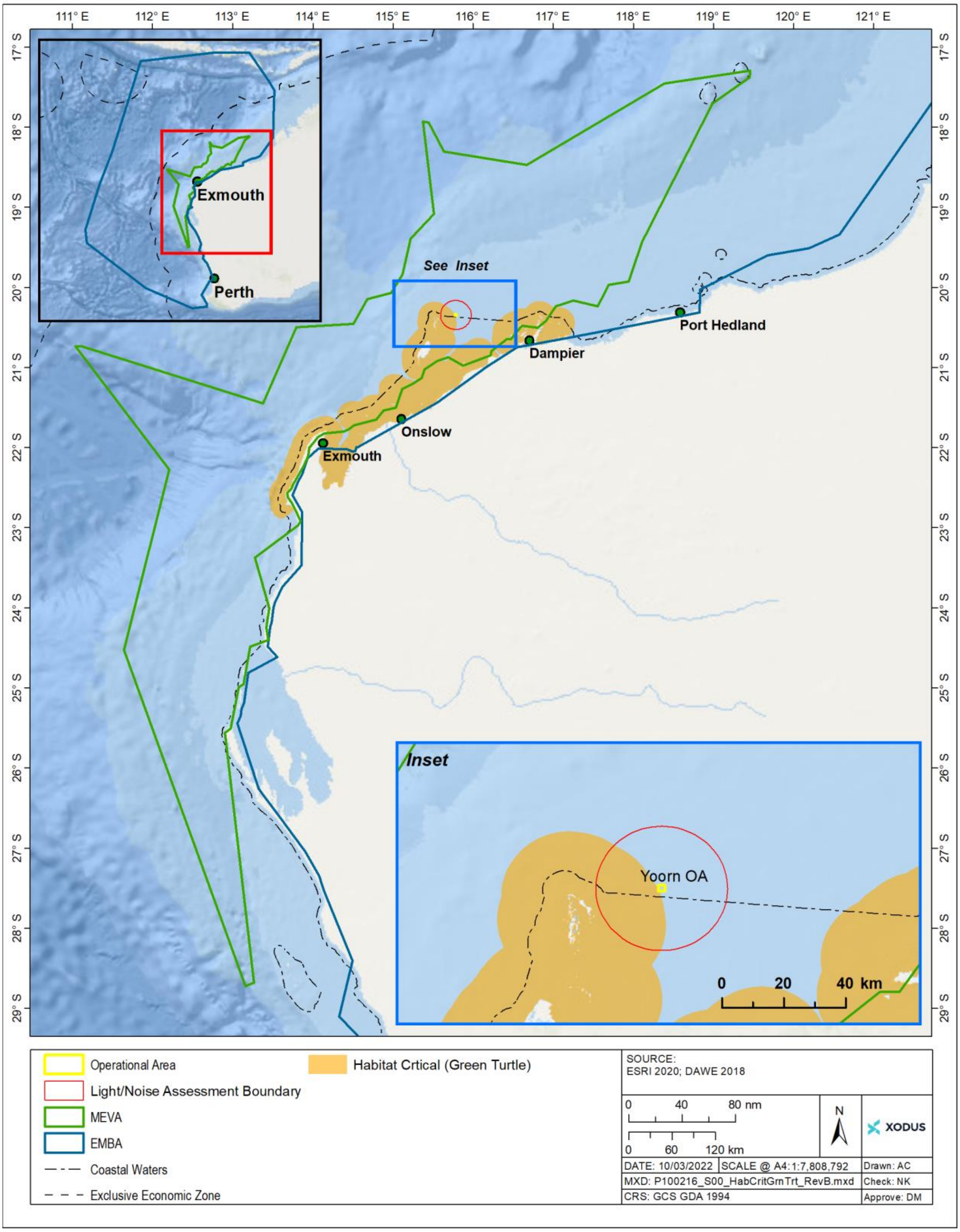

Figure 3-15: Habitat Critical areas for EPBC Protected Green Turtle within the vicinity of the EMBA and Operational Area

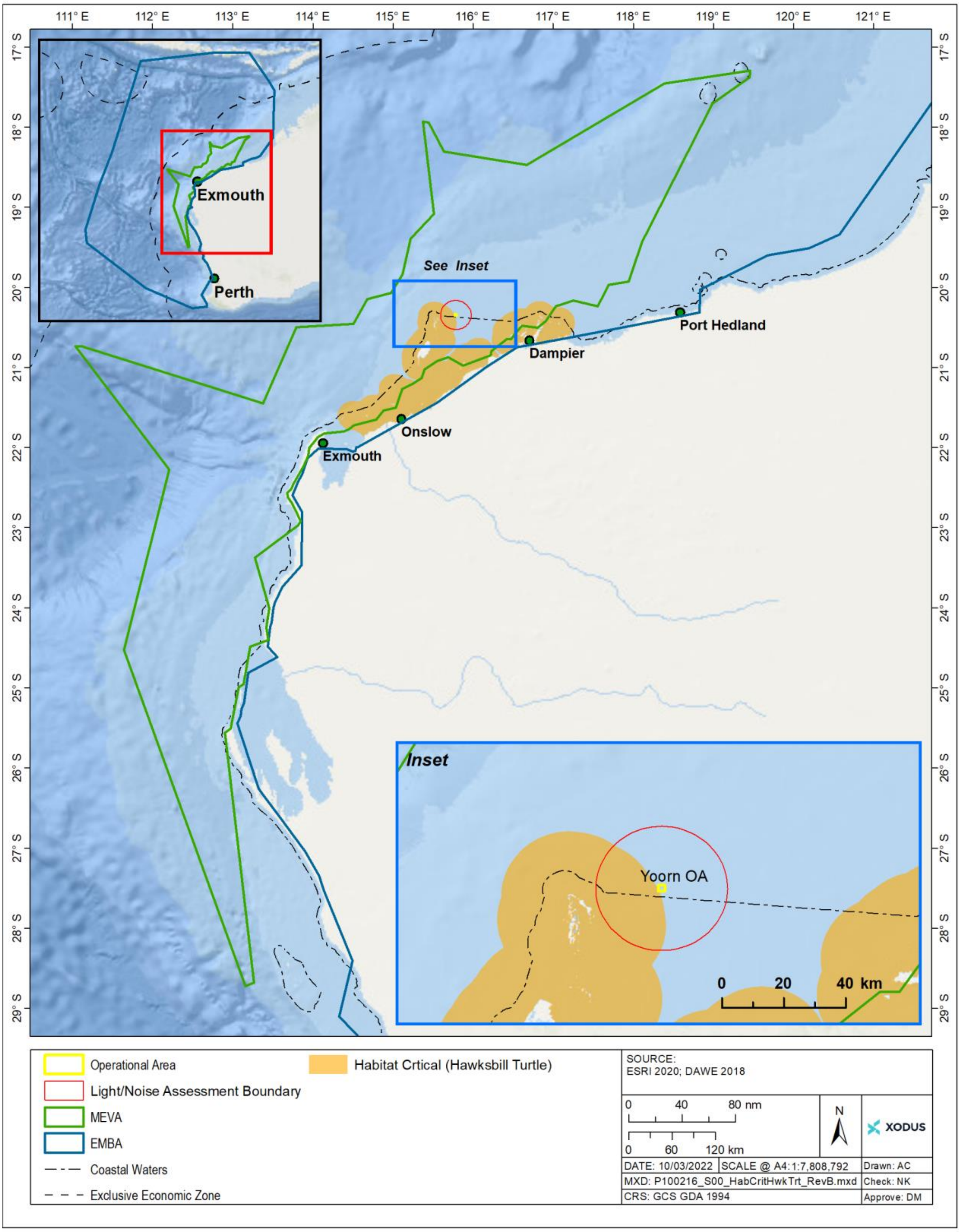

Figure 3-16: Habitat Critical areas for EPBC Protected Hawksbill Turtle within the vicinity of the EMBA and Operational Area

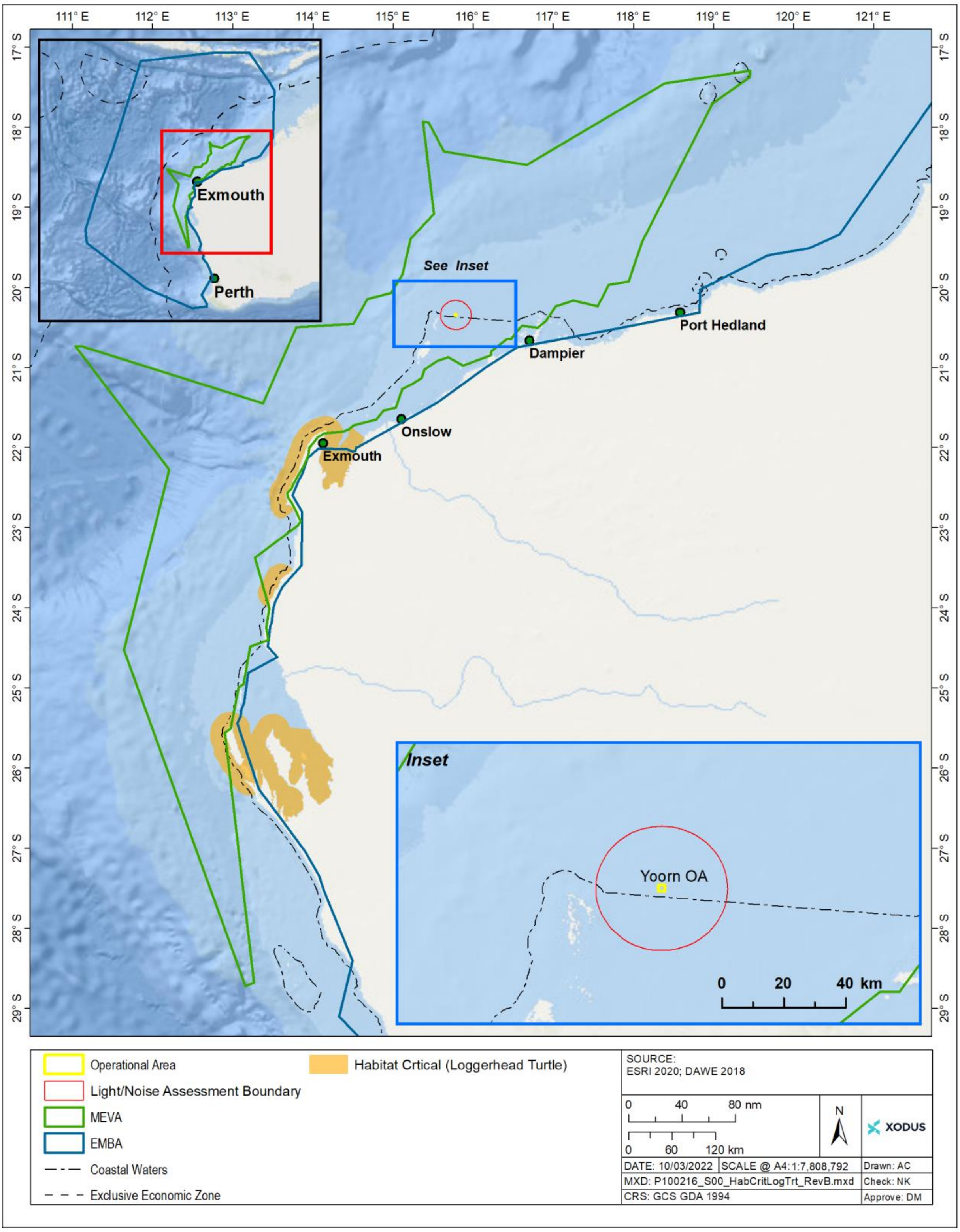

Figure 3-17: Habitat Critical areas for EPBC Protected Loggerhead Turtle within the vicinity of the EMBA and Operational Area

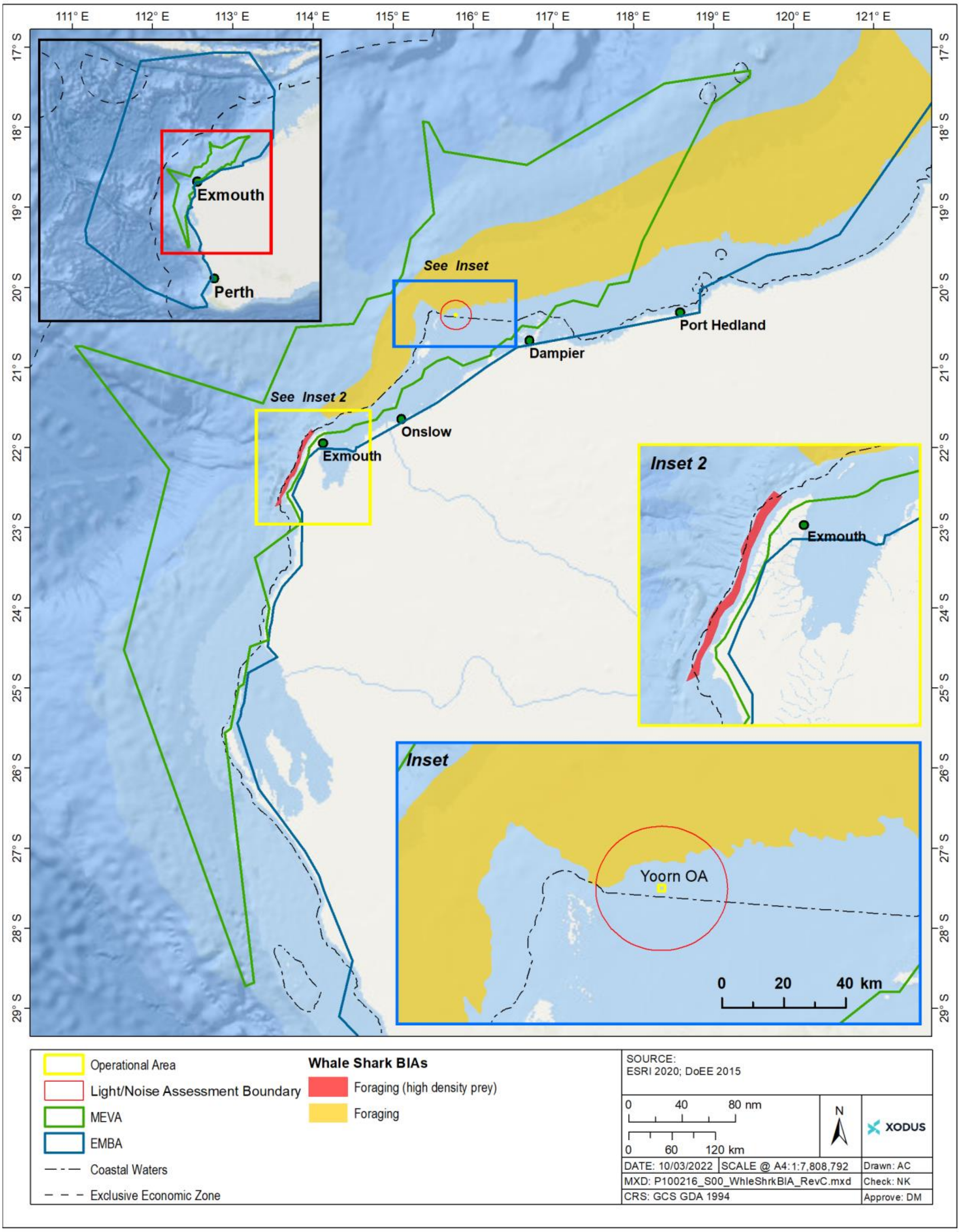

Figure 3-18: Biologically important areas for EPBC Protected Whale Sharks within the vicinity of the EMBA and Operational Area

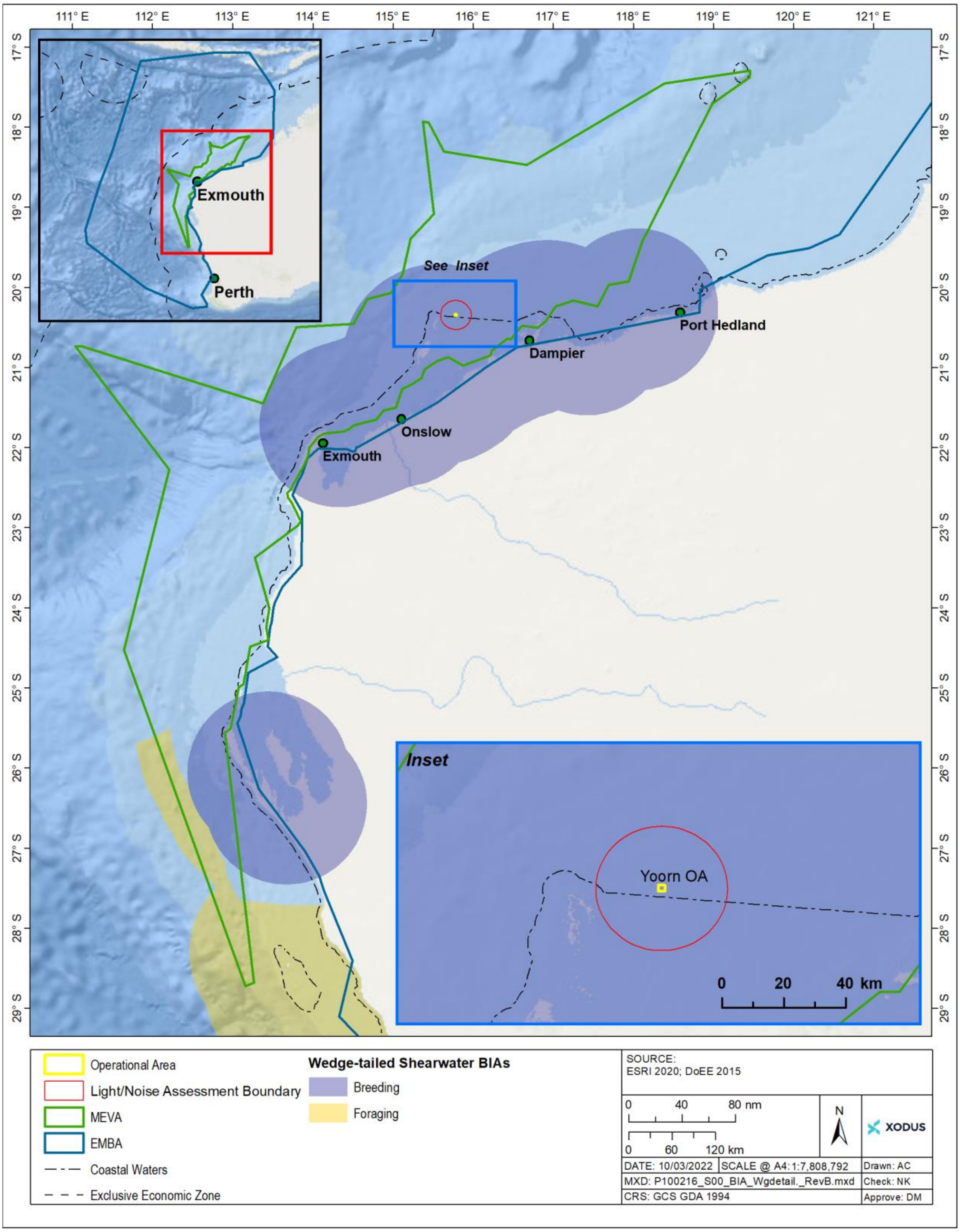

Figure 3-19: Biologically important areas for EPBC Protected Wedge-tailed Shearwater within the vicinity of the EMBA and Operational Area

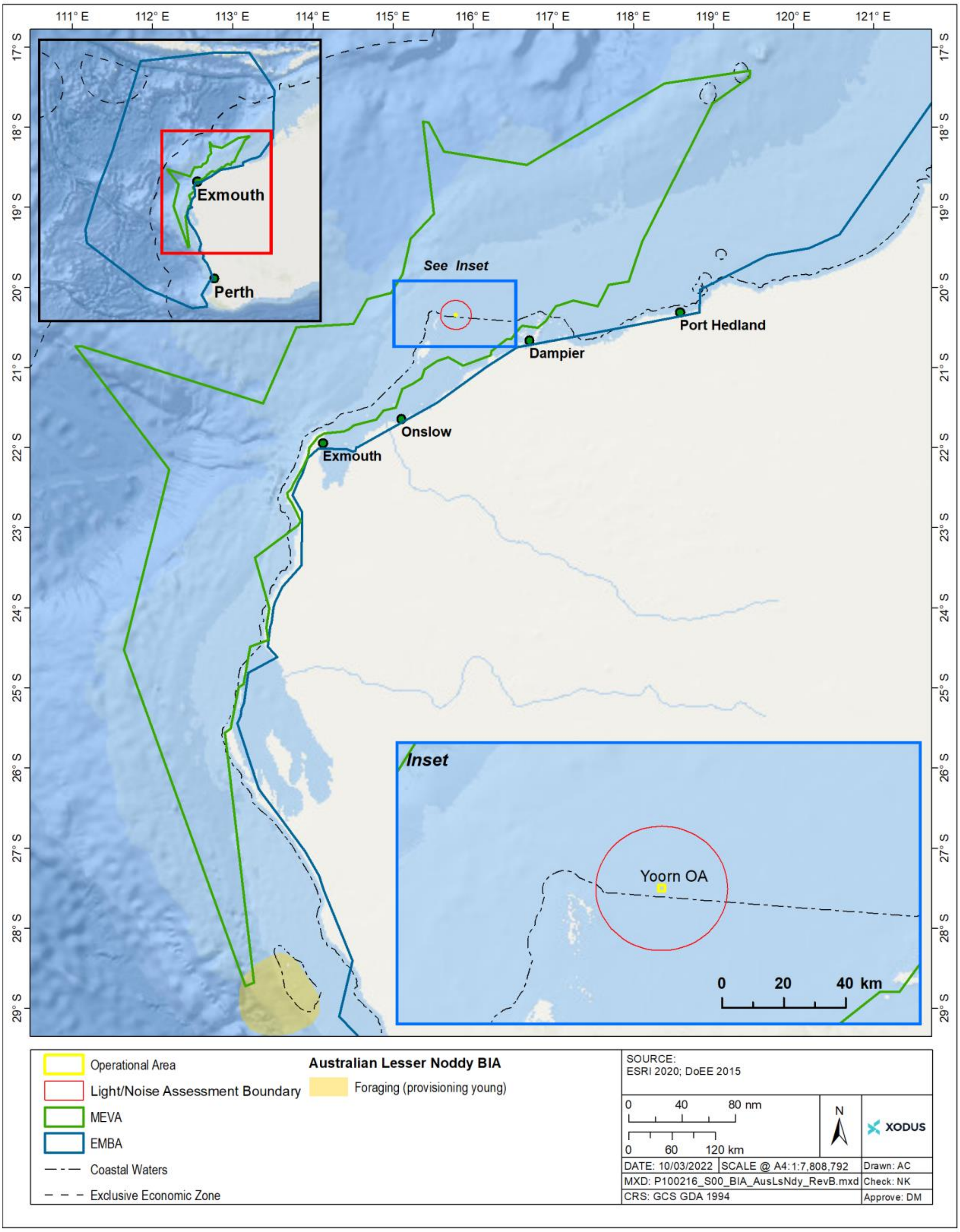

Figure 3-20: Biologically important areas for EPBC Protected Australian Lesser Noddy within the vicinity of the EMBA and Operational Area

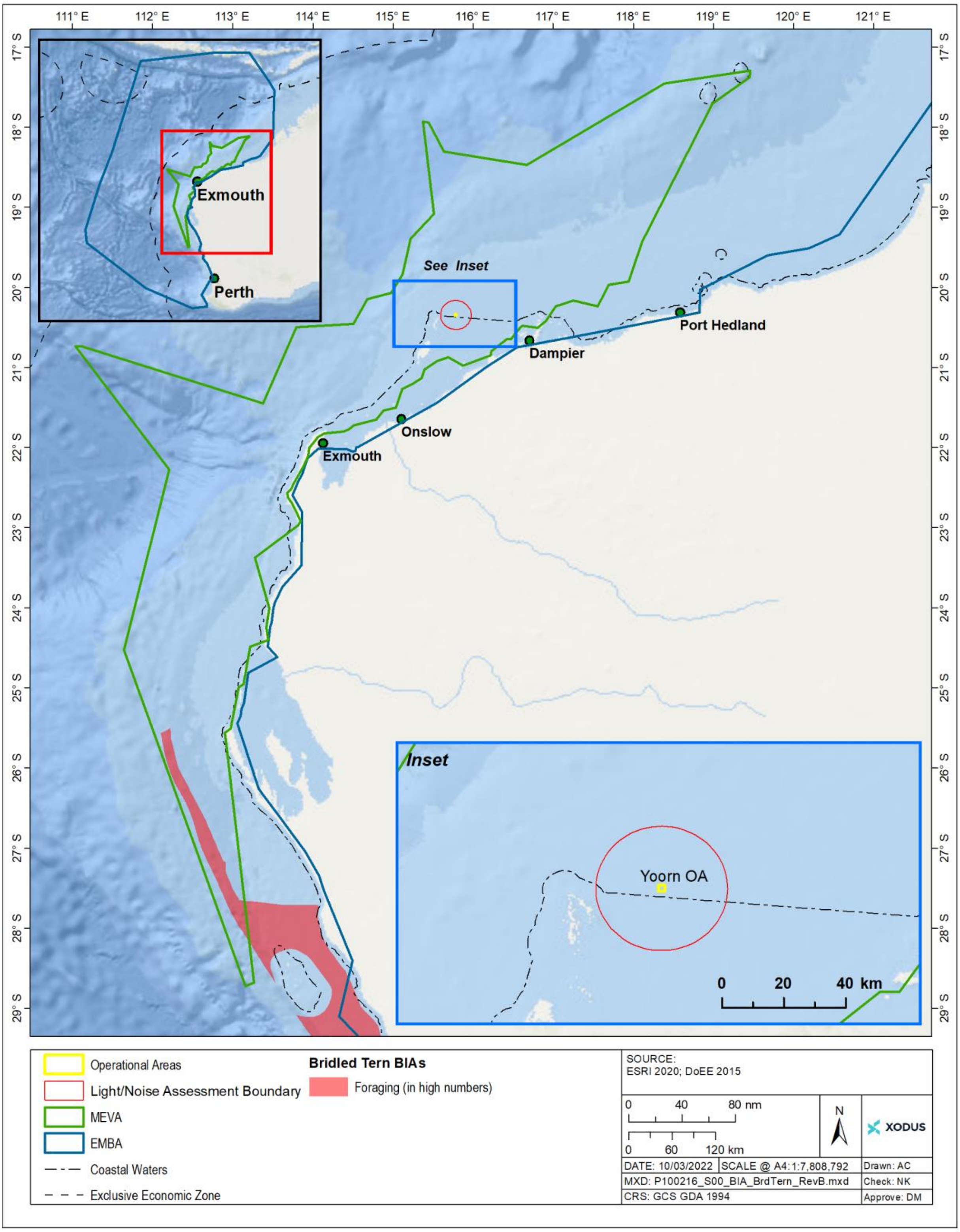

Figure 3-21: Biologically important areas for EPBC Protected Bridled Tern within the vicinity of the EMBA and Operational Area

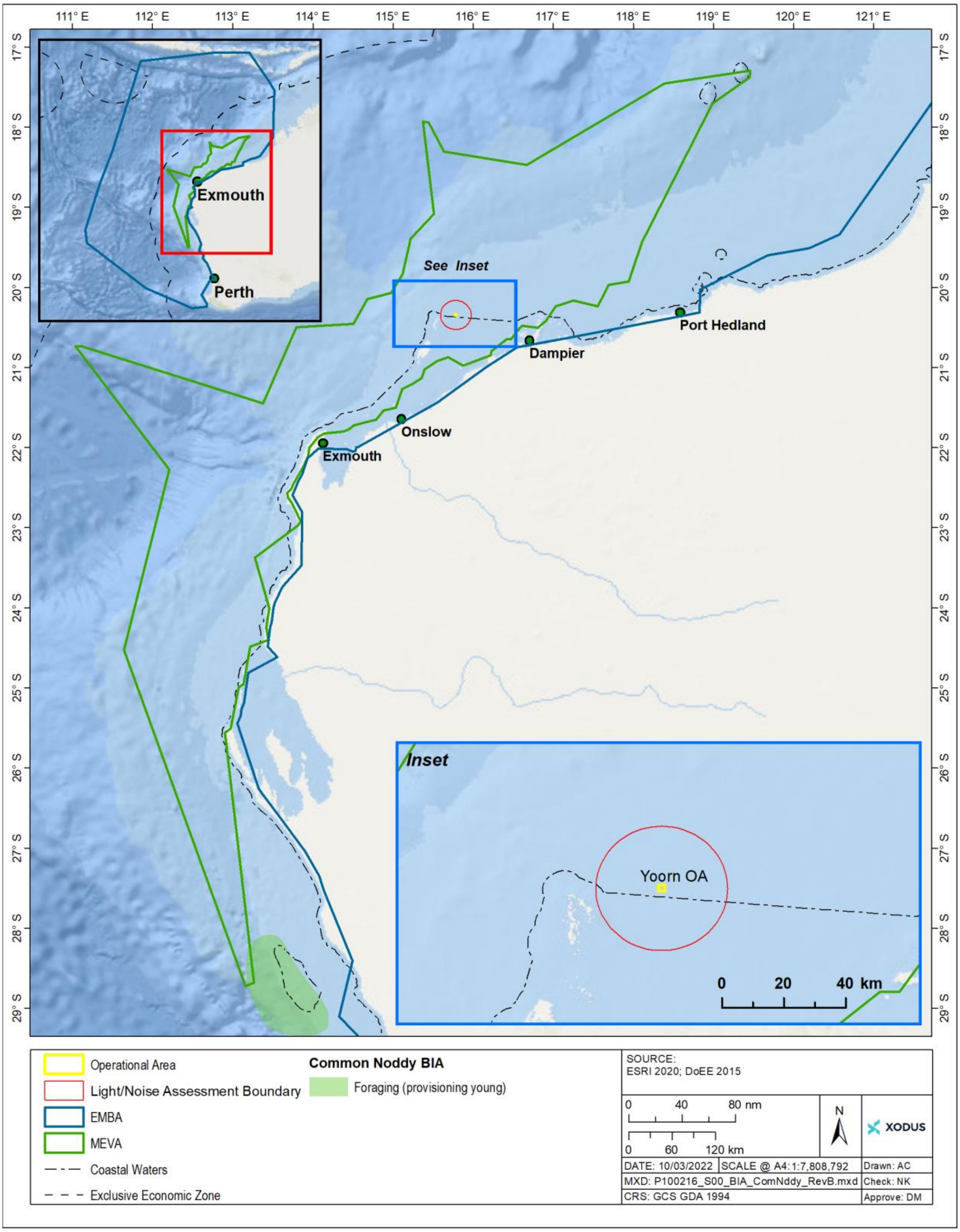

Figure 3-22: Biologically important areas for EPBC Protected Common Noddy within the vicinity of the EMBA and Operational Area

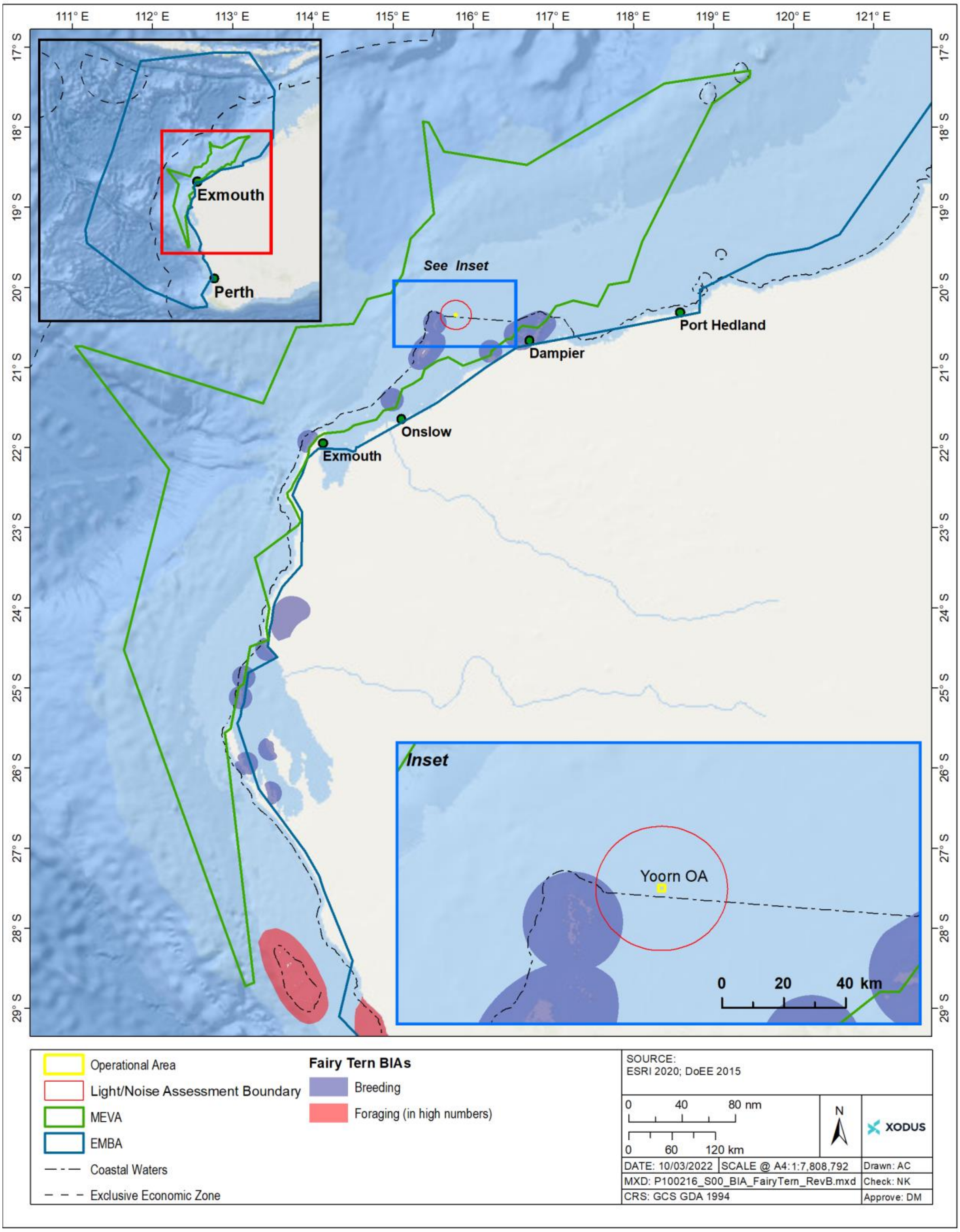

Figure 3-23: Biologically important areas for EPBC Protected Fairy Tern within the vicinity of the EMBA and Operational Area

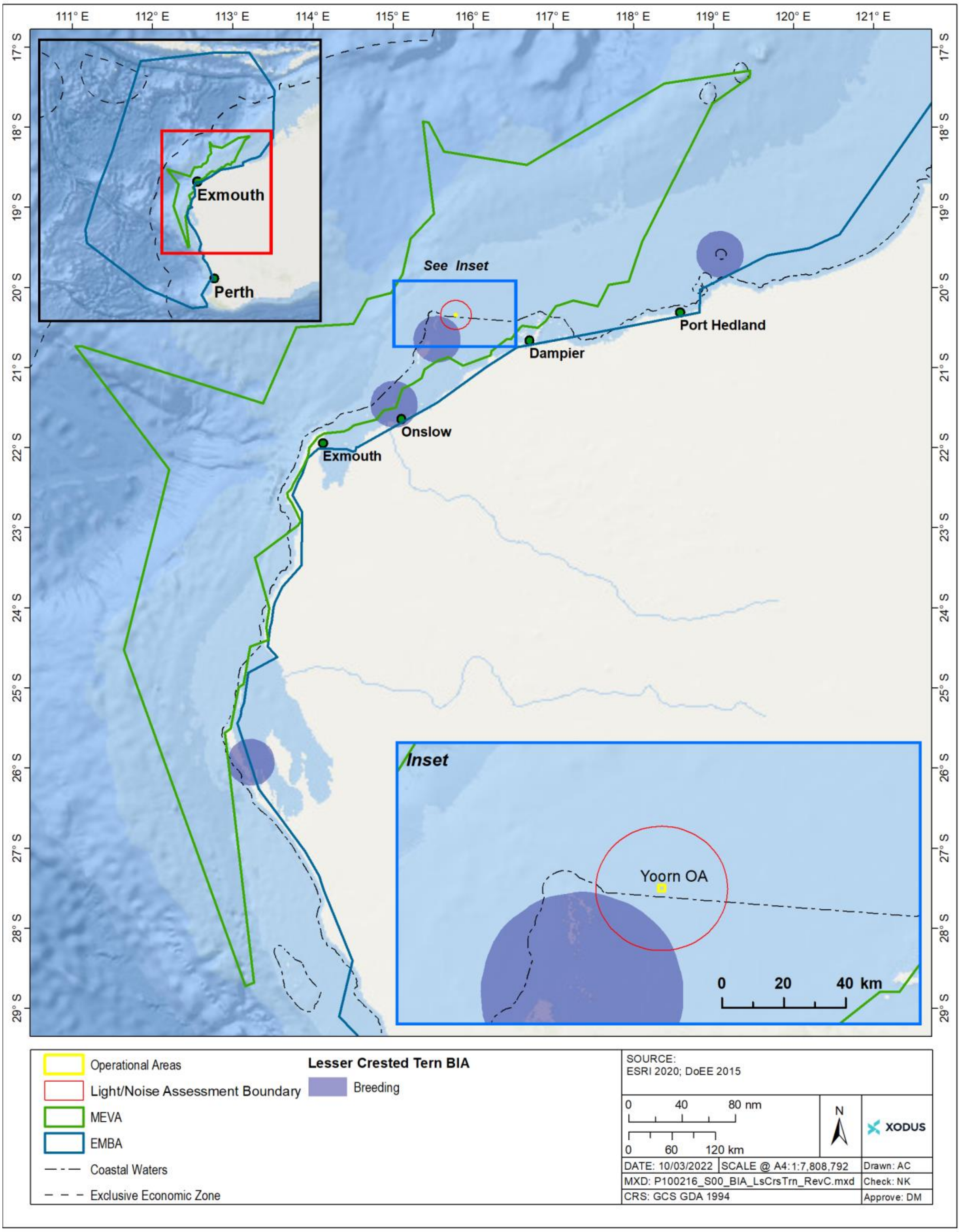

Figure 3-24: Biologically important areas for EPBC Protected Lesser Crested Tern within the vicinity of the EMBA and Operational Area

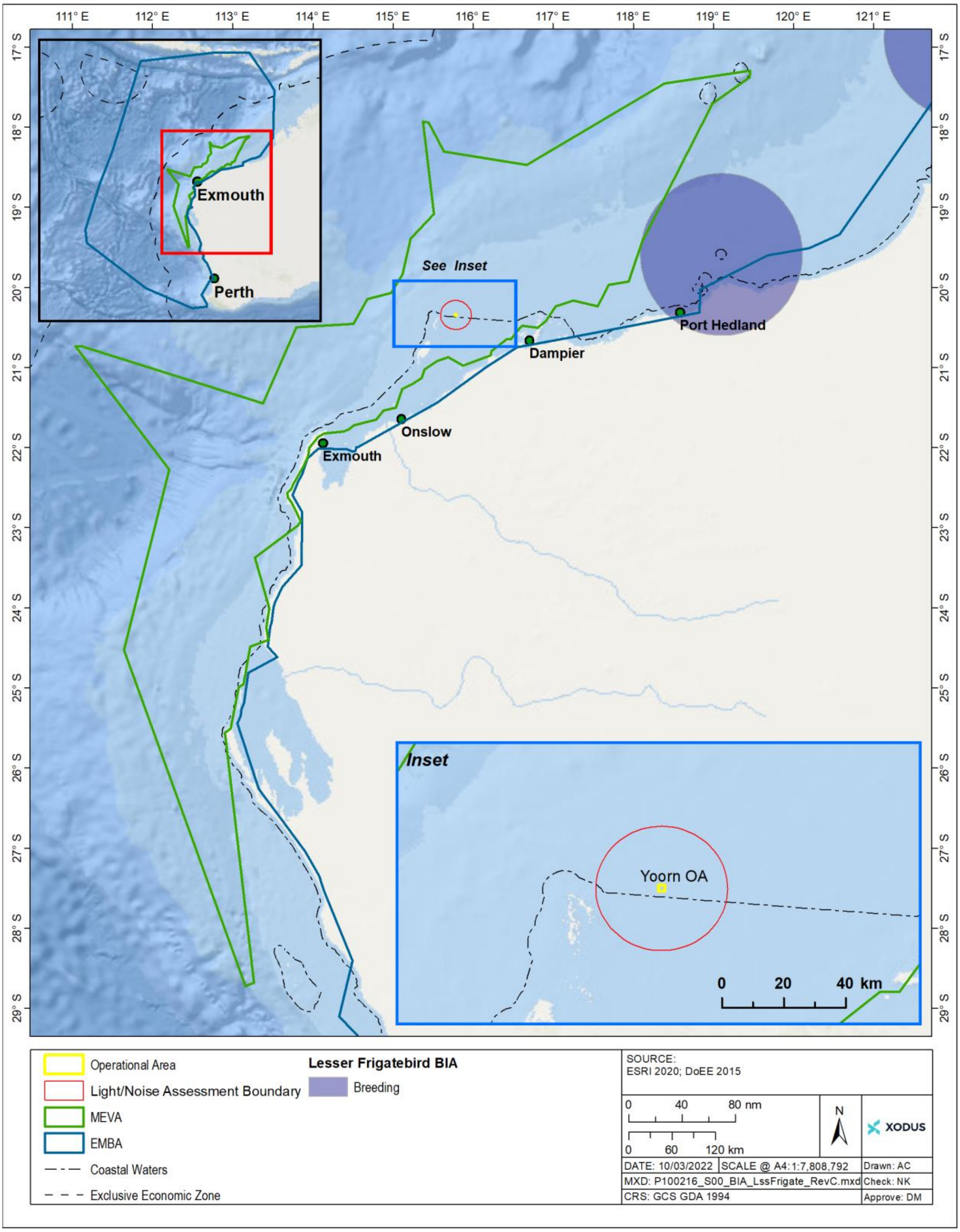

Figure 3-25: Biologically important areas for EPBC Protected Lesser Frigatebird within the vicinity of the EMBA and Operational Area

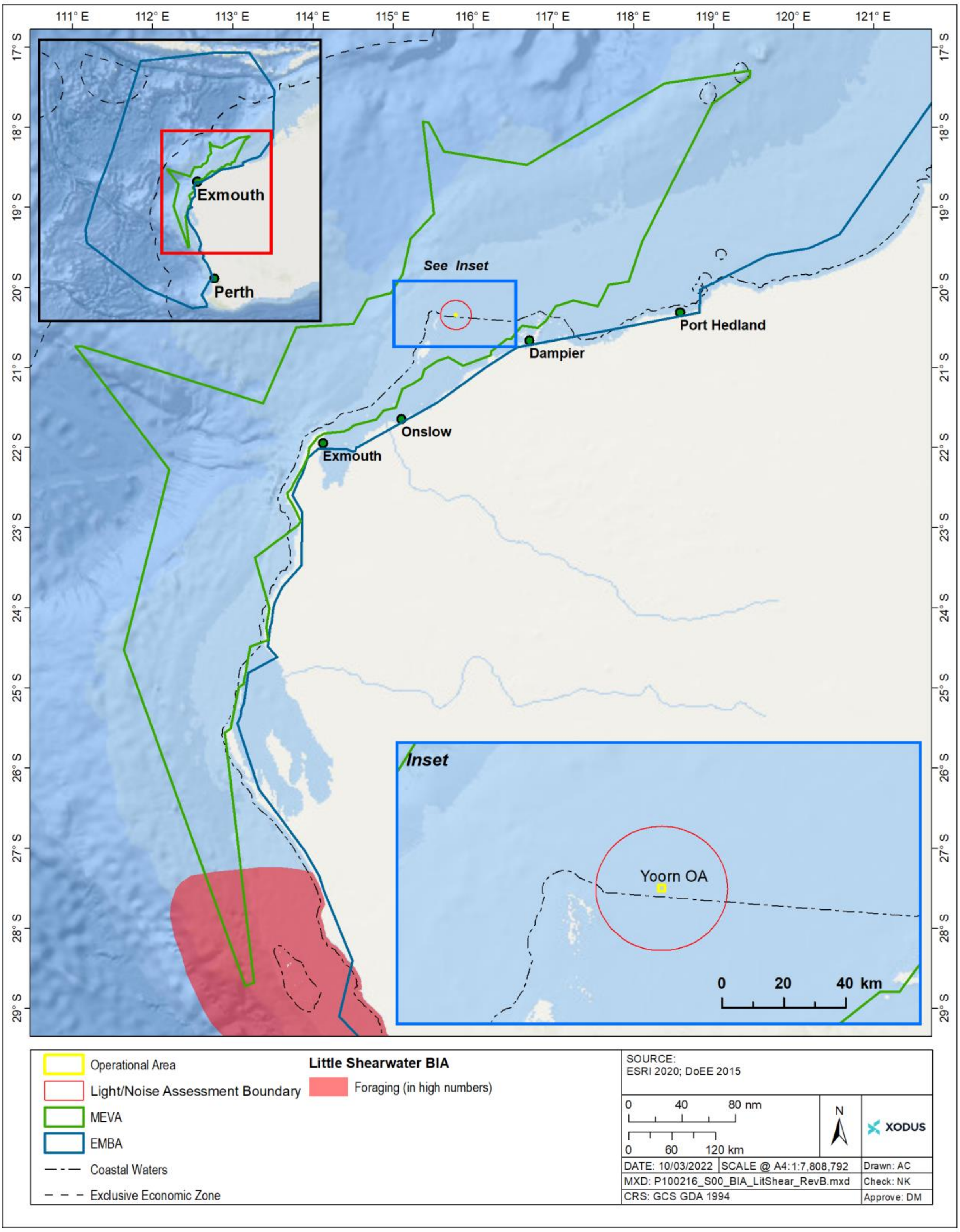

Figure 3-26: Biologically important areas for EPBC Protected Little Shearwater within the vicinity of the EMBA and Operational Area

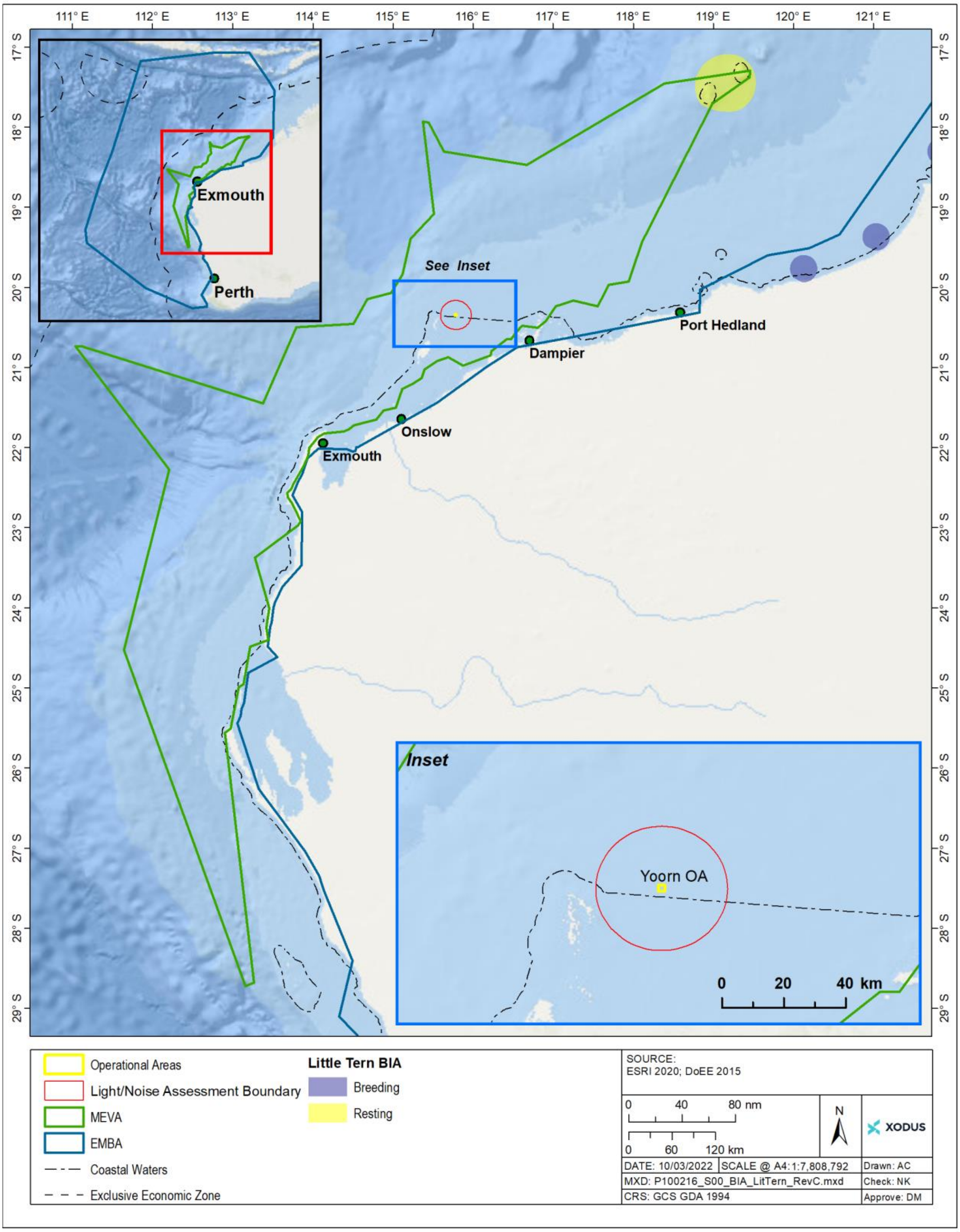

Figure 3-27: Biologically important areas for EPBC Protected Little Tern within the vicinity of the EMBA and Operational Area

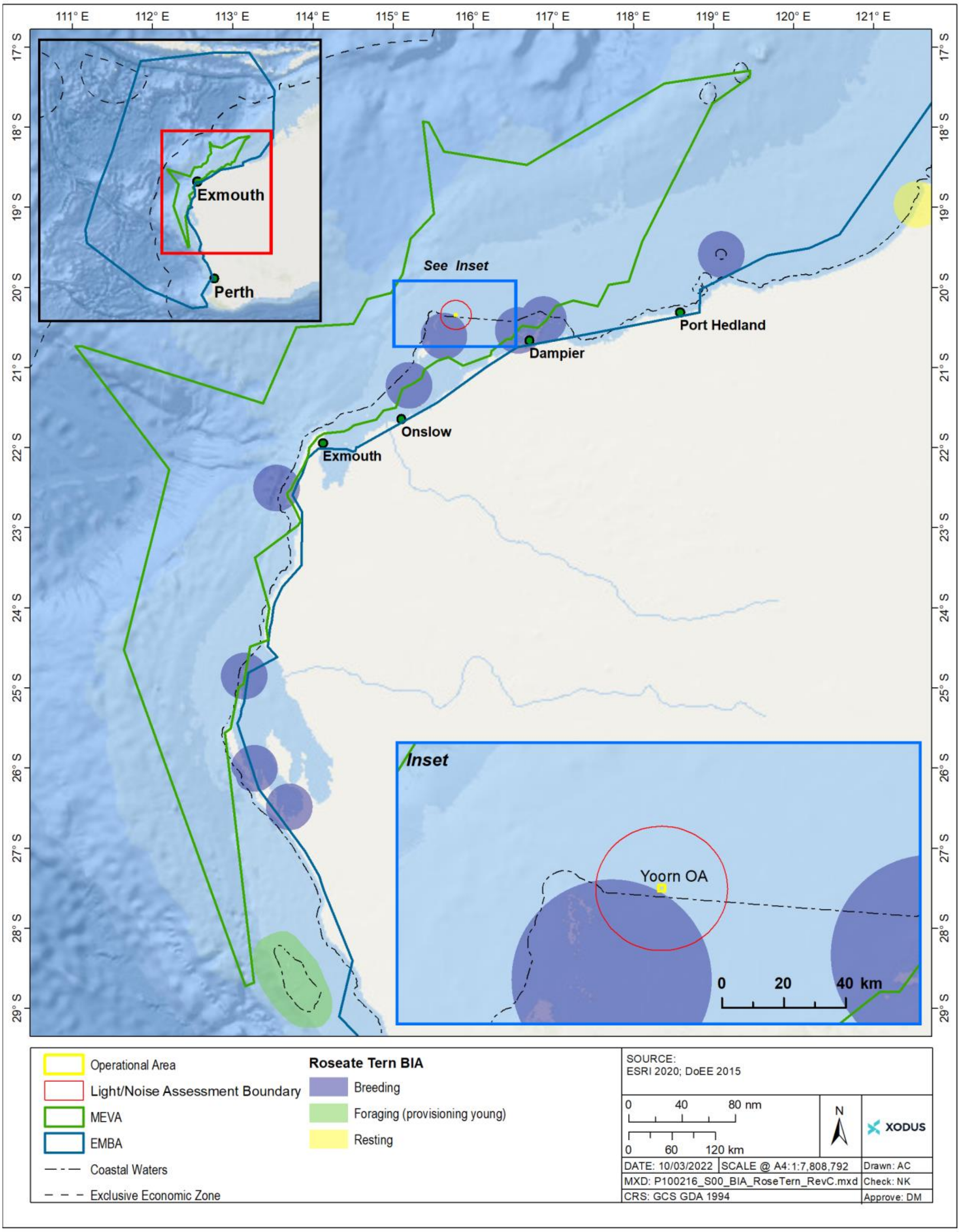

Figure 3-28: Biologically important areas for EPBC Protected Roseate Tern within the vicinity of the EMBA and Operational Area

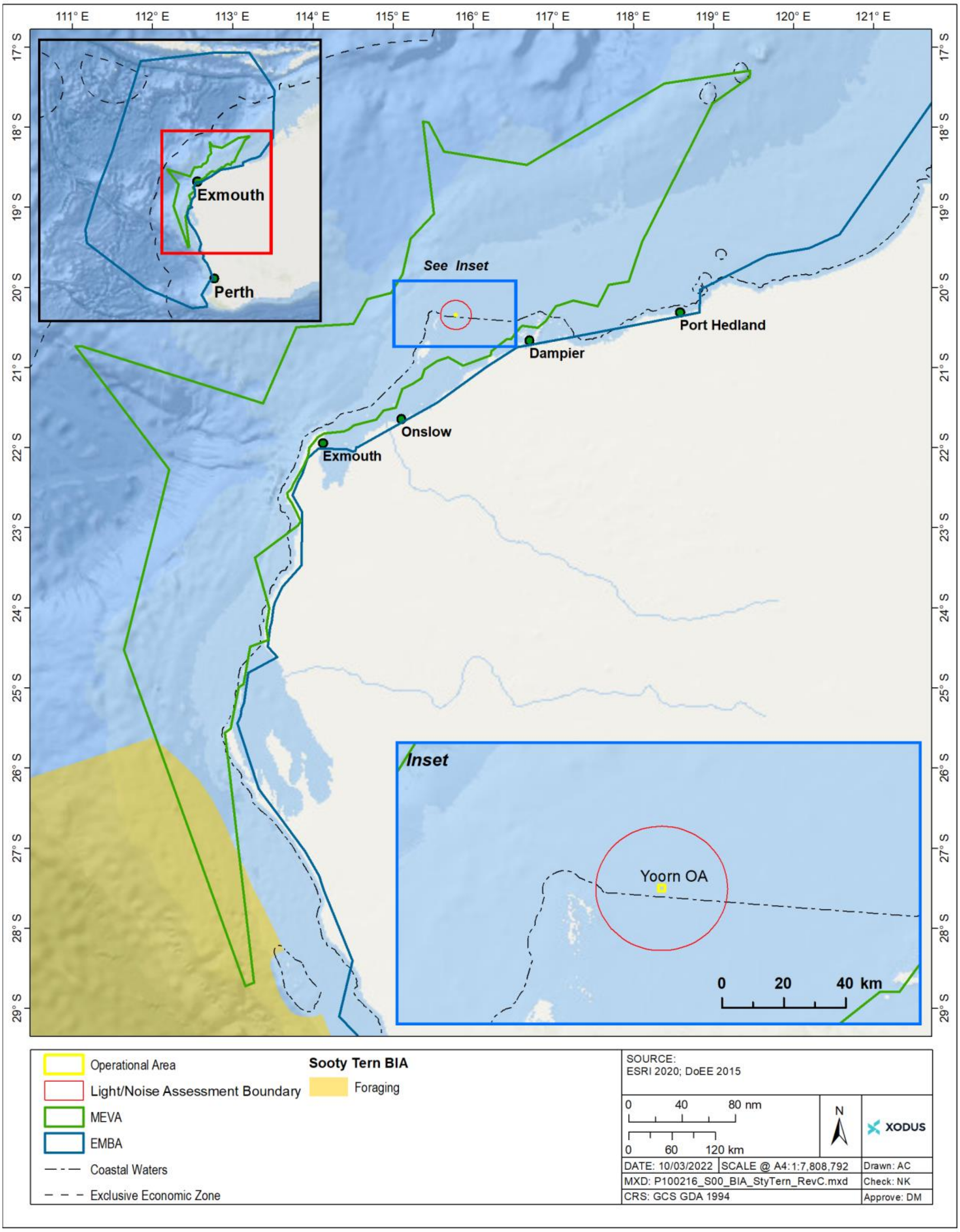

Figure 3-29: Biologically important areas for EPBC Protected Sooty Tern within the vicinity of the EMBA and Operational Area

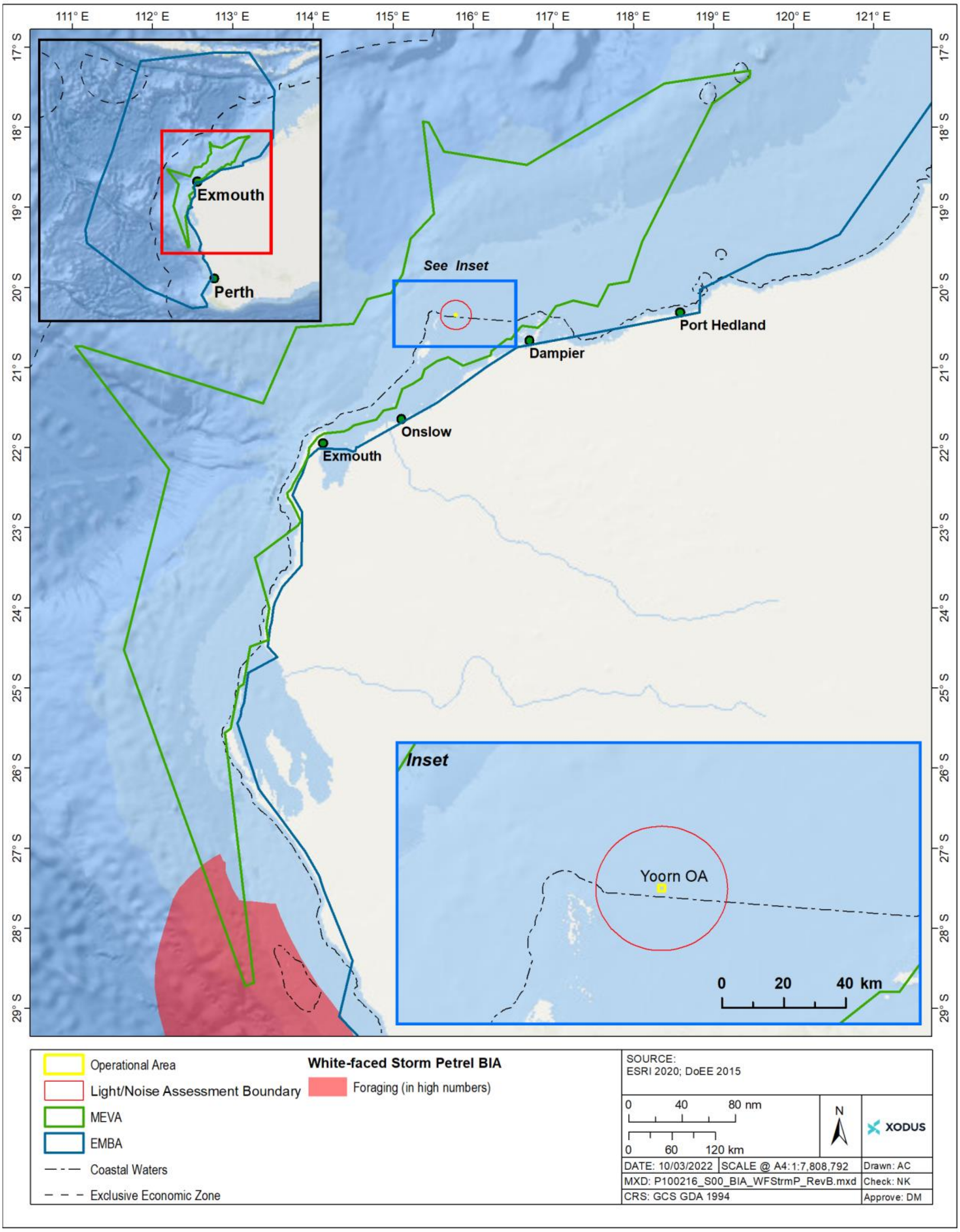

Figure 3-30: Biologically important areas for EPBC Protected White-faced Storm Petrel within the vicinity of the EMBA and Operational Area

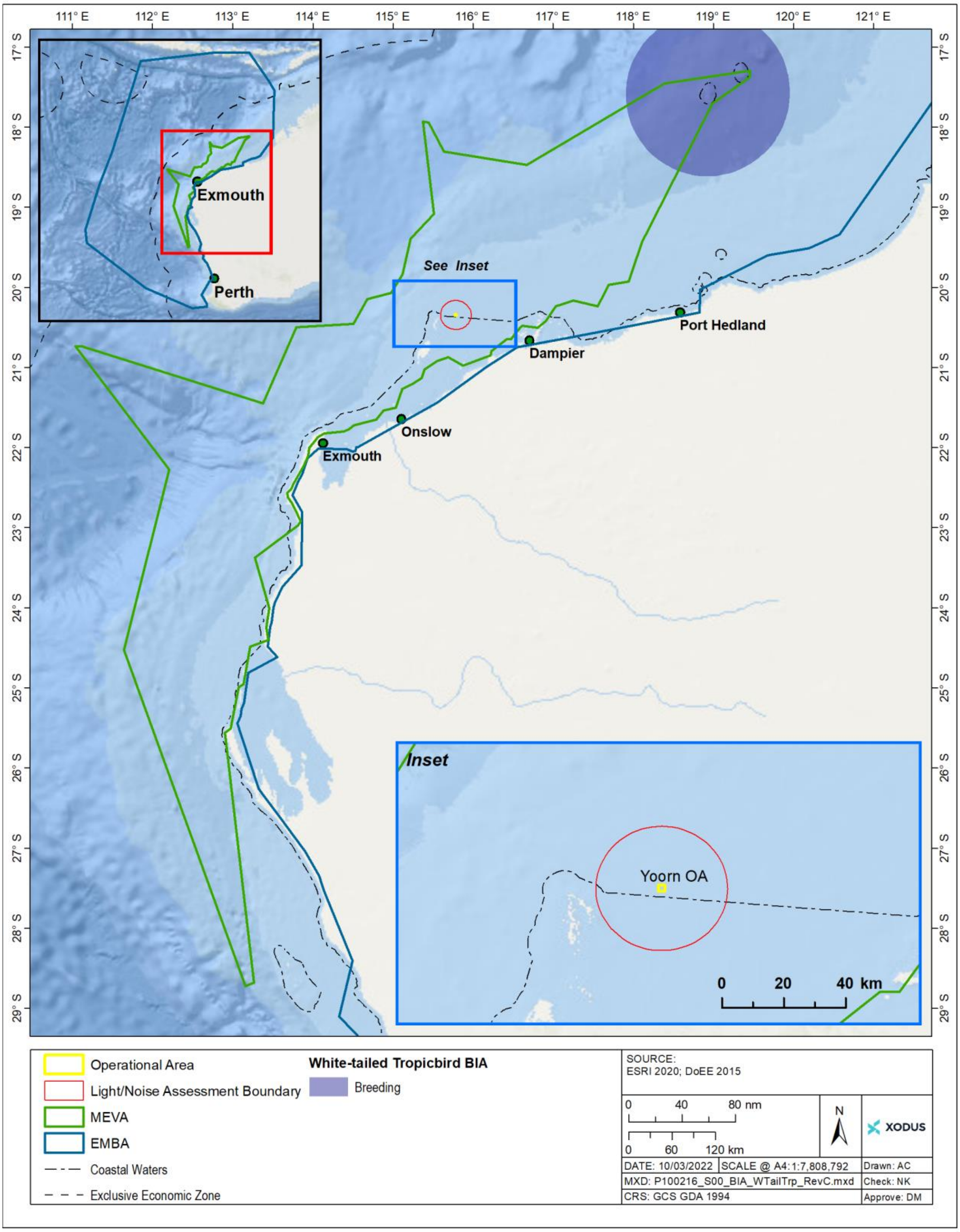

Figure 3-31: Biologically important areas for EPBC Protected White-tailed Tropicbird within the vicinity of the EMBA and Operational Area

3.2.3.1 Recovery Plans

Recovery Plans set out the research and management actions necessary to stop the decline of and support the recovery of listed threatened species.

Table 3-9 summarises the actions relevant to the activity with more information on the specific requirements of the relevant plans of management (including Conservation Advice and Conservation Management Plans) applicable to the Activity and demonstrates how current management requirements have been taken into account.

Table 3-9: Threats and Strategies from Recovery Plans, Conservation Advice and Management Plans relevant to the Activity

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
All Fauna					
All vertebrate fauna	Threat Abatement Plan for Impacts of Marine Debris on Vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018)	There are four main objectives: + Contribute to the long-term prevention of the incidence of harmful marine debris + Remove existing harmful marine debris from the marine environment + Mitigate the impacts of harmful marine debris on marine species and ecological communities + Monitor the quantities, origins and impacts of marine debris and assess the effectiveness of management arrangements over time for the strategic reduction of debris.	Marine debris	No explicit management actions for non-fisheries related industries (note that management actions in the plan relate largely to management of fishing waste (for example 'ghost' gear), and State and Commonwealth management through regulation.	**Section 7.6**
Fish and Sharks					
All Sawfish and River sharks including: + Dwarf Sawfish	Sawfish and River Sharks Multispecies Recovery Plan (2015)	The primary objective of this recovery plan is to assist the recovery of sawfish and river sharks in Australian waters with a view to:	Habitat degradation and modification	Identify risks to important sawfish and river shark habitat and measures needed to reduce those risks.	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
+ Green Sawfish + Freshwater Sawfish + Northern River Shark		+ Improving the population status leading to the removal of the sawfish and river shark species from the threatened species list of the EPBC Act + Ensuring that anthropogenic activities do not hinder recovery in the near future, or impact on the conservation status of the species in the future. The specific objectives of the recovery plan (relevant to industry) are: + Objective 5: Reduce and, where possible, eliminate adverse impacts of habitat degradation and modification on sawfish and river shark species. + Objective 6: Reduce and, where possible, eliminate any adverse impacts of marine debris on sawfish and river shark species noting the linkages with the Threat Abatement Plan for the Impact of Marine Debris on Vertebrate Marine Life.			

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
Dwarf Sawfish	Approved Conservation Advice on *Pristis clavate* (Dwarf Sawfish) (2009)	No explicit relevant objectives	Habitat degradation and modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as threats.	**Section 7.2 and 7.3**
Green sawfish	Approved Conservation Advice on *Pristis zijsron* (green sawfish) (2008)	No explicit relevant objectives	Habitat degradation and modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as threats.	**Section 7.2 and 7.3**
Blind Gudgeon	Approved Conservation Advice for *Milyeringa veritas* (Blind Gudgeon) (2008)	No explicit relevant objectives	Pollution	No explicit relevant management actions; pollution identified as a threat.	**Section 7.2 and 7.3**
Blind Cave Eel	Approved Conservation Advice for *Ophisternon candidum* (Blind Cave Eel) (2008)	No explicit relevant objectives	Pollution	No explicit relevant management actions; pollution identified as a threat.	**Section 7.2 and 7.3**
Freshwater Sawfish	Approved Conservation Advice for *Pristis pristis* (Largetooth sawfish) (2014)	No explicit relevant objectives	Habitat degradation and modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification.	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
Northern river shark	Approved Conservation Advice for *Glyphis garricki* (northern river shark) 2014	No explicit relevant objectives	Habitat degradation and modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification.	**Section 7.2 and 7.3**
			Marine debris	No explicit relevant management actions; marine debris identified as a threat.	**Section 7.6**
Great white shark	Recovery plan for the White Shark (*Carcharodon carcharias*) (2013)	The overarching objective of this recovery plan is to assist the recovery of the white shark in the wild throughout its range in Australian waters with a view to: + Improving the population status leading to future removal of the white shark from the threatened species list of the EPBC Act + Ensuring that anthropogenic activities do not hinder recovery in the near future, or impact on the conservation status of the species in the future. The specific objectives of the recovery plan (relevant to industry) are: + Objective 7: Continue to identify and protect habitat critical to the survival of the white shark and minimise the	Ecosystem effects as a result of habitat modification and climate change	No explicit relevant management actions; habitat modification and climate change identified as threats.	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
		impact of threatening processes within these areas.			
Grey nurse shark (west coast population)	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (2014)	The overarching objective of this recovery plan is to assist the recovery of the grey nurse shark in the wild, throughout its range in Australian waters, with a view to: + Improving the population status + Ensuring that anthropogenic activities do not hinder the recovery of the grey nurse shark	Pollution and disease	Review and assess the potential threat of introduced species, pathogens and pollutants.	**Section 7.2 and 7.3**
			Ecosystem effects as a result of habitat modification and climate change	Review the level and spatial extent of protection measures at key aggregation sites to ensure appropriate levels of protection, and a consistent approach to the designation and implementation of protective measures, are applied. Use Biologically Important Areas (BIA) to help inform the development of appropriate conservation measures, including through the application of advice in the marine bioregional plans on the types of actions which are likely to have a significant impact on the species and updating such conservation measures as new information becomes available.	**Section 7.2 and 7.3**
Whale shark	Approved Conservation Advice	To maintain existing levels of protection for the whale shark in Australia while working to increase the level of protection afforded to the whale shark within the Indian Ocean and	Boat strike from large vessels	Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with Whale Shark aggregations along the northward migration	**Section 7.8**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
	for *Rhincodon typus* (whale shark) (2015)	Southeast Asian region to enable population growth so that the species can be removed from the threatened species list of the EPBC Act.		route that follows the northern Western Australian coastline along the 200 m isobath (as set out in the Conservation Values Atlas, DoE, 2014).	
			Habitat disruption from mineral exploration, production and transportation	Implement measures to reduce adverse impacts of habitat degradation and/or modification.	**Section 7.2 and 7.3**
			Marine debris	No explicit relevant management actions; marine debris identified as a threat.	**Section 7.6**
			Climate change	No explicit relevant management actions; climate change identified as threat.	**Section 6.5**
Marine Mammals					
Blue whale	Blue Whale Conservation Management Plan 2015 - 2025 (2015)	The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the Blue Whale to improve so that it can be removed from the threatened species list under the EPBC Act.	Noise interference	Assess and address anthropogenic noise: shipping, industrial and seismic noise.	**Section 6.4**
			Habitat modification	No explicit relevant management actions; habitat modification identified as a threat.	**Section 7.2 and 7.3**
			Vessel disturbance	Minimise vessel collisions: + Develop a national vessel strike strategy that investigates the risk of vessel strike on blue whales and also	**Section 7.8**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
				identifies potential mitigation measures. + Ensure all vessel strike incidents are reported in the National Ship Strike Database. Ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented.	
			Climate Variability and Change	Understanding impacts of climate variability and change: + Continue to meet Australia's international commitments to reduce greenhouse gas emissions and regulate the krill fishery in Antarctica.	**Section 7.1 - 7.4**
			Marine debris	No explicit relevant management actions; marine debris identified as a threat.	**Section 7.6**
Southern right whale	Conservation Management Plan for the Southern Right	Long term recovery objective: + To minimise anthropogenic threats to allow the conservation status of the southern right whale to improve so	Vessel disturbance	Address vessel collisions: + Develop a national ship strike strategy that quantifies vessel movements within the distribution ranges of	**Section 7.8**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
	Whale 2011 – 2021 (2012)	that it can be removed from the threatened species list under the EPBC Act Interim Recovery Objective 5: + Anthropogenic threats are demonstrably minimised		southern right whales and outlines appropriate mitigation measures that reduce impacts from vessel collisions.	
			Habitat modification	No explicit relevant management actions; habitat modification identified as a threat.	**Section 7.2 and 7.3**
			Noise interference	Assess and address anthropogenic noise: shipping, industrial and seismic noise.	**Section 6.4**
			Entanglement (marine debris)	No explicit relevant management actions; entanglement in marine debris identified as a threat.	**Section 7.6**
			Climate Variability and Change	Assess impacts of climate variability and change. Continue to meet Australia's international commitments to reduce greenhouse gas emissions and regulate the krill fishery in Antarctica.	**Section 6.5**
Sei whale	Conservation Advice *Balaenoptera borealis* sei whale (2015)	Determine population abundance, trends and population structure for sei whales, and establish a long-term monitoring program in Australian waters.	Noise interference	Once the spatial and temporal distribution (including biologically important areas) of Fin Whales is further defined, assess the impacts of increasing anthropogenic noise (including seismic surveys, port expansion, and coastal development).	**Section 6.4**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
			Climate change	Understanding impacts of climate variability and change: + Continue to meet Australia's international commitments to reduce greenhouse gas emissions and regulate the krill fishery in Antarctica.	**Section 6.5**
			Vessel disturbance	Minimising vessel collisions: + Develop a national vessel strike strategy that investigates the risk of vessel strikes on Sei Whales and also identifies potential mitigation measures. + Ensure all vessel strike incidents are reported in the National Vessel Strike Database.	**Section 7.8**
			Habitat degradation	No explicit relevant management actions; habitat degradation identified as a threat.	**Section 7.2 and 7.3**
			Pollution (persistent toxic pollutants)	No explicit relevant management actions; pollution identified as a threat.	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
Fin whale	Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015)	Determine population abundance, trends and population structure for sei whales, and establish a long-term monitoring program in Australian waters. Describe the spatial and temporal distribution of Sei Whales and further define biologically important areas (feeding and breeding), and migratory routes within Australian and Antarctic waters.	Habitat degradation including pollution (increasing port expansion and coastal development)	No explicit relevant management actions; habitat degradation identified as a threat.	**Section 7.2 and 7.3**
			Pollution (persistent toxic pollutants)	No explicit relevant management actions; pollution identified as a threat.	**Section 7.2 and 7.3**
			Noise interference	Once the spatial and temporal distribution (including biologically important areas) of Fin Whales is further defined, assess the impacts of increasing anthropogenic noise (including seismic surveys, port expansion, and coastal development).	**Section 6.4**
			Vessel strike	Develop a national vessel strike strategy that investigates the risk of vessel strikes on Fin Whales and identifies potential mitigation measures. Ensure all vessel strike incidents are reported in the National Vessel Strike Database.	**Section 7.8**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
			Climate and Oceanographic Variability and Change	Understanding impacts of climate variability and change: + Continue to meet Australia's international commitments to reduce greenhouse gas emissions and regulate the krill fishery in Antarctica.	**Section 7.1 - 7.4**
Australian Sea-Lion	Approved Conservation Advice on *Neophoca cinerea* Australian Sea Lion (2020)	Primary conservation actions: + Mitigate the impacts of marine debris on Australian Sea Lions	Marine Debris	Assess the impacts of marine debris on Australian Sea Lion populations and identify the sources of marine debris which have an impact. Develop and implement measures to mitigate the impacts of marine debris on the species (including reducing the amount of these marine debris entering the oceans), noting linkages with the Threat Abatement Plan for the Impact of Marine Debris on Vertebrate Marine Life.	**Section 7.6**
			Disease and Parasites	Improve human wastewater management to minimise dispersal of bacteria, parasites and pollutants into the marine environment.	**Section 7.7**
			Habitat degradation and pollution	Require all vessels to have oil spill mitigation measures in place, and implement	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
				jurisdictional oil spill response strategies as required.	
			Noise interference	Monitor and mitigate impacts (including cumulative impacts) of human interactions on Australian Sea Lion colonies. Control access to breeding colonies to minimise the impacts of disturbance on Australian Sea Lions.	**Section 6.4**
			Climate Change	Review and adjust management measures to address the threats from disease/parasites and prey depletion, if it is demonstrated that increased temperatures compound these threats.	**Section 7.1 - 7.4**
	Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (2013)	The overarching objective of this recovery plan is to halt the decline and assist the recovery of the Australian sea lion throughout its range in Australian waters by increasing the total population size while maintaining the number and distribution of breeding colonies with a view to: + improving the population status leading to the future removal of the	Habitat degradation	No explicit management actions; habitat degradation recognised as a threat.	**Section 7.2 and 7.3**
			Disease	No explicit management actions; disease and pathogens recognised as a threat.	**Section 7.7**
			Pollution and oil spills	Implement jurisdictional oil spill response strategies as required.	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
		Australian sea lion from the threatened species list of the EPBC Act + ensuring that anthropogenic activities do not hinder recovery in the near future or impact on the conservation status of the species in the future.	Climate Change	No explicit management actions; climate change recognised as a threat.	**Section 7.1 - 7.4**
			Marine debris	Identify the sources of marine debris having an impact on Australian sea lion populations. Assess the impacts of marine debris on Australian sea lion populations. Develop and implement measures to mitigate the impacts of marine debris on Australian sea lion populations, noting the linkages with the Threat Abatement Plan for the Impact of Marine Debris on Vertebrate Marine Life.	**Section 7.6**
			Vessel strike	Collect data on direct killings and confirmed vessel strikes.	**Section 7.8**
Reptiles					
Short-nosed sea snake	Approved Conservation Advice for *Aipysurus apraefrontalis* (Short-nosed Sea Snake) (2011)	No explicit relevant objectives	Habitat degradation	Monitor known populations to identify key threats. Ensure there is no anthropogenic disturbance in areas where the species occurs, excluding necessary actions to manage the conservation of the species.	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
Leaf-scaled Seasnake	Approved Conservation Advice for *Aipysurus foliosquama* (Leaf-scaled Seasnake) (2011)	No explicit relevant objectives	Degradation of reef habitat	Ensure there is no disturbance in areas where the Leaf-scaled Sea Snake occurs, excluding necessary actions to manage the conservation of the species.	**Section 7.2 and 7.3**
All marine turtles including: + Loggerhead Turtle + Green Turtle + Leatherback Turtle + Hawksbill Turtle + Flatback Turtle + Olive Ridley Turtle	National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE, 2020)	Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present. Objectives should be described in terms of specific locations and times for which artificial light is necessary. Consideration should be given to whether colour differentiation is required and if some areas should remain dark – either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives. A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.	Light pollution	Best practice lighting design incorporates the following design principles: + Start with natural darkness and only add light for specific purposes. + Use adaptive light controls to manage light timing, intensity and colour. + Light only the object or area intended – keep lights close to the ground, directed and shielded to avoid light spill. + Use the lowest intensity lighting appropriate for the task. + Use non-reflective, dark-coloured surfaces. + Use lights with reduced or filtered blue, violet and ultra-violet wavelengths.	**Section 6.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
	Recovery plan for marine turtles in Australia 2017 – 2027 (Commonwealth of Australia 2017)	Long-term recovery objective: + Minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 3: + Anthropogenic threats are demonstrably minimised.	Marine debris	Reduce the impacts from marine debris: + Support the implementation of the EPBC Act Threat Abatement Plan for the impacts of marine debris on vertebrate marine life.	**Section 7.6**
			Chemical and Terrestrial Discharge	Minimise chemical and terrestrial discharge.	**Section 6.6, 6.7, 7.2 – 7.5**
			Vessel disturbance	Vessel interactions identified as a threat; no specific management actions in relation to vessels prescribed in the plan.	**Section 7.8**
			Light Pollution	Minimise light pollution: + Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats. + Develop and implement best practice light management guidelines for existing and future developments adjacent to marine turtle nesting beaches.	**Section 6.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
				+ Identify the cumulative impact on turtles from multiple sources of onshore and offshore light pollution.	
			Noise interference	Assess and address anthropogenic noise: + Understand the impacts of anthropogenic noise on marine turtle behaviour and biology.	**Section 6.4**
			Habitat modification	Manage anthropogenic activities to ensure marine turtles are not displaced from identified habitat critical to the survival. Manage anthropogenic activities in Biologically Important Areas to ensure that biologically important behaviour can continue.	**Section 7.2 and 7.3**
			Disease and Pathogens	No explicit management actions; disease and pathogens recognised as a threat.	**Section 7.7**
			Climate Change and Variability	Adaptively manage turtle stocks to reduce risk and build resilience to climate change and variability: + Continue to meet Australia's international commitments to address the causes of climate change.	**Section 6.5**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
				+ Identify, test and implement climate-based adaptation measures.	
Leatherback turtle	Commonwealth Conservation Advice on *Dermochelys coriacea* (2008)	No explicit relevant objectives	Boat strike	No explicit relevant management actions; vessel strikes identified as a threat.	**Section 7.8**
			Habitat degradation (changes to breeding sites and degradation to foraging areas)	Identify and protect migratory corridors between nesting beaches and common foraging areas to facilitate colonization.	**Section 7.2 and 7.3**
			Marine Debris	No explicit relevant management actions; marine debris identified as a threat.	**Section 7.6**
			Climate Change	No explicit relevant management actions; climate change identified as a threat.	**Section 7.1 - 7.4**
Birds					
All seabirds and shorebirds	National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE, 2020)	Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present. Objectives should be described in terms of specific locations and times for which artificial light is necessary. Consideration should be given to whether colour differentiation is required and if some areas	Light pollution	Best practice lighting design incorporates the following design principles: + Start with natural darkness and only add light for specific purposes. + Use adaptive light controls to manage light timing, intensity and colour. + Light only the object or area intended – keep lights close to the ground,	**Section 6.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
		should remain dark – either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives. A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.		directed and shielded to avoid light spill. + Use the lowest intensity lighting appropriate for the task. + Use non-reflective, dark-coloured surfaces. + Use lights with reduced or filtered blue, violet and ultra-violet wavelengths.	
All Migratory Shorebirds	Wildlife Conservation Plan for Migratory Shorebirds (Commonwealth of Australia 2015)	Anthropogenic threats to migratory shorebirds in Australia are minimised or, where possible, eliminated.	Habitat degradation / modification	No explicit relevant management actions; identified as a threat.	**Section 7.2 and 7.3**
			Anthropogenic disturbance	Investigate the significance of cumulative impacts on migratory shorebird habitat and populations in Australia. Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes (specifically for coastal developments).	**Section 7.8**
			Climate change	Investigate the impacts of climate change on migratory shorebird habitat and populations in Australia.	**Section 6.5**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
All seabirds	Draft Wildlife Conservation Plan for Seabirds (Commonwealth of Australia 2019)	Seabirds and their habitats are protected and managed in Australia.	Pollution (marine debris, light, water)	Enhance contingency plans to prevent and/or respond to environmental emergencies that have an impact on seabirds and their habitats.	**Section 6.3, 6.6, 6.7, 7.2, 7.3, 7.6**
			Climate change	No explicit relevant management actions; identified as a threat.	**Section 6.5**
			Habitat loss and degradation from pollution	No explicit relevant management actions; identified as a threat.	**Section 7.2 and 7.3**
			Anthropogenic disturbance	Ensure all areas of important habitat for seabirds are considered in the development assessment process. Manage the effects of anthropogenic disturbance to seabird breeding and roosting areas.	**Section 7.8**
			Invasive species	Ensure seabirds are protected from the adverse effects of invasive species.	**Section 7.7**
All threatened Albatrosses and Giant Petrels including:	National recovery plan for threatened albatrosses and giant	Overall objective: + To ensure the long-term survival and recovery of albatross and giant petrel	Marine pollution	Where feasible, population monitoring programs also monitor, in a standardised manner, the incidence of oiled birds at the nest.	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
+ Southern Giant-Petrel + Indian Yellow-nosed albatross + Shy Albatross + Campbell Albatross + Black-browed Albatross + White-capped Albatross + Soft-plumaged Petrel + Amsterdam Albatross + Tristan Albatross + Southern Royal Albatross + Wandering Albatross	petrels 2011-2016 (2011)	populations breeding and foraging in Australian jurisdiction by reducing or eliminating human related threats at sea and on land. Specific objectives: + Land-based threats to the survival and breeding success of albatrosses and giant petrels breeding within areas under Australian jurisdiction are quantified and reduced. + Marine-based threats to the survival and breeding success of albatrosses and giant petrels foraging in waters under Australian jurisdiction are quantified and reduced.	Climate Change	Where climate change is identified as having the potential for significant negative impacts on Australian populations of seabirds: + Appropriate monitoring strategies are implemented to fill information gaps + Mitigation actions are identified and adopted where feasible and appropriate.	**Section 6.5**
			Parasites and Disease	No explicit management actions; parasites and disease recognised as a threat.	**Section 7.7**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
+ Northern Royal Albatross + Northern Giant Petrel + Sooty Albatross					
Australian fairy tern	Approved Conservation Advice on *Sternula nereis nereis* (Fairy Tern) (2011)	No explicit relevant objectives	Oil spills, particularly in Victoria	Ensure appropriate oil spill contingency plans are in place for the subspecies' breeding sites that are vulnerable to oil spills.	**Section 7.2 and 7.3**
Curlew sandpiper	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (2015)	Australian Objective: + Reduce disturbance at key roosting and feeding sites	Habitat loss and degradation from pollution	No explicit relevant management actions; oil pollution recognised as a threat.	**Section 7.2 and 7.3**
Eastern curlew	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (2015)	Australian objectives: + Achieve a stable or increasing population. + Maintain and enhance important habitat. + Reduce disturbance at key roosting and feeding sites.	Habitat loss and degradation from pollution	No explicit relevant management actions; habitat loss and degradation recognised as a threat.	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
Red knot	Approved Conservation Advice for *Calidris canutus* (Red knot) (2016)	No explicit relevant objectives	Pollution/contamination impacts	No explicit relevant management actions; pollution / contamination recognised as a threat.	**Section 7.2 and 7.3**
			Habitat loss and degradation	Protect important habitat in Australia. Maintain and improve protection of roosting and feeding sites in Australia	**Section 7.2 and 7.3**
			Climate Change	No explicit relevant management actions; climate change recognised as a threat.	**Section 6.5**
			Anthropogenic Disturbance	Manage disturbance at important sites which are subject to anthropogenic disturbance when red knot are present.	**Section 7.8**
Shy Albatross	Approved Conservation Advice *Thalassarche cauta* (Shy Albatross) (2020)	Conservation Advice refers to the objectives set out in the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC 2011).	Marine plastics	No explicit management actions; marine debris recognised as a threat.	**Section 7.6**
			Climate Change	No explicit management actions; climate change recognised as a threat.	**Section 6.5**
			Disease	No explicit management actions; disease recognised as a threat.	**Section 7.7**
Soft-plumaged petrel	Approved Conservation Advice for *Pterodroma Mollis*	No explicit relevant objectives	Habitat degradation / modification	No explicit management actions; habitat loss, disturbance and modification recognised as a threat.	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
	(soft-plumaged Petrel) (2015)				
Northern Siberian bar-tailed godwit	Approved Conservation Advice *Limosa lapponica menzbieri* (Bar-tailed godwit (northern Siberian)) (2016)	No explicit relevant objectives	Habitat loss disturbance and degradation	Protect important habitat in Australia.	**Section 7.2 and 7.3**
			Pollution/contamination	No explicit management actions; pollution / contamination recognised as a threat.	**Section 7.2 and 7.3**
			Disease	Manage important sites to identify, control and reduce the spread of invasive species.	**Section 7.7**
			Climate Change	No explicit management actions; climate change recognised as a threat.	**Section 6.5**
			Direct mortality (collision)	No explicit management actions; direct mortality (collision) recognised as a threat.	**Section 7.8**
Australian painted snipe	Approved Conservation Advice for *Rostratula australis* (Australian Painted Snipe) (2013)	No explicit relevant objectives	Habitat loss disturbance and modifications	Habitat recovery actions are a priority.	**Section 7.2 and 7.3**
Australian Lesser Noddy	Conservation Advice *Anous tenuirostris*	No explicit relevant objectives	Pollution and oil spills	No explicit relevant management actions; oil pollution recognised as a threat.	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
	melanops (Australian lesser noddy) (2015)				
Australasian Bittern	Conservation Advice *Botaurus poiciloptilus* (Australasian Bittern) (2011)	The objective of this conservation advice is to provide guidance for actions that will expand the range and the number of Australasian Bitterns in Australia.	Habitat loss / degradation	No explicit relevant management actions; habitat loss and degradation recognised as a threat.	**Section 7.2 and 7.3**
			Climate Change	No explicit relevant management actions; climate change recognised as a threat.	**Section 6.5**
Great Knot	Conservation Advice *Calidris tenuirostriss* (Great knot) (2016)	No explicit relevant objectives	Habitat degradation	Identifies research priorities and the need for actions to prevent destruction of key breeding and migratory staging sites.	**Section 7.2 and 7.3**
			Climate Change	No explicit relevant management actions; climate change recognised as a threat.	**Section 7.1 - 7.4**
			Pollution and contaminants	No explicit relevant management actions; pollution / contaminants recognised as a threat.	**Section 7.2 and 7.3**
			Disease	No explicit relevant management actions; disease recognised as a threat.	**Section 7.7**
Greater Sand Plover	Conservation Advice *Charadrius leschenaultia* (Greater Sand Plover) (2016)	No explicit relevant objectives	Habitat loss and degradation	Identifies research priorities and the need for actions to prevent destruction of key breeding and migratory staging sites. Protect important habitat in Australia.	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
			Climate Change	No explicit relevant management actions; climate change recognised as a threat.	**Section 6.5**
			Pollution/contamination	No explicit relevant management actions; pollution / contaminants recognised as a threat.	**Section 7.2 and 7.3**
			Introduced Species	No explicit relevant management actions; introduced species recognised as a threat.	**Section 7.7**
			Disease	No explicit relevant management actions; disease recognised as a threat.	**Section 7.7**
Lesser Sand Plover	Conservation Advice *Charadrius mongolus* (Lesser Sand Plover) (2016)	No explicit relevant objectives	Habitat loss and degradation	Outlines research and survey priorities and recommends habitat restoration/ maintenance.	**Section 7.2 and 7.3**
			Climate Change	No explicit relevant management actions; climate change recognised as a threat.	**Section 7.1 - 7.4**
			Pollution/contamination	No explicit relevant management actions; pollution / contaminants recognised as a threat.	**Section 7.2 and 7.3**
			Introduced Species	No explicit relevant management actions; introduced species recognised as a threat.	**Section 7.7**
			Disease	No explicit relevant management actions; disease recognised as a threat.	**Section 7.7**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
Christmas Island Frigatebird	Conservation Advice for the Christmas Island Frigatebird (*Fregata andrewsi*) (2020)	Long-term Objective: + To reduce anthropogenic threats to allow the conservation status of *Fregata andrewsi* (the Christmas Island Frigatebird) to improve so that it can be removed from the threatened species list of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Short-term Objectives: + The extent and quality of habitat critical to the survival of the Christmas Island Frigatebird is maintained or improved. + Anthropogenic threats to Christmas Island Frigatebird are demonstrably reduced.	Habitat disturbance	Preventing activities in habitat critical to the survival that will remove nesting and roosting habitat. Preventing activities in buffer areas identified in Map 1 that may disturb nesting and roosting birds.	**Section 7.2 and 7.3**
			Marine Debris - plastics	No explicit relevant management actions; marine debris recognised as a threat.	**Section 7.6**
			Pollution	No explicit management actions; marine pollution recognised as a threat.	**Section 7.2 and 7.3**
			Disease	Undertake a risk assessment to determine the most likely source of a new avian disease so that any changes to procedure are targeted.	**Section 7.7**
Blue Petrel	Conservation Advice *Halobaena caerulea* (Blue Petrel) (2015)	No explicit relevant objectives	Habitat Loss, Disturbance and Modification	No explicit relevant management actions; habitat loss, disturbance and modification recognised as a threat.	**Section 7.2 and 7.3**
Grey Falcon	Conservation Advice *Falco hypoleucos* (Grey Falcon) (2020)	Support initiatives to improve habitat management, cat and camel control in arid and semi-arid Australia. However, given our	Habitat Loss and Fragmentation	No explicit relevant management actions; habitat loss, disturbance and modification recognised as a threat.	**Section 7.2 and 7.3**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
		understanding of threats is poor, these actions are tentative and may be subject to change in priority.	Invasive Species	No explicit management actions; invasive species recognised as a threat.	**Section 7.7**
			Climate Change	No explicit relevant management actions; climate change recognised as a threat.	**Section 7.1 - 7.4**
Fairy Prion (southern)	Conservation Advice *Pachyptila turtur subantactica* (Fairy Prion (Southern)) (2015)	No explicit relevant objectives	Habitat Loss, Disturbance and Modification	No explicit management actions; habitat loss, disturbance and modification recognised as a threat.	**Section 7.2 and 7.3**
Abbott's Booby	Conservation Advice for the Abbott's Booby – *Papasula abbotti* (2020)	Long-term Objective: + To reduce anthropogenic threats to allow the conservation status of *Papasula abbotti* (Abbott's Booby) to improve so that it can be removed from the threatened species list of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Short-term Objectives: + The extent and quality of habitat critical to the survival of Abbott's Booby is maintained or improved.	Climate Change	Develop and implement a response plan to enhance the adaptation of Abbott's Booby to climate change.	**Section 7.1 - 7.4**
			Introduction of Disease	No explicit management actions; disease recognised as a threat.	**Section 7.7**
			Marine Debris - plastics	No explicit management actions; marine debris recognised as a threat.	**Section 7.6**

Name	Recovery Plan / Conservation Advice / Management Plan	Relevant Objectives	Threats identified relevant to the activity	Relevant Conservation Actions	Addressed (where relevant) in the EP
		+ Anthropogenic threats to Abbott's Booby are demonstrably reduced.			

3.2.3.2 Humpback Whale

The OA overlaps a humpback whale migration BIA (**Figure 3-7**) whilst the EMBA also overlaps resting, nursing and calving BIAs.

Humpback whales traverse waters off the west coast of Australia as they migrate annually from summer feeding grounds in Antarctica to the nearshore waters of the Kimberley region where they breed and calve during winter. The waters up to 50 km from the coast of north-west WA are designated as a migration BIA and the Exmouth Gulf is an important resting area, particularly for mothers and calves on their southern migration (DEWHA 2008).

Humpback whales leave the Antarctic feeding grounds around March or April each year, reaching the Ningaloo Coast between approximately May and August on their northern migration. They commence their southern migration around August, with mothers and calves using known resting and nursing grounds along the way, significantly Exmouth Gulf along the Ningaloo Coast. Humpback whales are present along the Ningaloo Coast from approximately May through October; however, the exact timing of the migration can vary slightly from year to year, potentially as a result of water temperature, the extent of Antarctic sea-ice, predation risk, prey abundance and changes to feeding grounds (DBCA 2020b).

During the northbound migration, the data presented in Jenner et al. (2001) indicates the whales appear to remain within the 200 m isobath near the Montebello Island before moving closer to shore as they head further north to the calving grounds in the Kimberley. The humpback whale migration corridor is not an identified aggregation area or critical habitat; whales are in transit and are migrating from their southern polar 'summer' feeding grounds to their northern tropical 'winter' calving / breeding grounds.

3.2.3.3 Pygmy Blue Whale

The OA overlaps a distribution BIA for pygmy blue whale, whilst the MEVA and EMBA also overlaps a migration and foraging BIA (**Figure 3-8**).

The pygmy blue whale (*Balaenoptera musculus brevicauda*) is a subspecies of the blue whale, of which there are four species. Pygmy blue whales migrate as solitary animals or in small groups along the continental slope, typically at depths between 500 m and 1,000 m on the way to grounds in the Banda and Molucca Seas near Indonesia, where calving is understood to occur (Double et al. 2012).

The northern migration passes the Perth Canyon from January to May and north bound animals have been detected off Exmouth and the Montebello Islands between April and August (Double et al. 2012, McCauley and Jenner 2010). During the southern migration, pygmy blue whales pass south of the Montebello Islands and Exmouth from October to the end of January, with a peak in late November to early December (Double et al. 2012).

3.2.3.4 Marine Turtles

The BIAs and habitat critical to the survival of turtles are shown in **Figure 3-10** to **Figure 3-17**.

The EMBA intersects with the following marine turtle BIAs / habitat critical to the survival of the species as shown in **Table 3-8**:

+ Internesting buffer BIA for flatback, hawksbill, loggerhead and green turtles;
+ Habitat critical for the survival of the species for for green, hawksbill and flatback turtles;
+ Additional mating, nesting, interesting and foraging BIA for green turtles.

The internesting habitat critical buffer for green, loggerhead, hawksbill and leatherback turtles is 20 km; and 60 km for flatback turtles (CoA, 2017). These turtle species and their BIAs are shown in **Table 3-8** and described further in *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062, **Appendix C**).

In the Kimberley and Pilbara regions of Western Australia, from approximately the Lacepede Islands to Exmouth, there is a mid-summer peak nesting season for flatback turtles. More specifically, nesting and internesting in the Pilbara and south-west Kimberley stocks occurs between October and March with a peak period of December to January (DoEE, 2017). Flatback turtle hatchlings do not have an offshore pelagic phase. Instead, hatchlings grow to maturity in shallow coastal waters thought to be close to their natal beaches (DoEE, 2017).

Although turtles remain close to nesting beaches during the internesting period, there is evidence that some flatback turtles undertake long-distance migrations between breeding and feeding grounds. A survey carried out in the region between 2005 and 2012 identified the distances 73 female flatback turtles travelled to their foraging grounds; 11 remained within 100 km of their rookeries, four migrated an average of 400 km and 58 migrated between 1,000 and 1,500 km (Pendoley et al. 2014).

Western Australia (WA) is one of the largest remaining hotspots for hawksbill turtles (Fossette et al., 2021). A study of 42 hawksbill turtles between 2000 and 2017 provided evidence that turtles from WA rookeries (n =40) remained in WA waters during their internesting, migration and foraging life phases, whereas those from Timor-Leste (n=2) migrated to and foraged in WA (Fossette et al., 2021).

Turtles migrating from WA rookeries remained on the continental shelf. The majority followed the coastline and dispersed in a north-easterly direction while several turtles from the Montebello Archipelago and Lowendals (Varanus Island, Beacon Island) moved in a south-westerly direction towards the mainland with some of them stopping in the waters around Barrow Island. All hawksbill turtles previously tracked from Australian rookeries have similarly remained on the Australian continental shelf, migrating over similar distances. This reveals that hawksbill turtles are not only exposed to anthropogenic threats during nesting season but also while migrating and foraging along the coast (Fossette et al., 2021).

The study suggests that favourable foraging habitat for hawksbill turtles is available, predictable and abundant enough throughout WA waters to allow adult females to undertake relatively short migrations from WA rookeries which is a direct contrast to the two turtles from Timor-Leste that migrated over 1,000 km to forage on the Australian continental shelf (Fossette et al., 2021).

3.2.3.5 Whale Shark

The whale shark (*Rhincodon typus*) is the world's largest fish, and one of only three filter-feeding shark species. Whale sharks have a broad distribution in tropical and warm temperate seas. In Australian waters, they are known to aggregate at Ningaloo Reef and in the Coral Sea. The whale shark is a highly migratory fish and only visits Australian waters seasonally, aggregating in coastal waters off Ningaloo Reef between March and July each year. Seasonal aggregations are thought to be linked to 'pulses' of food productivity. In general, migration along the northern WA coastline broadly follows the 200 m isobath and typically occurs between July and November (TSSC 2015a).

3.2.3.6 Breeding Seabirds

The BIAs for seabird species within the EMBA are shown in **Figure 3-19** to **Figure 3-31**. The EMBA overlaps with BIAs for sixteen bird species. These species and BIAs are shown in **Table 3-8** and described in *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062, **Appendix C**).

The OA overlaps with the breeding/foraging BIA for the roseate tern with the Montebello Islands supporting the largest breeding population of Roseate Terns in WA (DEWHA 2008). The OA also overlaps with the breeding/foraging BIA for the wedge-tailed shearwater

Wedge-tailed Shearwaters are a pelagic, migratory visitor to WA; estimates indicate more than one million shearwaters migrate to the Pilbara islands each year (DBCA 2017); out of an estimated global population of 5 million (CoA 2012). Known breeding locations in the North-west Marine Region include Forestier Island (Sable Island), Bedout Island, Dampier Archipelago, Passage Island, Lowendal Island, islands off Barrow Island (Mushroom, Double and Boodie islands), islands in the Onslow area (including Airlie, Bessieres, Serrurier, North and South Muiron and Locker islands), islands in Freycinet Estuary, and south Shark Bay (Slope, Friday, Lefebre, Charlie, Freycinet, Double and Baudin islands) (DEWHA 2008a). Breeding populations on some of the Pilbara inshore islands (e.g. Serrurier, Locker, Airlie and Flat islands) have been estimated as approximately 1,000–10,000 (Conservation Commission 2009).

North and South Muiron Island are significant nesting sites for the Wedge-tailed Shearwater, with 292,844 breeding pairs observed between March 2013 and January 2014 (Surman and Nicholson 2015).

3.2.4 Socio-economic Factors

Socio-economic activities that may occur within the OA and EMBA include commercial fishing, oil and gas exploration and production, and to a lesser extent, recreational fishing and tourism as summarised in **Table 3-10**.

More detailed descriptions of socio-economic consideration are provided in *Values and Sensitivities of the Western Australian Marine Environment* (EA-00-RI-10062**, Appendix C**).

Table 3-10: Summary of Socio-economic Activities that may occur within the Operational Area and EMBA

Value/ sensitivity	Description	OA Presence	EMBA Presence	Relevant events within OAs	Relevant events within EMBA
Commercial fisheries - Commonwealth	Three Commonwealth fisheries management areas overlap the OA: the Western Tuna and Billfish Fishery, Southern Bluefin Tuna Fishery, and the Western Skipjack Tuna Fishery, however there has been no recent recorded activity (refer to **Section 3.2.4.1** and **Table 3-12**).	✓	✓	<u>Planned</u> Interaction with other marine users (**Section 6.1**)	<u>Unplanned</u> Unplanned hydrocarbon spills (**Sections 7.2 - 7.5**)
Commercial fisheries - State	State fisheries that intersect the OA are described in **Section 3.2.4.1** and **Table 3-12**.	✓	✓	<u>Planned</u> Interaction with other marine users (**Section 6.1**)	<u>Unplanned</u> Unplanned hydrocarbon spills (**Sections 7.2 - 7.5**)
Shipping	Shipping using North West Shelf (NWS) waters includes iron ore carriers, LNG and oil tankers and other vessels proceeding to or from the ports of Barrow Island, Varanus Island, Dampier, Port Walcott and Port Hedland. Vessel traffic may be encountered throughout the operational areas as commercial vessels transit around the Dampier Archipelago, Montebello Islands and Barrow Island and support vessel(s) conduct operations with the offshore infrastructure (**Figure 3-39**).	✓	✓	<u>Planned</u> Interaction with other marine users (**Section 6.1**)	<u>Unplanned</u> Unplanned hydrocarbon spills (**Sections 7.2 - 7.5**)
Recreational fishing	Within the operational areas, there are no known natural seabed features that would aggregate	X	✓	N/A	<u>Unplanned</u>

Value/ sensitivity	Description	OA Presence	EMBA Presence	Relevant events within OAs	Relevant events within EMBA
	fishes and which are typically targeted by recreational fishers. It is unlikely recreational fishing would occur in the operational areas, but it may occur in around the nearby Dampier Archipelago and Montebello Islands. Recreational fishing does occur within the EMBA, and therefore could be impacted by a spill arising from a vessel collision.				Unplanned hydrocarbon spills (**Sections 7.2 - 7.5**)
Defence	The nearest Defence area is a training area located 45.5 km from the closest OA.	X	✓	N/A	N/A
Shipwrecks	There are no shipwrecks within the OAs. The nearest historic shipwreck is located in the Dampier Archipelago.	X	✓	<u>Planned</u> Interaction with other marine users (**Section 6.1**)	<u>Unplanned</u> Unplanned hydrocarbon spills (**Sections 7.2 - 7.5**)
Oil and gas	Various petroleum exploration and production activities have been undertaken within the northwest shelf. The Santos operated Campbell platform is the closest petroleum facility, at approximately 8 km from the OA. Vessels servicing oil and gas operations in the region may pass through the area en-route to facilities, which is discussed under 'Shipping' above. Oil and gas facilities and permits are present within the EMBA, operated by other titleholders.	X	✓	<u>Planned</u> Interaction with other marine users (**Section 6.1**)	<u>Unplanned</u> Unplanned hydrocarbon spills (**Sections 7.2 - 7.5**)

Value/ sensitivity	Description	OA Presence	EMBA Presence	Relevant events within OAs	Relevant events within EMBA
	As such, oil and gas activities could be impacted by unplanned events.				
Tourism	Recreational activities such as boating, diving and fishing occur near the coast, Dampier Archipelago and Montebello Islands. These activities are concentrated in the vicinity of the population centres such as Exmouth, Dampier and Onslow. Planned events are not predicted to have a significant impact on tourism given that the majority of operational activities occur at a greater water depth than aquatic recreational activities. The EMBA overlaps a number of AMPs and State Marine Parks along the length of the Western Australian coastline. As such, eco-tourism based on specific local values (whale sharks, game fish, nearshore reef snorkelling and diving) could be impacted by unplanned events.	X	✓	N/A	<u>Unplanned</u> Unplanned hydrocarbon spills (**Sections 7.2 - 7.5**)
Cultural Heritage	No known sites of Aboriginal Heritage significance occur within the operational areas. A search of the Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Inquiry System was undertaken and identified 2125 registered Aboriginal heritage sites that occur within the EMBA. The nearest sites include middens, burial, ceremonial, artefacts, rock shelters, mythological and engraving sites recorded in the Dampier	X	✓	N/A	N/A

Value/ sensitivity	Description	OA Presence	EMBA Presence	Relevant events within OAs	Relevant events within EMBA
	Archipelago and on the Montebello and Legendre Islands.				

3.2.4.1 Commercial Fisheries

A valuable and diverse commercial fishing industry is supported by both the offshore and coastal waters in the NWS Region, mainly dominated by the Pilbara fisheries. The major fisheries in the Pilbara region target tropical finfish, large pelagic fish species, crustaceans (prawns and scampi) and pearl oysters. Commonwealth and State fisheries overlapping with the operational area and the EMBA are illustrated in **Figure 3-32** to **Figure 3-**. **Table 3-12** describes each of these fisheries and indicates which events associated with the activity may impact on these.

Consultation with the Department of Primary Industries and Regional Development (DPIRD) has previously identified commercial fishing interests that exist in, or in close proximity to, proposed activities under this EP. Further, Santos continually updates its understanding of the fisheries through reviews of annual status of the fishery reports published by DPIRD and the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), other relevant fisheries management publications, and fishery catch and effort data.

A review of available fishery management information for pelagic and demersal finfish fisheries indicated that whilst fisheries management measures includes annual quotas, and closure of specific areas all the time, none of the fisheries have specific time periods of closure for spawning/aggregation.

Five Commonwealth-managed commercial fisheries have management areas that intersect with the OA:

+ Western Tuna and Billfish Fishery (Cwlth)
+ Western Skipjack Tuna Fishery (Cwlth)
+ Southern Bluefin Tuna (Cwlth)
+ Western Deepwater Trawl Fishery (Cwlth)
+ Northwest Slope Trawl Fishery (Cwlth).

However, not all the fisheries are active within the full extents of the management areas. Based on historical fishing effort data (ABARES, 2020), species for the Western Tuna and Billfish Fishery, Western Skipjack Tuna Fishery, and Southern Bluefin Tuna Fishery may occur within the OA but no active fishing within the operation areas were identified (**Figure 3-32** to **Figure 3-**) (**Table 3-12**).

3.2.4.2 FishCube Data

Santos requested annual catch and effort data (FishCube data) from DPIRD for fisheries understood to operate within or near to the operational areas. Data was assessed for 60 nm x 60 nm Catch and Effort System (CAES) blocks for the following:

+ Catch and effort data for 2010-2020 and
+ Annual catch and effort data for 2010-2020.

Due to confidentiality reasons, DPIRD do not release catch and effort data for CAES blocks where less than three vessels fished during the period of interest (i.e. less than three vessels per year or less than three vessels over the complete six-year period). Where this applies, the Vessel Count is marked 'Less than 3', while Weight and Fishing Day Count are marked as 'N/A'. CAES blocks where the results are provided in this way confirm that fishing effort did occur within the block during that period, but the associated catch and effort values are not available. CAES blocks where no fishing is recorded do not return any data.

Commercial Fisheries that have activity identified to overlap with the OA are identified below and a summary of the data is available in **Table 3-11**.

- Pilbara Line Fishery (WA)
- Pilbara Trap Managed Fishery (WA)
- Pilbara Crab Managed Fishery
- Mackerel Managed Fishery (WA)
- Nickol Bay Prawn Managed Fishery
- West Australian Sea Cucumber Fishery
- Onslow Prawn Managed Fishery.

Table 3-11: FishCube Data Summary

Migrations	Description
Pilbara Line Fishery (WA).	FishCube Data for 2010-2020 indicates regular activity by this fishery of less than three vessels with occasional activity of three vessels recorded. However, three vessels have not been recorded in the OA since October 2017.
Pilbara Trap Managed Fishery (WA)	FishCube Data for 2010-2020 indicates regular activity by this fishery of less than three vessels in the OA. However, on two occasions in 2020 (May and July) the fishery recorded three active vessels.
Pilbara Crab Managed Fishery	FishCube Data indicates the fishery was only active on one occasion during the 2010-2020 period, in November 2016 with less than three vessels.
Mackerel Managed Fishery (WA).	FishCube Data for 2010-2020 indicates regular activity by this fishery of less than three vessels in the OA. August 2013 was the only occasion in the 2010-2020 period where the vessel count was at three active vessels.
Nickol Bay Prawn Managed Fishery	FishCube Data indicates limited fishing activity by this fishery in the OA with less than three vessels active on four occasions between 2010-2020 (July 2013, July 2014, July 2020 and September 2020).
West Australian Sea Cucumber Fishery	FishCube Data for 2010-2020 indicates no activity by the fishery in the OA since January 2019. Prior to January 2019 the fishery showed activity in the Spring/Summer periods of less than three vessels.

Migrations	Description
Onslow Prawn Managed Fishery	FishCube Data for 2010-2020 indicates no activity in the OA by the fishery since August 2011 with less than three vessels in the area.

Source: DPIRD (2021)

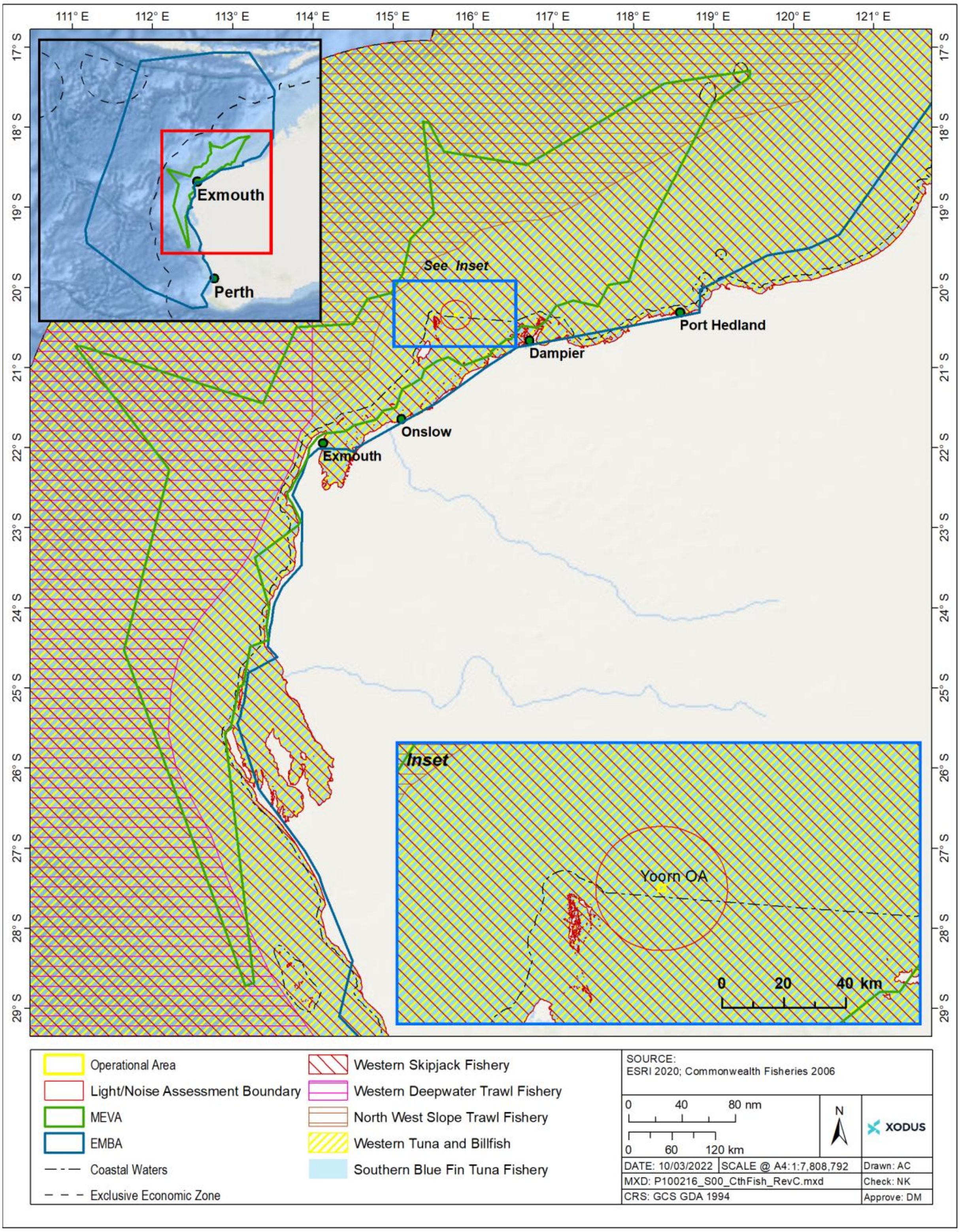

Figure 3-32: Commonwealth Fisheries within the EMBA and Operational Areas

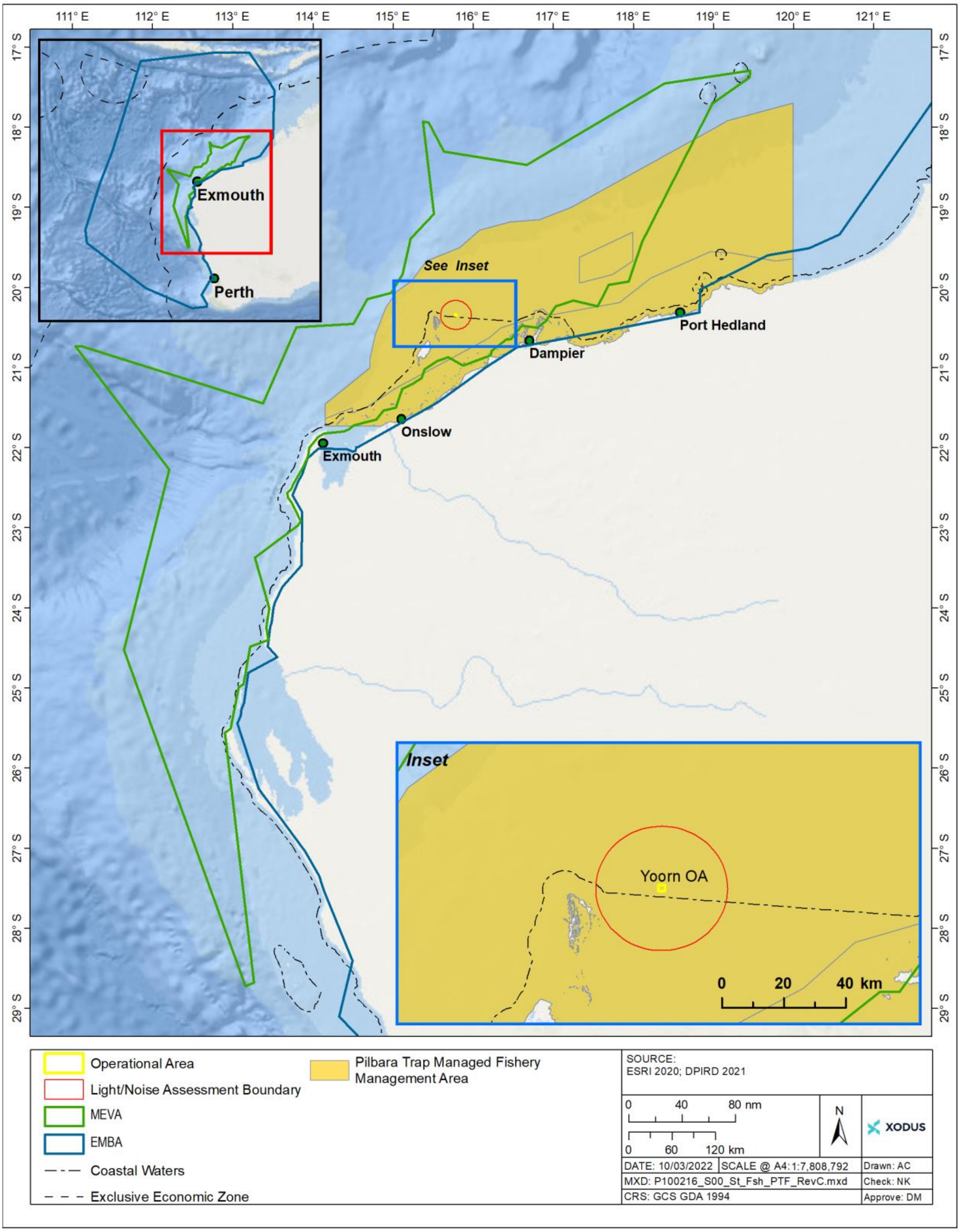

Figure 3-33: State and Commercial Pilbara Trap Managed Fishery Management Area within the EMBA and Operational Areas

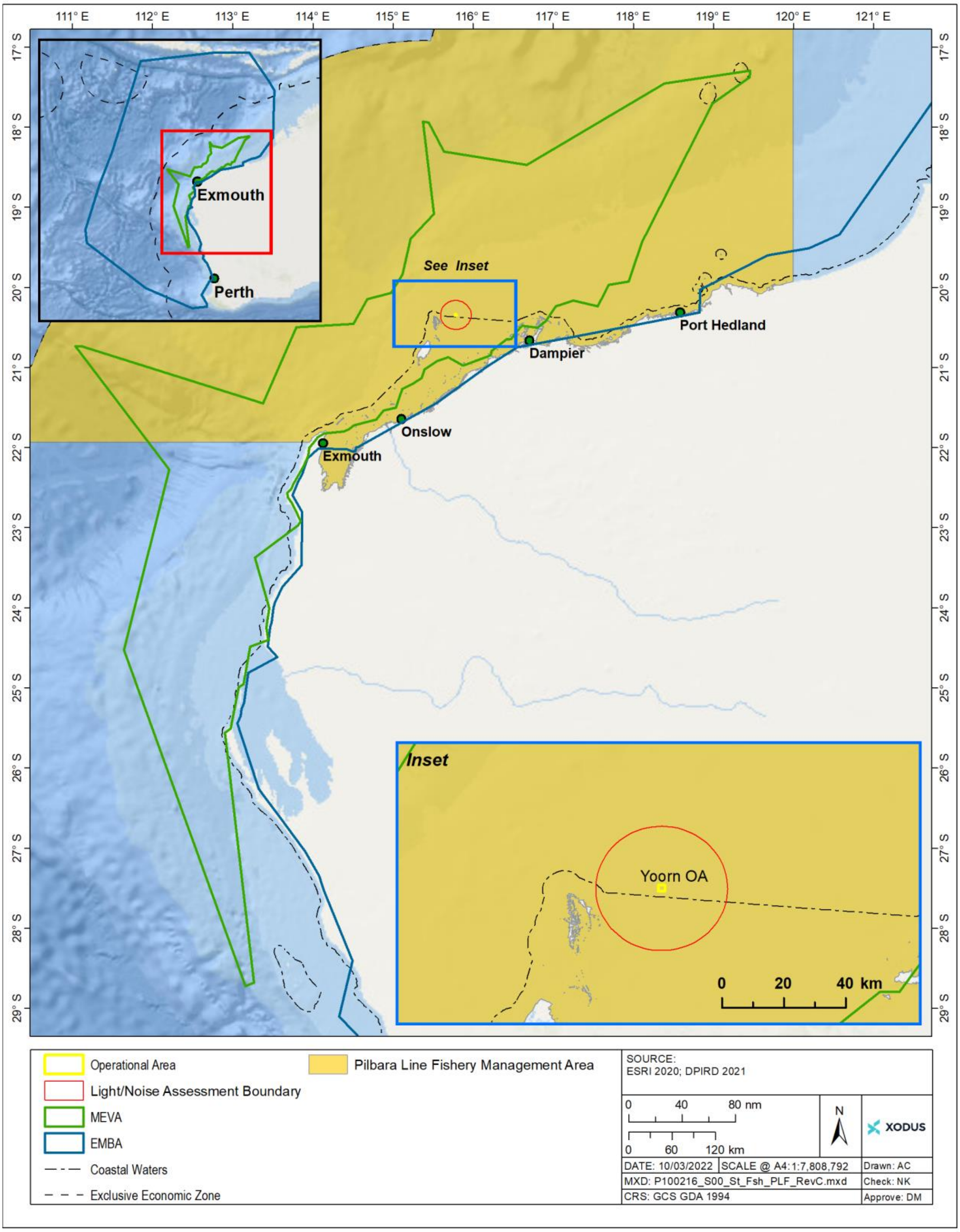

Figure 3-34: State Commercial Pilbara Line Fishery Management Area within the EMBA and Operational Areas

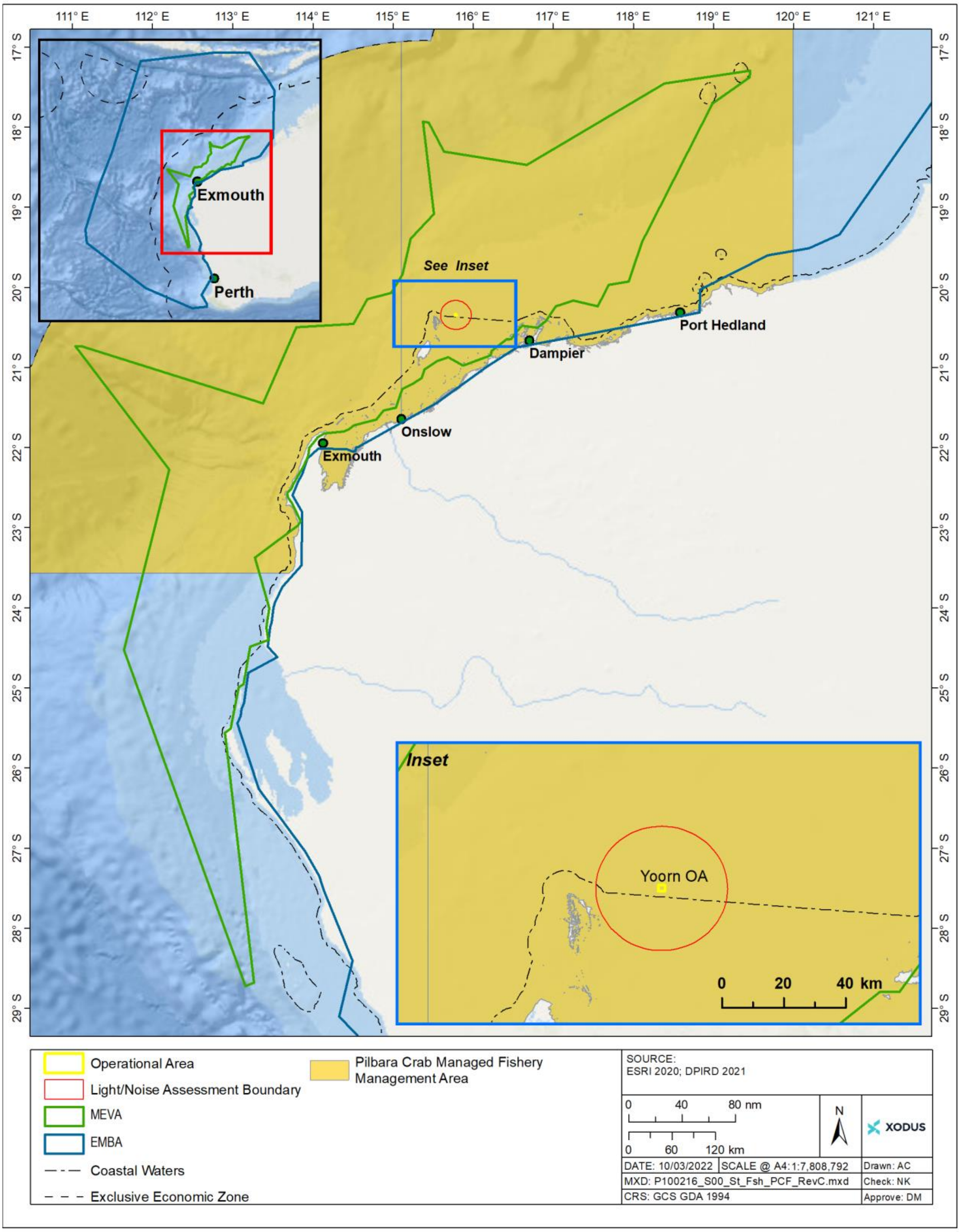

Figure 3-35: State Commercial Pilbara Crab Managed Fishery Management Area within the EMBA and Operational Areas

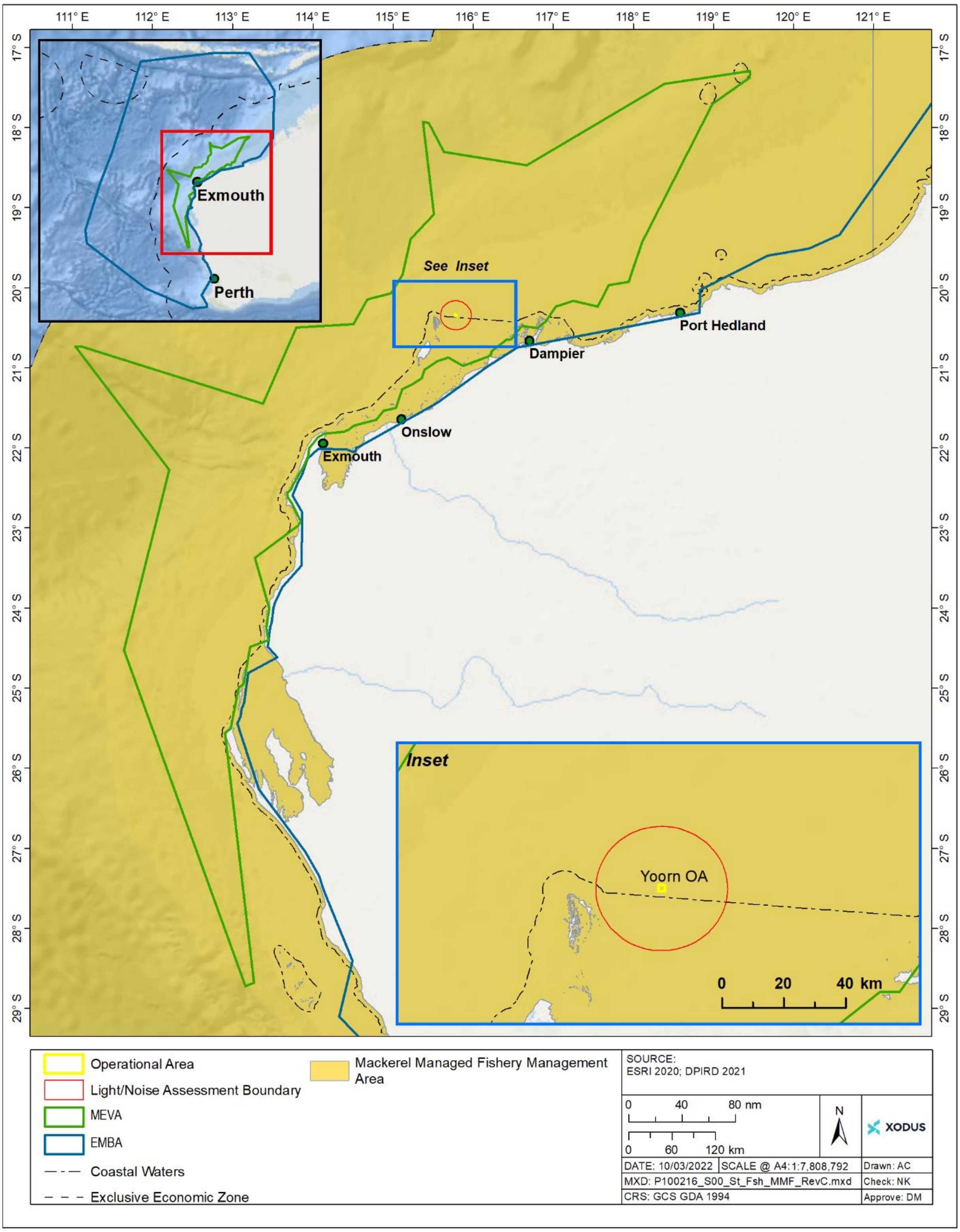

Figure 3-36: State Commercial Mackerel Managed Fishery Management Area within the EMBA and Operational Areas

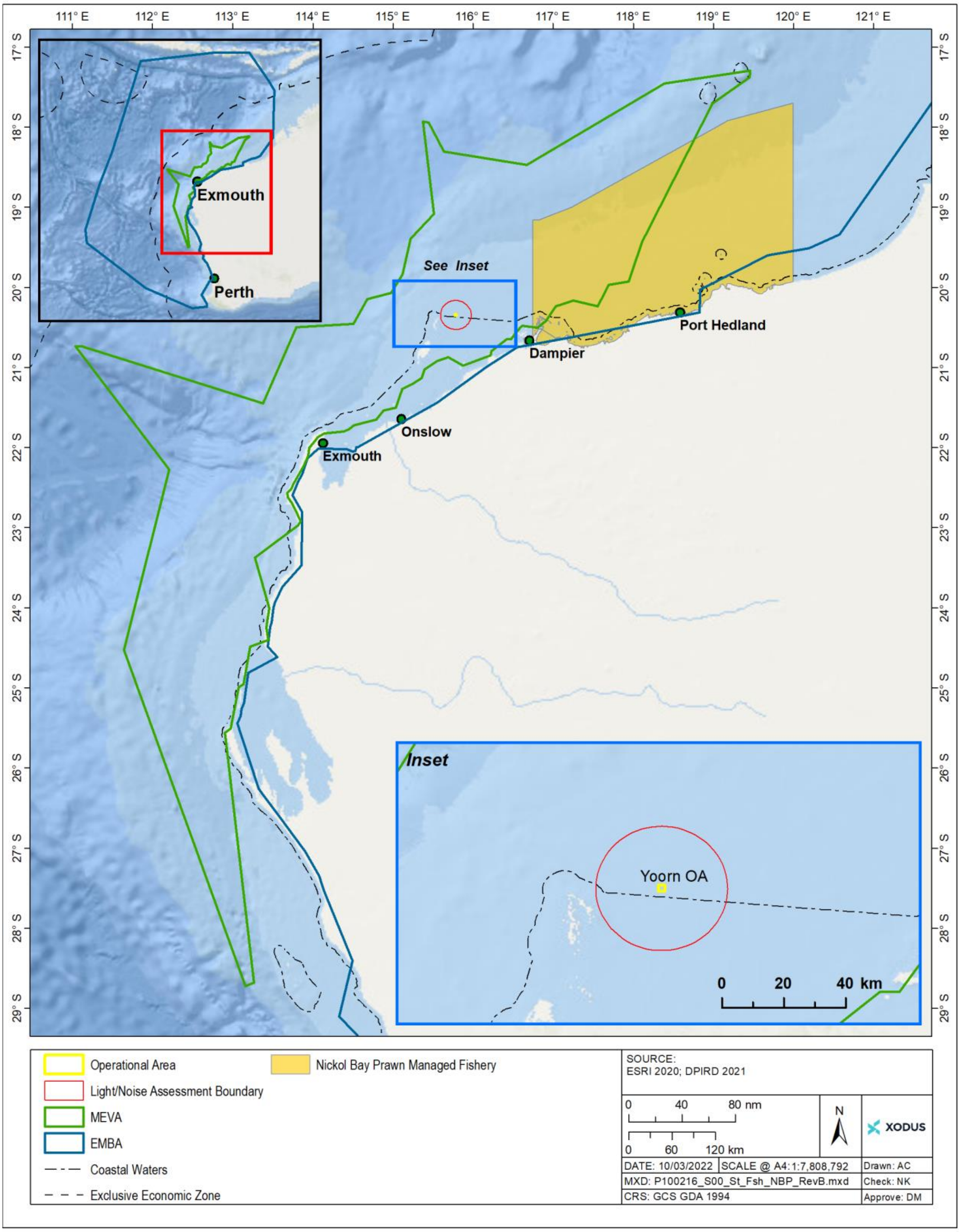

Figure 3-37: State Commercial Nickol Bay Prawn Managed Fishery Management Area within the EMBA and Operational Areas

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Table 3-12: State and Commonwealth Fisheries in the Operational Areas and Moderate Exposure Value Area (MEVA)

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
Commonwealth Managed Fisheries							
North West Slope Trawl Fishery Harte & Curtotti (2018) Patterson et al. (2018) Patterson et al. (2019)	+ Australian scampi (*Metanephrops australiensis*) + Smaller quantities of velvet scampi (*M. velutinus*) and Boschma's scampi (*M. boschmai*) are also harvested. + Mixed deep-water snappers are also a component of the catch.	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).	Deep water demersal trawling	Fishing occurs on the continental slope in water depths greater than 200 metres (m). Fishing effort has typically occurred along the slope offshore from the Pilbara region, in the Rowley Shoals area and north-east towards and around Scott Reef. Fishing occurs year-round. The number of vessels involved in the fishery has been one or two vessels each year since 2008/2009. The primary landing ports are Point Samson in WA and Darwin in the NT. Four fishing permits and two vessels were active in the fishery during the 2016-17 fishing season. Total catch in the 2016-17 fishing season was 57.8 tonnes (t) over 114 days of fishing effort. Fishing effort increased in the 2017-2018 season. Total catch was 79.7 t over 219 days.	X	✓	The fishery overlaps the MEVA. However, the fishing zone for North West Slope Trawl Fishery extends past the 200m depth and does not interact with the OA which is at a depth of approximately 45 m. Target species are most common on Globigerina ooze (deep sea muds rich in the shells of planktonic organisms) at depths of 420-500m.
Western Tuna and Billfish Fishery	Key target species: + Bigeye tuna + Yellowfin tuna + Broadbill swordfish + Striped marlin + Some albacore tuna are also taken.	The Western Tuna and Billfish Fishery covers the sea area west from the tip of Cape York in Queensland, around WA, to the border between Victoria and South Australia.	Primarily pelagic longline. Minor line (including handline, troll, rod and reel) and purse seine are also used.	Fishing occurs in both the AFZ and adjacent high seas of the Indian Ocean. Fishing occurs year-round. Over the last five years, fishing effort has been concentrated south of the operational areas. Fishing effort from 2014 to 2018 has been recorded from offshore Point Cloates (Exmouth) south along the WA coast to Augusta in the south-west of WA	✓	✓	The Western Tuna and Billfish Fishery operates in Australia's Exclusive Economic Zone and high seas of the Indian Ocean. In recent years, fishing effort has concentrated off south-west Western Australia, with occasional activity off South Australia.

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
				Since 2005, there has been fewer than five vessels active in the Western Tuna and Billfish Fishery each year, down from 50 active vessels in 2000 (ABARES Fishery Status Reports, 2020).			The management area overlaps with the OA and MEVA.
Western Skipjack Fishery Australian Fisheries Management Authority (2019)	Skipjack tuna (*Katsuwonus pelamis*)	The Western Skipjack Tuna Fishery is located in all Australia waters west of 142° 30′ 00°E, out to 200 nm from the coast (Patterson et al., 2019).	Purse seine Some pole and line	There has been no fishing effort in the Skipjack Tuna Fishery since the 2009 season, and in that season, Activity concentrated off South Australia (Patterson et al. 2019). Fishing in the Skipjack Tuna Fishery is opportunistic, and highly dependent on availability and the domestic cannery market. Currently, no domestic cannery has active contracts for skipjack tuna.	✓	✓	The fishery management area overlaps with the OA and MEVA, however no fishing activities have occurred in the region since 2019. Should the fishery recommence efforts in the future, fishing effort in the OA and wider MEVA will not occur as historical fishing effort was concentrated off southern Australia.
Southern Bluefin Tuna Fishery Patterson et al (2019)	Southern Bluefin tuna	Fishery includes all waters of Australia, out to 200 nm from the coast. Young fish move from spawning grounds in the north-east Indian Ocean into the Australian EEZ and southward along the Western Australian coast (Patterson et al., 2019).	Purse seine Pelagic longline	Most of the Australian catch has been taken by purse seine, targeting juvenile tuna in the Great Australian Bight. Australian domestic longliners operating along the east coast catch some tuna and recreational fishing has increased (Patterson et al. 2019). No current effort on North West Shelf (NWS), fishing Activity is concentrated in the Great Australian Bight and off South-east Australia (Patterson et al. 2019).	✓	✓	The management area of the fishery overlaps with the OA and MEVA. However, no overlap of fishing activities occurs within the OA or MEVA due to an overfished status. Given the current distribution of fishing effort and fishing methods utilised by the industry, fishing for Bluefin tuna is unlikely to occur in the OA.

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
Western Deepwater Trawl Fishery	Key target species: + orange roughy + oreos + boarfish + eteline and apsiline snapper + sea bream	The Western Deepwater Trawl Fishery (WDTF) operates in Commonwealth waters off the coast of WA between the western boundary of the Southern and Eastern Scalefish and Shark Fishery in the south (115°08'E) and the western boundary of the North West Slope Trawl Fishery (NWSTF) in the north (114°E). There have been recent changes to the boundary of this fishery to more closely align with the 200 m isobath.	Demersal trawl	Total fishing effort was comparatively low between 2005–06 and 2016–17. Only three vessels were active in 2017–18, trawl-hours increased markedly to just over 1,100 hours. Total catch had been relatively low in recent years, consisting mostly of deepwater bugs, with minimal catch of finfish. However, catches increased substantially in 2017–18, consisting mostly of ruby snapper, deepwater bugs and mixed fish.	X	✓	No overlap of fishing activities with the OA. The fishery operates within the MEVA.
State Managed Fisheries							
South West Coast Salmon Managed Fishery	WA Salmon (*Arripis truttaceus*)	The South West Coast Salmon Managed Fishery operates on various beaches south of the metropolitan area and includes all Western Australian waters north of Cape Beaufort except Geographe Bay. This	Insufficient information	Insufficient information	X	✓	No fishing takes place north of the Perth metropolitan area, despite the managed fishery boundary extending to Cape Beaufort (WA/NT border).

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
		fishery uses beach seine nets to take western Australian salmon (Arripis truttaceus). No fishing takes place north of the Perth metropolitan area, despite the managed fishery boundary extending to Cape Beaufort (Western Australia/Northern Territory (NT) border).					
Pilbara Trap Managed Fishery (PTMF)	+ Bluespotted emperor (*Lethrinus punctulatus*) + Red emperor (*Lutjanus sebae*) + Rankin cod (*Epinephelus multinotatus*) + Goldband snapper (*Pristipomoides multidens*) + Other demersal snapper, emperor, cod and grouper species are also caught.	The Pilbara Trap Managed Fishery lies north of latitude 21°44'S and between longitudes 114°9.6'E and 120°00'E on the landward side of a boundary approximating the 200 m isobath and seaward of a line generally following the 30 m isobath.	Demersal fish traps	In the 2018 season, there were six licenses in the Pilbara Trap Fishery, held between two operators. In 2018, the total catch for the PTMF was 563 t, making up 21% of the total catch by the PDSF (Newman et al 2019). Fishing occurs year-round.	✓	✓	Fishing Activity and target species occur in the OA and MEVA. FishCube data for the 2010-2020 period indicates regular activity of less than three vessels in the OA. On two occasions in 2020 (May and July) the fishery recorded three active vessels.

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
Pilbara Line Managed Fishery (PLMF)	+ Goldband snapper (*Pristipomoides multidens*) + Ruby snapper (*Etelis carbunculus*) + Other demersal snapper, emperor, cod and grouper species are also caught.	The PLMF fishing boat licensees are permitted to operate anywhere within "Pilbara waters", bounded by a line commencing at the intersection of 21°56'S latitude and the high water mark on the western side of the North West Cape on the mainland of WA; west along the parallel to the intersection of 21°56'S latitude and the boundary of the AFZ and north to longitude 120°E.	Demersal long line	In the 2018 season there are nine individual licences in the Pilbara Line Fishery, held by seven operators. The total catch in 2018 for the PLMF was 93 t, making up 3% of the total catch by the PDSF (Newman et al 2019). Fishing occurs year-round.	✓	✓	FishCube Data for 2010-2020 indicates tregular activity by this fishery of less than three vessels with occasional activity of three vessels recorded. However, three vessels have not been recorded in the OA since October 2017.
Pilbara Fish Trawl (Interim) Managed Fishery (PFTIMF)	Including: + goldband snapper (*Pristipomoides multidens*), + red emperor (*Lutjanus sebae*), + bluespotted emperor (*Lethrinus punctulatus*), + crimson snapper (*Lutjanus erythropterus*),	The Pilbara Fish Trawl (Interim) Managed Fishery is situated in the Pilbara region in the north west of Australia. It occupies the waters north of latitude 21°35'S and between longitudes 114°9'36"E and 120°E. The Fishery is seaward of the 50 misobath and landward of the 200 m isobath. The Fishery consists of two zones; Zone 1 in	Demersal Trawl	The trawl fishery lands the largest component of the catch of demersal finfish in the Pilbara (and North Coast Bioregion) comprising more than 50 scalefish species.	X	✓	Target species occur in the OA and MEVA. FishCube data indicates the Pilbara Fish Trawl Fishery has had no activity in the OA between 2010-2020.

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
	+ saddletail snapper (*Lutjanus malabaricus*), + Rankin cod (*Epinephelus multinotatus*), + brownstripe snapper (*Lutjanus vitta*), + rosy threadfin bream (*Nemipterus furcosus*), + spangled emperor (*Lethrinus nebulosus*) and + frypan Moses' snapper (*Argyrops Lutjanusspinifer russelli*)	the south west of the Fishery (whichis closed to trawling) andZone 2 in the North, which consists of six management areas.					
Gascoyne Demersal Scalefish Managed Fishery (Jackson, et al. 2019)	+ Pink snapper (*Chrysophrys auratus*) and goldband snapper (*Pristipomoides multidens*) + Other demersal species caught include tropical snappers,	The Gascoyne Demersal Scalefish Managed Fishery operates in the waters of the Indian Ocean and Shark Bay between latitudes 23°07'30" S and 26°30'S. Vessels are not permitted to fish in inner Shark Bay.	Mechanised handlines	The fishery principally operates in depths of >20 m water in the Gascoyne Coast Bioregion. In 2017/18 the total commercial catch reported by the GDSMF was 210 t comprising 45 tonnes of pink snapper, 96 of goldband snapper and 69 of other mixed species.	X	✓	No overlap of fishing activities within the OA. The fishery occurs in the MEVA.

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
	emperors, cods, mulloway and trevallies.	Commercial vessels in these waters historically focused on the oceanic stock of pink snapper during the winter months. The fishery licensed vessels fish throughout the year with mechanised handlines and, in addition to pink snapper, catch a range of other demersal species.					
Mackerel Managed Fishery (Area 2 – Pilbara) Lewis and Brand-Gardner (2017) Mackie et al. (2010)	+ Spanish mackerel (*Scomberomorus commerson*) + Grey mackerel (also called broad-barred Spanish mackerel), school mackerel, spotted mackerel, shark mackerel and + other pelagic species are also caught as bycatch species.	The Mackerel Managed Fishery licence area extends from Cape Leeuwin in the south west of WA to the WA/NT border. Management Area 1 of the fishery (Kimberley sector) extends from 121º E to the WA/NT border. Management Area 2 of the fishery (Pilbara sector) extends from 114° E near the North West Cape to 121° E. Management Area 3 of the fishery (Gascoyne/West Coast	Primarily surface or mid-water trolling by line. Jigging methods are also used.	The fishery operates year-round, however, most fishing effort occurs from April/May to October/November. In the Pilbara sector, approximately 65% of effort has historically occurred from July to August. The commercial catch of Spanish mackerel from all sectors of the fishery has been 270-330 per year since 2006.	✓	✓	FishCube Data for 2010-2020 indicates regular activity by this fishery of less than three vessels in the OA. August 2013 was the only occasion in the 2010-2020 period where the vessel count was at three active vessels.

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
		sector) extends south from 114° E to Cape Leeuwin.					
Exmouth Gulf Prawn Managed Fishery	+ Western king prawns (*Penaeus latisulcatus*), + brown tiger prawns (*Penaeus esculentus*), + endeavour prawns (*Metapenaeus spp*.) and + banana prawns (*Penaeus merguiensis*).	Sheltered waters of Exmouth Gulf Essentially the western half of the Exmouth Gulf (eastern part is a nursery ground). The Muiron Islands and Point Murat provide the western boundary; Serrurier Island provides the northern limit	Low opening otter trawls	The total landings of prawns in 2018 were 880 tonnes, comprising 392 of brown tiger prawns, 174 of western king prawns and 313 of blue endeavour prawns (Kangas, et al. 2019a).	X	✓	Fishing activity occurs within the Exmouth Gulf. No overlap of fishing activities with the OA.
Nickol Bay Prawn Managed Fishery (NBPMF)	Primarily targets banana prawns (*Penaeus merguiensis*)	Operates along the western part of the North-West Shelf in coastal shallow waters The boundaries of the NBPMF are 'all the waters of the Indian Ocean and Nickol Bay between 116°45' east longitude and 120° east longitude on the landward side of the 200 m isobath'. The NBPMF incorporates the Nickol Bay, Extended Nickol Bay, Depuch and De Grey	Otter trawl	The total landings of major penaeids for the 2018 season were 81 t, comprised of 66 t of banana prawns, 13 t of brown tiger prawns and 1.5 t of blue endeavour prawns. Negligible western king prawns (Kangas et al. 2019b)	✓	✓	FishCube Data indicates limited fishing activity by this fishery in the OA with less than three vessels active on four occasions between 2010-2020.

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
		size managed fish grounds					
Onslow Prawn Managed Fishery (OPMF)	+ Brown tiger prawns (*Penaeus esculentus*), + Banana prawns (*Penaeus merguiensis*).	The boundaries of the OPMF are 'all the Western Australian waters between the Exmouth Prawn Fishery and the Nickol Bay prawn fishery east of 114º39.9' on the landward side of the 200 m depth isobath'.	Trawl	The total landings in 2018 was less than 60 t (Kangas et al. 2019b)	✓	✓	FishCube Data for 2010-2020 indicates no activity in the OA by the fishery since August 2011 with less than three vessels in the area.
Specimen Shell Managed Fishery	Various shells	The fishing area includes all Western Australian waters between the high-water mark and the 200 m isobath.	Hand collection, wading, diving in shallow coastal waters. One licence exemption permits the use of ROV.	The main method of specimen shell collection is by hand, by a small group of divers operating from small boats in shallow coastal waters or by wading along coastal beaches below the high-water mark. A current Exemption permits the use of a remote-controlled underwater vehicle at depths of up to 300 m. This is a limited entry fishery with 23 active licences in 2016. A maximum of two divers are allowed in the water per licence at any one time and specimens may only be collected by hand. Remotely operated vehicles were limited to one per license in 2016.	✓	✓	The FishCube data shows the fishery has not been active in the Yoorn OA since 2016 with less than 3 licences recorded. Water depths in the OA are not conducive for this fishery. Fishing generally occurs in shallower waters.
Marine Aquarium Fish Managed Fishery (MAFMF)	Various species of fish, coral, algae, seagrass and invertebrates	The MAFMF can operate in all State waters (between the	Hand collection, diving	The fishery is typically more active in waters south of Broome with higher levels of effort around the Capes region, Perth, Geraldton,	X	✓	Activities in the OA are unlikely due to the depth and the dive-based method of collection.

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
		NT border and South Australian border).		Exmouth, Dampier and Broome (Gaughan et al., 2019).			FishCube data shows no fishing effort within the OA.
West Coast Deep Sea Crustacean Managed Fishery	Crystal crab (*Chaceon albus*)	The boundaries of this fishery include all the waters lying north of latitude 34° 24' S (Cape Leeuwin) and west of the NT border on the seaward side of the 150m isobath out to the extent of the AFZ.	Fish traps	Fishing effort and the target species occurs on the west and south coasts of WA, primarily in water depths of 400–900 m.	X	✓	No fishing Activity or target species in the OA.
Shark Bay Prawn and Scallop Managed Fishery (Kangas et al 2019c)	+ Western king prawns (*Penaeus latisulcatus*), + brown tiger prawns (*Penaeus esculentus*) and + lesser quantities of endeavour (*Metapenaeus endeavouri*) and coral prawns (*Metapenaeopsis sp*).	Within inner Shark Bay	Trawl nets	The total landings of target prawns in Shark Bay in 2018 were 1,091 t, with 652 t of western king prawn, 438 t of brown tiger prawn and 1 t of endeavour prawn.	X	✓	No fishing Activity or target species in the OA.
Shark Bay Crab Managed Fishery (WAFIC 2020)	Blue swimmer crab (*Portunus armatus*)	Waters of Shark Bay north of Cape Inscription, to Bernier and Dorre Islands and Quobba Point. In addition, two fishers with long-standing	Trawl and trap	There are five crab trap permits with combined total of 1500 units of entitlement (currently valued at one trap each) in Shark Bay under the Shark Bay Crab Fishery (Interim) Management Plan 2005 which sets the number of traps that can be fished, fishery specific spatial closures, gear specifications and other controls.	X	✓	No fishing Activity or target species in the OA

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
		histories of trapping crabs in Shark Bay are permitted to fish in the waters of Shark Bay south of Cape Inscription.					
Shark Bay Seine and Mesh Net (WAFIC 2020)	+ whiting (mostly yellowfin with some goldenline), + sea mullet (*Mugil cephalus*), + tailor (*Pomatomus saltatrix*) and + western yellowfin bream (*Acanthopagrus morrisoni*)	Operates in the waters of the Eastern Gulf, Denham Sound and Freycinet Estuary in inner Shark Bay.	Uses a combination of beach seine and mesh net gears	Managed by limited entry, gear restrictions (eg. vessel size, net length and mesh size) and permanently closed waters (eg. Hamelin Pool, Big Lagoon, Denham foreshore).	X	✓	No fishing Activity or target species in the OA.
West Coast Rock Lobster Fishery	Western rock lobster (*Panulirus cygnus*)	West coast of Western Australia between Shark Bay and Cape Leeuwin.	Pot-based	The total commercial landings of western rock lobster in 2018 from the WCRLMF were 6,400 t plus 9.5 t of “additional” domestic quota from the Local Lobster Program.	X	✓	No fishing Activity or target species in the OA.
Abalone Managed Fishery	+ Greenlip abalone (*Haliotis laevigata*) + Brownlip abalone (*H. conicopora*)	Shallow coastal waters off the south-west and south coasts of Western Australia Covers all Western Australian coastal waters, which are divided into eight management areas. Commercial fishing for	Dive and wade	In 2018 the total commercial catch was 48 t whole weight, 1 t less than the catch in each of the last 2 seasons and only 71% of the 68 t whole weight	X	✓	No fishing Activity or target species in the OA.

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
		greenlip/brownlip abalone is managed in three separate areas.					
Octopus Interim Managed Fishery (Hart et al 2019)	Octopus (*CF. Tetricus*), occasional bycatch of (*O. Ornatus*) and (*O. Cyaneain*) in the northern parts of the fishery	Zone 1 fishery is from 26° 30'S and 30° 00'S	Lines and pots	In 2018 the total commercial octopus catch was 314 t live weight, which was 22% higher than the 2017 catch of 257 t and represents the highest catch recorded	X	✓	No fishing Activity or target species in the OA.
Abrolhos Islands and Mid-West Trawl Managed Fishery	Saucer scallops (*Ylistrum balloti*), with a small component targeting the western king prawn (*Penaeus latisulcatus*)	All the waters of the Indian Ocean adjacent to Western Australia between 27°51´ south latitude and 29°03´south latitude on the landward side of the 200 m isobath'.	Low opening otter trawl systems.	Vessel counts range from 15 in 2010 to 5 in 2019. The fleet are restricted to very small areas of higher scallop abundance (WAFIC 2020).	X	✓	No fishing Activity or target species in the OA.
West Coast Demersal Scalefish (Interim Managed Fishery) (WAFIC 2020)	Key species targeted: Pink snapper (*Pagrus auratus*), Western Australian Dhufish (*Glaucosoma hebraicum*) and Baldchin Groper (*Choerodon rubescens*) but up to 100 species caught.	Encompasses the waters of the Indian Ocean just south of Shark Bay (at 26 30'S) to just east of Augusta (at 115 30'E) and extends seaward to the 200nm boundary of the Australian Fishing Zone (AFZ) (Fairclough et al 2015).	Handline and Dropline	Access to the fishery is restricted to 59 interim managed permit holders.	X	✓	No fishing Activity or target species in the OA.
West Coast Demersal Gillnet and Demersal Longline Interim	Gummy shark (*Mustelus antarcticus*), dusky shark (*Carcharhinus*	Operates between 26° and 33° S.	Demersal gillnets and demersal longline (not widely used)	Insufficient information	X	✓	No fishing Activity or target species in the OA.

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
Managed Fishery	*obscurus*), whiskery shark (*Furgaleus macki*) and sandbar shark (*C. plumbeus*)						
Pilbara Crab Managed Fishery (Johnston et al 2019)	Blue swimmer (*Portunus armatus*), Mud Crab (*Scylla spp*)	The majority of the commercially and recreationally-fished stocks are concentrated in the coastal embayments and estuaries between Geographe Bay in the south west and Nickol Bay in the north. Crabbing activity along the Pilbara coast is centred largely on the inshore waters from Onslow through to Port Hedland, with most commercial and recreational activity occurring in and around Nickol Bay.	Commercial crab pots Recreational fishers use drop nets or scoop nets or diving	In 2018 the total commercial catch was 35 t.	✓	✓	FishCube Data indicates the fishery was only active on one occasion during the 2010-2020 period, in November 2016 with less than three active vessels.
West Australian Sea Cucumber Fishery (DPIRD, 2018)	Sandfish (*H. scabra*), Redfish (*A. echinites*)	While the fishery is permitted to operate throughout WA waters, with the exception of several permanently-closed areas, fishing to date has only occurred in the NCB, from Exmouth Gulf to the Northern Territory	The West Australian Sea Cucumber Fishery is a hand-harvest fishery, with animals caught principally by diving, and a smaller amount (less than 5%) by wading.	Sea cucumbers in WA are currently targeted primarily by the commercial fishing sector, with the recreational and customary harvest considered to be negligible. The total annual catch of sea cucumbers in the WASCF has ranged between 0 (due to the rotational harvesting approach) and 252 tonnes live weight in the last 10 years. The fishery is managed through a range of input	X	✓	The fishery is not active within the OA with FishCube data fro 2010-2020 showing no activity in the OA since January 2019. Activity typically occurs in coastal areas and Yoorn OA is 68.12 km from coast.

Fishery	Key Target / Indicator Species	Licence Area Description	Gear Types	Summary of Fishing Activities	Yoorn OA	MEVA	Potential for interaction in the Operational Areas
		border. This fishery is primarily a "pulse" fishing operation, whereby extremely remote areas of the Kimberley with sandfish occurring in commercial densities are generally accessed two or three times a year for approximately two to three weeks per fishing trip. Other areas are targeted less frequently. Redfish stocks have typically been fished in the Pilbara only for a period of two months every third year.		controls including limited entry, a maximum number of divers, spatial closures and gear restrictions (that includes permission of only hand-harvest methods). In addition to sandfish and redfish, six other species are permitted to be retained and records show minimal catches.			
Hermit Crab Fishery			Insufficient information	Insufficient information	X	✓	The fishery is not active within the OA. Activity occurs in coastal areas and Yoorn OA is 68.12 km from coast.

3.2.4.3 Recreational Fisheries

The OA is located within the North Coast Bioregion, which is a focal point for winter recreational fishing and is a key component of many tourist visits. The Dampier Archipelago, Lowendal Islands and Montebello Islands are popular offshore recreational fishing locations.

The predominant target species include the tropical species such as tropical emperors, mangrove jack, trevallies, sooty grunter, threadfin, cods and catfish, and invertebrate species including blue swimmer crabs, mud crabs and squid. The offshore islands, coral reefs and continental shelf waters contain other species such as tropical snappers, cod, mackerel, sharks and tunas for recreational fishing opportunities (Gaughan, D.J. and Santoro, K. (eds). 2020). The OA does not overlap any of these mentioned fishing locations.

The closest coastline to the OA is Trimouille Island (part of the Montebello Islands group), which is approximately 20 km from the OA, with next closest being Lowendal Island (approximately 40 km).

Recreational fishing activities are primarily based out of the Montebello Islands. Given the distance to the Yoorn-1 well and its water depths (approximately 45 m), recreational fishing activities in the OA are not expected to occur.

3.2.4.4 Petroleum Industry

The Santos operated Campbell platform is the closest petroleum facility, at approximately 8 km from the OA (**Figure 3-38**), followed by Apache's Sinbad platform (approximately 16 km from the OA).

In the EMBA, there are many exploration and production permits and leases throughout the Western Australian and Commonwealth waters which include current exploration and production activities including platforms, floating, production, storage and offloading (FPSOs), pipelines, drilling and potentially seismic activities. There are also onshore production facilities on Varanus Island and Barrow Islands.

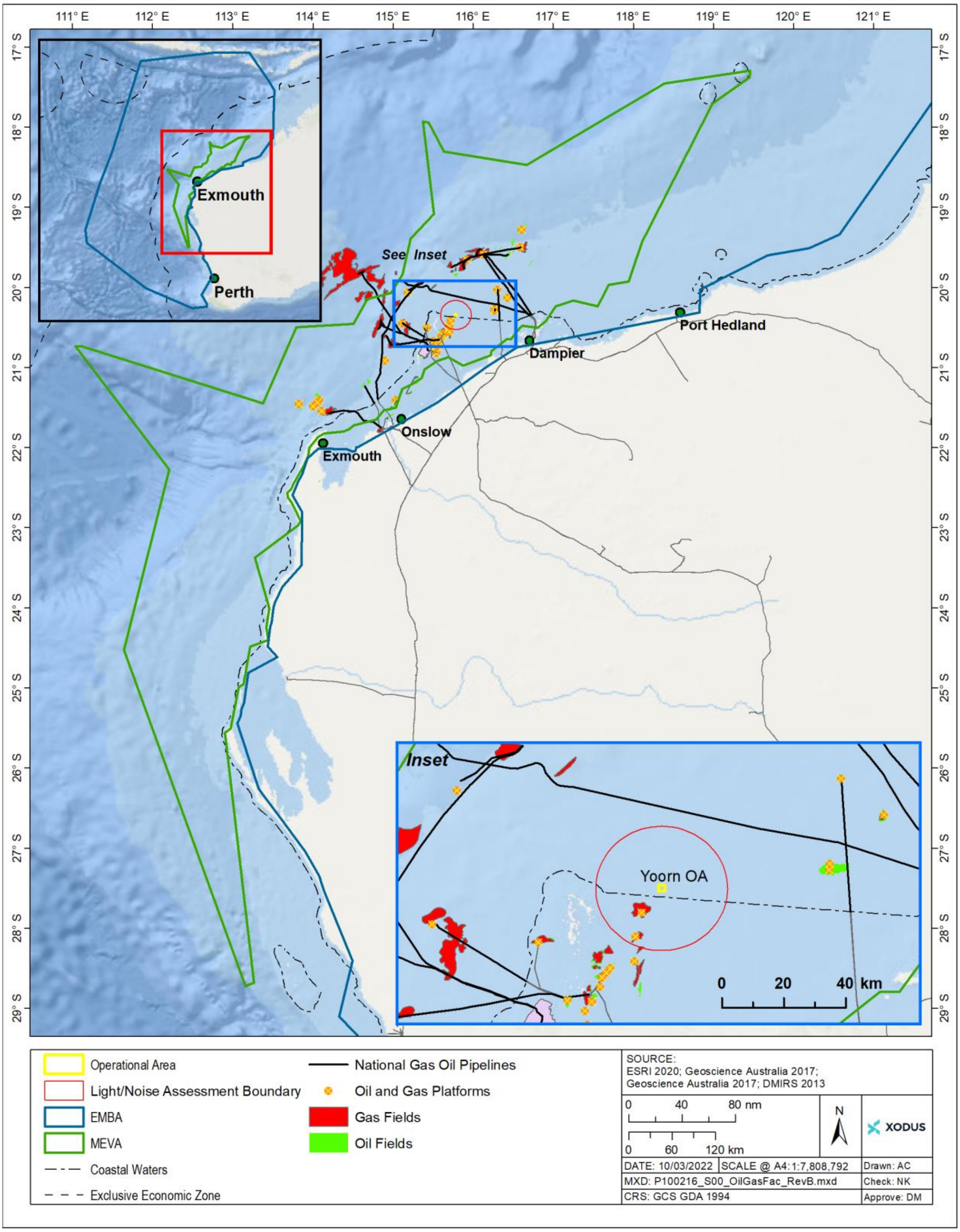

Figure 3-38: Existing Petroleum Infrastructure within the EMBA

3.2.4.5 Commercial Shipping

Large commercial vessels mostly associated with the oil and gas industry and Western Australian major ports move through the OA in transit.

The Australian Maritime Safety Authority (AMSA) has established a network of shipping fairways off the north-west coast of Australia to manage traffic patterns (AMSA 2019). AMSA shipping routes within and in close proximity to the OA and the EMBA are shown in **Figure 3-39**.

There is one recognised shipping fairway in the OA for vessels transiting in and out of Barrow Island.

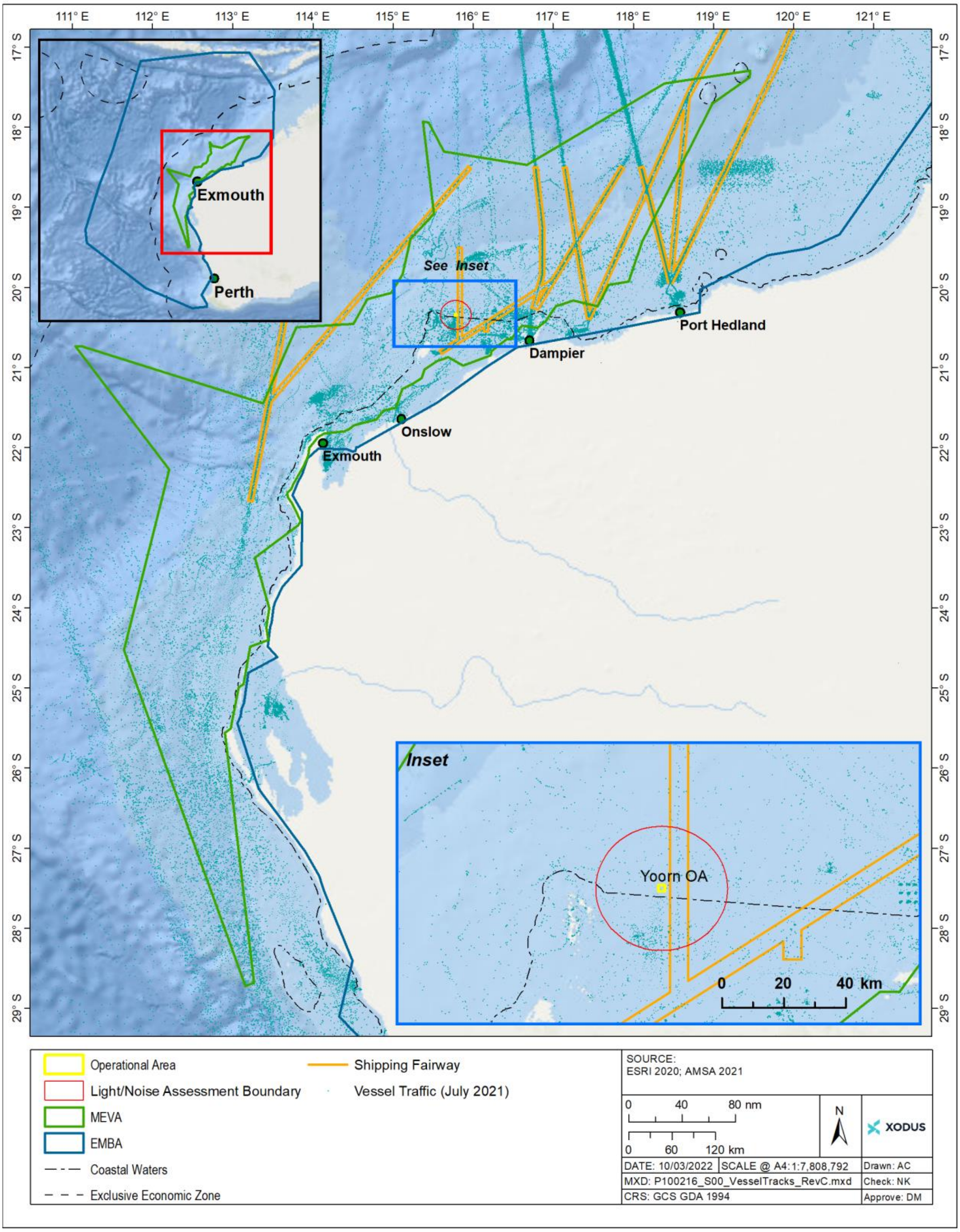

Figure 3-39: AMSA ship locations and shipping routes within and close to the EMBA

3.2.4.6 Tourism

Tourism activities occur within the EMBA in areas such as Ningaloo Marine Park, North West Cape, Montebello Islands and the Dampier Archipelago. Popular water-based activities that may occur within the EMBA include fishing, swimming, snorkelling/diving, surfing/windsurfing/kiting and boating.

Seasonal nature-based tourism such as humpback whale watching, whale shark encounters and tours of turtle hatching mainly occurring around Ningaloo Reef and Cape Range National Park. Seasonal aggregations of whale sharks, manta rays, sea turtles and whales, as well as the annual mass spawning of coral, attract large numbers of visitors to Ningaloo each year (CALM 2005).

Given the water depths of the OAs and the lack of notable seabed features, there is unlikely to be any tourism-based activities in the surrounding waters of the OAs.

Popular water-based activities that may occur in the MEVA and EMBA include fishing, swimming, snorkelling, diving, surfing, windsurfing, kiting and boating. Within the MEVA these activities are concentrated in the vicinity of the population centres such as Exmouth, Dampier, Onslow, Point Samson and Port Hedland.

The nearest area where recreational activities are likely to occur is the Montebello Islands, which are located approximately 20 km from the OA.

Given the water depths of the OA (45 m) and the lack of notable seabed features, there is unlikely to be any tourism-based activities in the surrounding waters of the OA, however there could be seasonal tourism such as whale watching and fishing charters.

3.2.5 Windows of Sensitivity

Timing of peak activity for threatened species and other relevant, significant sensitivities is given in **Table 3-13**.

Table 3-13: Windows of Sensitivity in the Vicinity of the EMBA

Receptors (critical life cycle stages)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
All shoreline habitats												
Coral (spawning periods)												
Macroalgae	growing				shedding fronds				growing			
Other benthic and terrestrial habitats												
Fish/Sharks and fisheries species												
Whale sharks			Aggregations at Ningaloo Coast									
Fisheries species spawning/aggregation times [1]												
Marine Mammals												
Dugong (breeding)	breeding								breeding			
Australian sea lion (breeding)	Breeding and caring for young											
Humpback whale (migration)						northern			southern			
Blue whale (migration)					northern						southern	
Marine Reptiles												
Hawksbill turtle's resident adult and juveniles[2]	Widespread throughout NWS waters, highest density of adults and juveniles over hard bottom habitat (coral reef, rocky reef, pipelines, etc.)											
Hawksbill turtle (mating aggregations[2])												
Hawksbill turtle (nesting and internesting[2])												
Hawksbill turtle (hatching[1])												

Receptors (critical life cycle stages)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Flatback turtles (resident adult and juveniles[2])	Widespread throughout NWS waters, increased density over soft bottom habitat 10 – 60m deep, post hatchling age classes and juveniles spread across shelf waters											
Flatback turtle (mating aggregations[2])												
Flatback turtle (nesting and internesting[2])												
Flatback turtle (hatching[2])												
Flatback turtle (nesting[2])												
Green turtles (resident adult and juveniles[2])	Widespread throughout the NWS waters, highest density associated with seagrass beds and macro algae communities, high density juveniles in shallow waters off beaches, amongst mangroves and in creeks											
Green turtle (mating aggregations[2])												
Green turtle nesting and internesting[2])												
Green turtle (hatching[2])												
Loggerhead turtles (resident adult and juveniles[2])	Widespread throughout the NWS waters, increased density associated with soft bottom habitat supporting their bivalve food source, juveniles associated with nearshore reef habitat											
Loggerhead turtle (mating aggregations[2])												
Loggerhead turtle (nesting and internesting[2])												
Loggerhead turtle (hatching[2])												
Leatherback turtles	Can occur at low density across the NWS year-round											
Olive Ridley turtle	Can occur at low density across the NWS year-round											
Short-nosed seasnake	Can occur at low density across the NWS year-round											
Seabirds												

Receptors (critical life cycle stages)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Terns, shearwaters, petrels (nesting)												
Commercial Managed Fisheries												
Oil and gas												
Shipping												
Tourism/ recreational												

KEY / NOTES		
	Peak activity, presence reliable and predictable	[1] Information provided from Department of Fisheries consultation
	Lower level of abundance/activity/presence	[2] Information provided by K. Pendoley
	Very low activity/presence	
	Activity can occur throughout year	
	Proposed timing of activity	

4 Stakeholder Consultation

OPGGS(E)R 2009 Requirements
Regulation 9AB
If the Regulator's provisional decision under regulation 9AA is that the environment plan includes material apparently addressing all the provisions of Division 2.3 (Contents of an environment plan), the Regulator must publish on the Regulator's website as soon as practicable: (a) the plan with the sensitive information part removed (b) the name of the titleholder who submitted the plan (c) a description of the activity or stage of the activity to which the plan relates (d) the location of the activity (e) a link or other reference to the place where the accepted offshore project proposal (if any) is published (f) details of the titleholder's nominated liaison person for the activity. Note: If the plan is a seismic or exploratory drilling environment plan, the Regulator must also publish an invitation for public comment on the plan: see regulation 11B.
Regulation 16
16 The environment plan must contain the following: (b) a report on all consultations under regulation 11 A of any relevant person by the titleholder, that contains: (i) a summary of each response made by a relevant person (ii) an assessment of the merits of any objection or claim about the adverse impact of each activity to which the environment plan relates (iii) a statement of the titleholder's response, or proposed response, if any, to each objection or claim (iv) a copy of the full text of any response by a relevant person.

4.1 Summary

Santos proposes to drill an exploration well in the WA-499-P petroleum exploration permit. The well location is in Commonwealth waters located approximately 102 kilometres offshore from Dampier in Western Australia.

Santos is familiar with stakeholders and other users of the marine environment in this region given recent consultation in relation to the Dancer Exploration Drilling Environment Plan and Commonwealth Waters Vessel Based Activity (VBA) Environment Plan. Santos has also been active across these areas for many years including the Reindeer gas field and associated wellhead platform since the commencement of the Devil Creek Gas Plant and the Varanus Island Gas Plant operations in 2011 and the late 1980s respectively.

Stakeholders (**Table 4-1**) were informed of activities covered in this EP via several channels of engagement commencing in July 2021, including:

+ WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Package distributed to identified stakeholders on 21 July 2021
+ WA-499-P, WA-208-P and WA-546-P Exploration Drilling Consultation Package for Commercial Fishers distributed to identified fishing licence holders on 22 July 2021
+ Santos' Quarterly Consultation Update issued in July 2021 and distributed to a broad group of stakeholders including many identified in **Table 4-1**
+ WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Package Update distributed to identified stakeholders on 26 October 2021
+ WA-499-P, WA-208-P and WA-546-P Exploration Drilling Consultation Package Update distributed to identified fishing licence holders on 22 July 2021.

Stakeholders were also informed of changes to the original Exploration Drilling program, and changes to the estimated activity duration respectively in March 2022 via Santos distributing the following updates::

+ Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters,
+ Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters.

Based on Santos' experience with previous drilling Environment Plans and from subsequent stakeholder feedback and regulator discussions, the primary stakeholder issues of concern for this activity are:

+ Interaction with other Marine users and commercial fishers (addressed in **Section 3.2.4**).

Santos has considered all stakeholder responses and assessed the merits of all objections and claims about the potential impact of the proposed activity. The process adopted to assess these claims is outlined in **Section 4.4**. A summary of Santos' response statements to the objections and claims is provided in **Table 4 2**.

Santos considers that consultation with relevant stakeholders has been adequate to inform the development of this EP. Notwithstanding this, Santos recognises the importance of ongoing stakeholder consultation and notification, and these are described in **Table 8-4**.

4.2 Stakeholder Identification

Santos understands retaining a broad licence to operate depends on the development and maintenance of 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. Fostering effective consultation between Santos and relevant stakeholders is an important part of this process.

Santos began the stakeholder identification process for this EP with a review of its stakeholder database, including stakeholders consulted for other recent activities in the area. The list of stakeholders was then reviewed and refined based on the defined operational areas (refer to **Section 2.1**) and the relevance of the stakeholder according to Regulation 11A of the OPGGS (E) Regulations and NOPSEMA Bulletin #2 Clarifying statutory requirements and good practice consultation (November 2019). More specifically, stakeholders for this EP were identified through the following:

+ Regular review of legislation applicable to petroleum and marine activities
+ Identification of marine user groups and interest groups active in the area (e.g., commercial fisheries, other oil and gas producers, merchant shipping, etc.)
+ A review, as required, of the most recent Department of Primary Industries and Regional Development (DPIRD) FishCube data
+ Updated fishing licence holder contact details, from these identified fisheries, as provided by DPIRD
+ Discussions with identified stakeholders to identify other potentially impacted persons
+ Active participation in industry bodies and collaborations (e.g., APPEA, AMOSC, NERA)
+ Records from previous consultation activities in the area.

Currently identified stakeholders and an assessment of their relevance under the OPGGS (E) Regulations for the purposes of consultation for this activity are listed in **Table 4-1**.

Table 4-1: Assessment of Relevance of Identified Stakeholders for the Proposed Activities

Stakeholder	Relevant to Activity	Relevance / Reason for Engagement
Commonwealth government agencies/departments		
Australian Fisheries Management Authority (AFMA)	Considered relevant persons under Regulation 11A (1) (a)	AFMA is responsible for managing Commonwealth fisheries and is a relevant agency where the activity has the potential to impact on fisheries resources in AFMA managed fisheries.
Australian Hydrographic Office (AHO)	Considered relevant persons under Regulation 11A (1) (a)	The AHO is the part of the Commonwealth Department of Defence responsible for maintaining and disseminating nautical charts, including the distribution of Notice to Mariners. The operational areas are in commonwealth waters.
Australian Maritime Safety Authority (AMSA)	Considered relevant persons under Regulation 11A (1) (a)	AMSA is the statutory and control agency for maritime safety and vessel emergencies in Commonwealth Waters. AMSA is a relevant agency when proposed offshore activities may impact on the safe navigation of commercial shipping in Australian waters. The operational areas are in commonwealth waters.

Stakeholder	Relevant to Activity	Relevance / Reason for Engagement
Department of Agriculture, Water and the Environment (DAWE) – Biosecurity (marine pests)	Considered relevant persons under Regulation 11A (1) (a)	The DAWE (marine pests) has primary policy and regulatory responsibility for managing biosecurity for incoming goods and conveyances, including biosecurity for marine pests. The Department is the relevant agency where an offshore activity has the potential to transfer marine pests between installations and mainland Australia. The operational areas are in commonwealth waters.
Department of Agriculture, Water and the Environment (DAWE) –Biosecurity (vessels, aircraft and personnel)	Considered relevant persons under Regulation 11A (1) (a)	DAWE (vessels and aircraft) has inspection and reporting requirements to ensure that all conveyances (vessels, installations and aircraft) arriving in Australian territory comply with international health regulations and that any biosecurity risk is managed. The department is the relevant agency where the titleholder's activity involves: + the movement of aircraft or vessels between Australia and offshore petroleum activities either inside or outside Australian territory the exposure of an aircraft or vessel (which leaves Australian territory not subject to biosecurity control) to offshore petroleum activities.
Department of Agriculture, Water and the Environment (DAWE) – Fisheries	Considered relevant persons under Regulation 11A (1) (a)	DAWE (fisheries) has primary policy responsibility for promoting the biological, economic and social sustainability of Australian fisheries. The Department is the relevant agency where the activity has the potential to negatively impact fishing operations and / or fishing habitats in Commonwealth waters.
Department of Defence (Defence)	Considered relevant persons under Regulation 11A (1) (a)	Defence is a relevant agency where the proposed activity may impact operational requirements; encroach on known training areas and/or restricted airspace, or when nautical products or other maritime safety information is required to be updated. The operational areas are in commonwealth waters.
Director of National Parks (DNP)	Considered relevant persons under Regulation 11A (1) (a)	The DNP is the statutory authority responsible for administration, management and control of Commonwealth marine reserves (CMRs). The Director of National Parks is a relevant person for consultation where: + the activity or part of the activity is within the boundaries of a proclaimed Commonwealth marine reserve

Stakeholder	Relevant to Activity	Relevance / Reason for Engagement
		+ activities proposed to occur outside a reserve may impact on the values within a Commonwealth marine reserve; and / or + an environmental incident occurs in Commonwealth waters surrounding a Commonwealth marine reserve and may impact on the values within the reserve.
State government agencies/departments		
Department of Biodiversity, Conservation and Attractions (DBCA)	Considered relevant persons under Regulation 11A (1) (b)	DBCA is a relevant State agency responsible for the management of State marine parks and reserves and protected marine fauna and flora.
Department of Mines, Industry Regulation and Safety (DMIRS)	Considered relevant persons under Regulation 11A (1) (c)	Department responsible for the management of offshore petroleum in the adjacent State waters.
Department of Primary Industries and Regional Development (DPIRD)	Considered relevant persons under Regulation 11A (1) (b)	DPIRD is responsible for managed West Australian State fisheries. The operational areas intersect with state managed fisheries.
Department of Transport (DoT)	Considered relevant persons under Regulation 11A (1) (b)	DoT is the control agency for marine pollution emergencies in State waters.
Pilbara Ports Authority	Considered relevant persons under Regulation 11A (1) (e)	Pilbara Ports Authority manages port land at Dampier, Port Hedland, Ashburton and Cape Preston East, and facilitates the development of land and leases to support port-related industries.
Industry bodies		
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	Considered relevant persons under Regulation 11A (1) (e)	ASBTIA represents the Australian SBT industry. ASBTIA is also listed on the AFMA website as a contact for petroleum operators to use when consultation with Commonwealth fishing operators is required.
Commonwealth Fisheries Association (CFA)	Considered relevant persons under Regulation 11A (1) (e)	The CFA was engaged as a representative body for Commonwealth fisheries. The CFA is also listed on the AFMA website as a contact for petroleum operators to use when consultation with fishing operators is required.
Conservation Council of Western Australia	Considered relevant persons	CCWA is a non-profit, non-government conservation organisation. CCWA represents more than

Stakeholder	Relevant to Activity	Relevance / Reason for Engagement
	under Regulation 11A (1) (e)	100 community environmental organisations from across WA
Marine Tourism WA (MTWA)	Considered relevant persons under Regulation 11A (1) (e)	MTWA represents the charter sector in WA. MTWA is identified as being able to assist in reaching its membership to inform them of activity timing should this be requested.
Pearl Producers Association (PPA)	Considered relevant persons under Regulation 11A (1) (e)	The PPA is the peak representative organisation of The Australian South Sea Pearling Industry. PPA membership includes all *Pinctada maxima* pearl oyster licensees that operate within the Australian North-west Bioregion.
Recfishwest	Considered relevant persons under Regulation 11A (1) (e)	Recfishwest is the peak body representing recreational fishers in WA. Recfishwest is identified as being able to assist in reaching its membership to inform of activity timing should this be requested.
Tuna Australia	Considered relevant persons under Regulation 11A (1) (e)	Tuna Australia represents statutory fishing right owners, holders, fish processors and sellers, and associate members of the Eastern and Western Tuna and Billfish fisheries.
Western Australian Fishing Industry Council (WAFIC)	Considered relevant persons under Regulation 11A (1) (e)	WAFIC is the peak industry body representing the interests of the WA commercial fishing, pearling and aquaculture sector.

Commercial fisheries – Commonwealth managed		
Western Tuna and Billfish Fishery	Considered relevant persons under Regulation 11A (1) (d)	The management area overlaps with the OA and MEVA. The licence holders have been consulted via their representative organisation as there has been no effort in recent years.
Commercial fisheries – state managed		
Mackerel Managed Fishery (Area 2)	Considered relevant persons under Regulation 11A (1) (d)	Based on a review of DPIRD information, the Mackerel Managed Fishery (Area 2) boundary overlaps the proposed operational areas and the licence holders in this fishery should be consulted.
Nichol Bay Prawn Managed Fishery	Considered relevant persons under Regulation 11A (1) (d)	Based on a review of DPIRD fishery information, the Nichol Bay Prawn Fishery boundary overlaps the proposed operational areas and the licence holders in this fishery should be consulted.
Onslow Prawn Fishery	Considered relevant persons under Regulation 11A (1) (d)	Based on a review of DPIRD fishery information, the Onslow Prawn Fishery boundary overlaps the proposed operational areas and the licence holders in this fishery should be consulted.
Pearl Oyster Managed Fishery	Considered relevant persons under Regulation 11A (1) (e)	Based on a review of DPIRD information, and in previous consultation with WAFIC, licence holders in the Pearl Oyster Managed Fishery should be consulted via the Pearl Producers Association.
Pilbara Crab Fishery	Considered relevant persons under Regulation 11A (1) (d)	Based on a review of DPIRD fishery, the Pilbara Crab Fishery boundary overlaps the proposed operational areas and the relevant licence holders in this fishery should be consulted.
Pilbara Fish Trawl Interim Managed Fishery	Considered relevant persons under Regulation 11A (1) (d)	Based on a review of DPIRD information, the Pilbara Fish Trawl Interim Managed Fishery boundary overlaps the proposed operational areas and the licence holders in this fishery should be consulted.
Pilbara Line Fishery	Considered relevant persons under Regulation 11A (1) (d)	Based on a review of DPIRD information, the Pilbara Line Fishery boundary overlaps the proposed operational areas and the licence holders in this fishery should be consulted.
Pilbara Trap Managed Fishery	Considered relevant persons under Regulation 11A (1) (d)	Based on a review of DPIRD information, the Pilbara Trap Managed Fishery boundary overlaps the proposed operational areas and the licence holders in this fishery should be consulted.
Other Stakeholders		
Australian Marine Oil Spill Centre (AMOSC)	Considered relevant persons under Regulation 11A (1) (a)	AMOSC operates the Australian oil industry's major oil spill response facility.

Boating Industry Association of WA (BIAWA)	Considered relevant persons under Regulation 11A (1) (d)	The BIAWA represents the West Australian recreational boating industry which is made up of manufacturers and retailers, brokers, importers and exporters, distributors/wholesalers, shipwrights/boat builders, mechanical repairers, boat lifters, yacht clubs, community organisations, financial & insurance providers, and a range of other product & service providers for boating, fishing & aquatic sports.

4.3 Stakeholder Consultation

The approach to stakeholder consultation for this EP is consistent with approaches adopted previously for EP applications. Some modifications to this approach have been made based on feedback from WAFIC, commercial fishers and NOPSEMA. These include:

+ Where required, providing more detailed information to commercial fishers, targeted to their fishery, in the initial consultation packs
+ Where required, engaging WAFIC to assist in the review and distribution of commercial fisher consultation material
+ Refinements to the stakeholder identification process to clearly identify and maintain current lists of ‘relevant’ persons
+ Clearly documenting and tracking notification commitments to relevant persons
+ Updating relevant stakeholders on any changes to the scope of the Exploration Drilling program.

Key stakeholders were contacted prior to providing the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package in July 2021 to increase activity awareness and to encourage two-way communication. Stakeholders, wherever possible, were provided personal emails with information tailored to their functions, interests and activities, including outlining why they have been identified as a relevant stakeholder.

The consultation package contains details such as an activity summary, location map, coordinates, water depth, distance to key regional features, exclusion zone details and estimated timing and duration. This consultation package outlined potential risks and impacts together with a summary of proposed management control measures.

Individual fishing licence holders were provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Commercial Fishers Stakeholder Consultation* package by via post.

The intent of providing this level of information early in the consultation process was to facilitate each party proceeding with their business in a safe and efficient manner, and without loss or conflict, by minimising the extent of interruption by the activities on commercial fishing operators’ activities to the lowest practicable level.

Stakeholders were afforded at least six weeks to review consultation packs, although Santos accepted stakeholder feedback after this period. A summary of the Consultation material sent to stakeholders is contained in **Appendix F** – Stakeholder Consultation**.**

Relevant stakeholders were then provided with detailed updated information about changes to the scope of the Exploration Drilling program in March 2022 by email and by post. This information included information specific to the change in scope and updated map of location of the activity.

4.4 Assessment of Stakeholder Objections and Claims

A summary of the stakeholder consultation undertaken for this EP, including Santos' assessment of all stakeholder comments received, is outlined in **Table 4-2**.

Full transcripts between Santos and stakeholders are provided in the *Yoorn-1 Exploration Drilling Environment Plan Sensitive Stakeholder Information Report* (SO-91-BI-20003.03) as a confidential submission to NOPSEMA.

Santos adopted the following process to address objections and claims received during the consultation process:

+ Santos acknowledged receipt of all comments made by stakeholders.
+ Santos assessed the merits of all objections and claims made by stakeholders. This included assessing all reasonably available options for resolving or mitigating the degree to which a stakeholder's functions, interests or activities may be affected. Control measures were proposed and adopted where reasonably practicable.
+ Santos responded to all stakeholder objections and claims, and advised the stakeholder how each of their objections and claims would be addressed in the EP.
+ Santos invited the stakeholder to provide additional feedback and comment.
+ As soon as possible, or on publication of the EP on the NOPSEMA website, Santos will advise the stakeholders listed in **Table 4-2** or their industry body, the EP was available for public review and comment.

A similar process was applied to information provided and requests made by stakeholders not deemed to be an objection or claim.

Santos recognises the importance of ensuring a high degree of transparency in how a titleholder manages ongoing stakeholder consultation during the life of the EP. As such, should additional stakeholder comments be received to those described in **Table 4-2** then Santos will assess the comments using the above process and update the EP to document the assessment of additional objections or claims.

In relation to stakeholder consultation Santos is of the opinion that Regulation 10A of the OPGGS(E) Regulations has been met.

Table 4-2: Consultation Summary for Activity

Stakeholder	Stakeholder Consultation Summary (OPGGS(E) Regulation 16 (b)(i))
Commonwealth agencies/departments	
Australian Fisheries Management Authority (AFMA)	AFMA was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via email on 21 July 2021. AFMA responded on 9 August 2021 advising: + It is important to consult with all fishers who have entitlements to fish within the proposed area. This can be done through the relevant fishing industry associations or directly with fishers who hold entitlements in the area. In particular we request that you consult directly with Commonwealth concession holders in the North West Slope Trawl Fishery, as well as the Western Australia Fishing Industry Council (WAFIC). AFMA provided guidance on where to find this information **[REQUEST 001]** Santos responded to AFMA on 10 August 2021 and addressed the matters raised in their correspondence of 9 August 2021 (refer assessment of stakeholder objections, claims, information and requests below). AFMA responded on 12 August 2021 and confirmed the proposed operational areas for the WA-499-P, WA-208-P and WA-546-P Exploration Drilling program do not intersect with the fishery boundary. AFMA was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* Update via email on 26 October 2021. Santos provided this stakeholder with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* on 9 March 2022 advising of changes in scope of the activities. AFMA acknowledged on 15 March 2022 receipt of the update and confirmed initial advice provided would continue to apply. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA. Santos considers the level of consultation to be adequate and will address any additional comments from this stakeholder should they arise in the future.

<table>
<tr><td></td><td>Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
<tr><td></td><td>[REQUEST 001] Santos has consulted directly with relevant fishers and fishing industry associations as outlined in Table 4-1 and Table 4-2.
The proposed operational areas for the WA-499-P, WA-208-P and WA-546-P Exploration Drilling program do not intersect with the North West Slope Trawl Fishery and therefore consultation is not required.</td><td>Santos responded to AFMA and acknowledged their advice. Santos also provided mapping to AFMA to indicate the North West Slope Trawl Fishery did not intersect with the proposed operational areas.</td></tr>
<tr><td rowspan="3">Australian Hydrographic Office (AHO)</td><td colspan="2">AHO was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via email on 21 July 2021.
AHO Acknowledged receipt of the consultation material on 22 July 2021.
AHO was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021.
AHO notification requirements, as requested by AMSA (refer to below), are addressed in Table 8-4.
Santos provided this stakeholder with the Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters on 9 March 2022 advising of changes in scope of the activities.
This stakeholder is listed as a recipient of Santos’ Quarterly Consultation Update for WA.
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.</td></tr>
<tr><td>Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
<tr><td>No assessment required.</td><td>No response required.</td></tr>
<tr><td>Australian Maritime Safety Authority (AMSA)</td><td colspan="2">AMSA was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via email on 21 July 2021.
AMSA responded on 22 July 2021 advising:</td></tr>
</table>

	+ Please ensure that timely and relevant Maritime Safety Information (MSI) is promulgated for the area and nature of your operations. To promulgate MSI, you should contact the Australian Hydrographic Office at datacentre@hydro.gov.au no less than four weeks before operations, with details relevant to the operations. The AHO will promulgate the appropriate Notice to Mariners (NTM), which will ensure other vessels receive information of your activities. **[REQUEST 001]** + Notify AMSA's Joint Rescue Coordination Centre (JRCC) by e-mail to rccaus@amsa.gov.au (Phone: 1800 641 792 or +61 2 6230 6811) for promulgation of radio-navigation warnings at least 24-48 hours before operations commence. AMSA's JRCC will require the vessel details (including name, callsign and Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSAT-C and satellite telephone numbers), area of operation, requested clearance from other vessels and any other information that may contribute to safety at sea. JRCC will also need to be advised when operations start and end. **[REQUEST 002]** + You should plan to provide updates to both the Australian Hydrographic Office and the JRCC on progress and, importantly, any changes to the intended operations. **[REQUEST 003].** + We remind vessels of their obligation to comply with the International Rules for Preventing Collisions at Sea (COLREGs), in particular, the use of appropriate lights and shapes to reflect the nature of your operations (e.g. restricted in the ability to manoeuvre). Vessels should also ensure their navigation status is set correctly in the ship's AIS unit. **[INFORMATION 001]** + To obtain a vessel traffic plot showing Automatic Identification System (AIS) traffic data for your area of interest, please visit AMSA's spatial data gateway and Spatial@AMSA portal to download digital data sets and maps. **[INFORMATION 002**] Santos responded to AMSA on 6 August 2021 and addressed the matters raised in their correspondence of 22 July 2021 (refer assessment of stakeholder objections, claims, information and requests below). AMSA was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* Update via email on 26 October 2021. Santos provided this stakeholder with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* on 9 March 2022 advising of changes in scope of the activities. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA. Santos considers the level of consultation to be adequate and will address any additional comments from this stakeholder should they arise in the future.

	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
	[REQUEST 001] Santos will notify the AHO no less than four working weeks before operations commence, where practicable. Notification requirements are addressed in **Table 8-4**.	Santos responded to AMSA confirming the notifications requirements would be addressed in the EP.
	[REQUEST 002] Santos will notify AMSA's JRCC at least 24–48 hours before operations commence and advise when operations start and end. Notification requirements are addressed in **Table 8-4**.	Santos responded to AMSA confirming the notifications requirements would be addressed in the EP.
	[REQUEST 003] Santos will provide updates to both the AHO and the JRCC on any changes to the intended operations. Notification requirements are addressed in **Table 8-4**.	Santos responded to AMSA confirming the notifications requirements would be addressed in the EP.
	[INFORMATION 001] Santos notes the advice reminding vessels of their obligation to comply with the International Rules for Preventing Collisions at Sea (COLREGs).	Santos responded to AMSA and acknowledged their feedback.
	[INFORMATION 002] Santos notes the information provided on traffic data.	Santos responded to AMSA and acknowledged their feedback.
Department of Agriculture, Water and the Environment (DAWE) – Biosecurity (marine pests)	The department was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via email on 21 July 2021. The department was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021. No response received to date. Management of invasive marine pest species is addressed in **Section 7.7**. Santos provided this stakeholder with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* on 9 March 2022 advising of changes in scope of the activities.	

	Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required	No response required
Department of Agriculture, Water and the Environment (DAWE) – Biosecurity (vessels, aircraft and personnel)	The department was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via email on 21 July 2021. The department was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021. No response received to date. The department has previously advised Santos of their Agriculture biosecurity requirements. The Environment Plan refers to applying to the Department, using the form provided, at least one month prior to the commencement of the activity, for the MODU and associated support vessel/s biosecurity risk to be assessed as low (as applicable to vessel and location). Notification requirements are addressed in **Table 8-4** of the EP. Santos provided this stakeholder with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* on 9 March 2022 advising of changes in scope of the activities. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA. Santos considers the level of consultation to be adequate and will address any additional comments from this stakeholder should they arise in the future.	

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<tr><td rowspan="2"></td><td>Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
<tr><td>No assessment required</td><td>No response required</td></tr>
<tr><td rowspan="3">Department of Agriculture, Water and the Environment (DAWE) – Fisheries</td><td colspan="2">The department was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via email on 21 July 2021.
The department was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021.
No response received to date.
Santos has assessed the impact to fish and commercial fisheries in Section 6.1 and 6.2. and consulted with relevant licence holder and fishing industry associations as outlined in Table 4-1 and Table 4-2.
Santos provided this stakeholder with the Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters on 9 March 2022 advising of changes in scope of the activities.
Santos provided this stakeholder with Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022 advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement.
This stakeholder is listed as a recipient of Santos’ Quarterly Consultation Update for WA.
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.</td></tr>
<tr><td>Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
<tr><td>No assessment required.</td><td>No response required.</td></tr>
<tr><td>Department of Defence (Defence)</td><td colspan="2">Defence was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via email on 21 July 2021.
Defence was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021.</td></tr>
</table>

	No response has been received to date. Defence has previously requested continued liaison with AHO, in particular to ensure the AHO is notified three weeks prior to the actual commencement of activities. Santos has addressed AHO notification requirements, in **Table 8-4**. This stakeholder also receives Santos' Quarterly Consultation Update for WA. Since July 2021 this update has provided information on the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Program. Santos provided this stakeholder, via the AHO, with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* on 9 March 2022 advising of changes in scope of the activities. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. Santos considers the level of consultation to be adequate and will address any additional comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required.	No response required.
Director of National Parks (DNP)	The Director of National Parks (DNP) was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via email on 21 July 2021. DNP responded on 1 September 2021 and provided the following feedback: + DNP noted the EP for WA-499-P, located within Montebello Marine Park, has already been approved and therefore will not be considered in this comment. **[INFORMATION 001]** + Based on the information provided, we note that the planned activities do not overlap any Australian Marine Parks. You have noted that the Jelen-1 wellhead is approximately 29.8 km from the Montebello Marine Park. You have noted that the Parnassus-1 wellhead is approximately 26.8 km from the Montebello Marine Park. Therefore, there are no authorisation requirements from the DNP. **[INFORMATION 002].**	

	+ To assist in the preparation of an EP for petroleum activities that may affect Australian marine parks, NOPSEMA has worked closely with Parks Australia to develop and publish a guidance note that outlines what titleholders need to consider and evaluate. In preparing the EP, you should consider the Australian marine parks and their representativeness. In the context of the management plan objectives and values, you should ensure that the EP **[REQUEST 001]**: o identifies and manages all impacts and risks on Australian marine park values (including ecosystem values) to an acceptable level and has considered all options to avoid or reduce them to as low as reasonably practicable. o clearly demonstrates that the activity will not be inconsistent with the management plan. + DNP do not require further notification of progress made in relation to this activity unless details regarding the activity change and result in an overlap with or new impact to a marine park, or for emergency responses (see details below) **[REQUEST 002]**. + Emergency responses: the DNP should be made aware of oil/gas pollution incidences which occur within a marine park or are likely to impact on a marine park as soon as possible. Notification should be provided to the 24-hour Marine Compliance Duty Officer on 0419 293 465. The notification should include **[REQUEST 003]:** – titleholder details – time and location of the incident (including name of marine park likely to be affected) – proposed response arrangements as per the Oil Pollution Emergency Plan (e.g. dispersant, containment, etc.) – confirmation of providing access to relevant monitoring and evaluation reports when available; and – contact details for the response coordinator. Note that the DNP may request daily or weekly Situation Reports, depending on the scale and severity of the pollution incident. Santos responded to DNP on 2 September 2021 and addressed the matters raised in their correspondence of 28 July 2021 (refer assessment of stakeholder objections, claims, information and requests below). Santos contacted DNP on 17 September via phone call and a follow up email to clarify that the approved EP for WA-499-P was for a geophysical survey only and that the exploration drilling within WA-499-P was included in this EP, therefore drilling activities are proposed to occur within the Montebello AMP. DNP responded on 20 September with the following additional feedback: + DNP noted that additional comments relate to exploration drilling within WA-499-P that will occur within the Montebello Marine Park [**INFORMATION 003**]

- We recommend the EP give consideration to avoiding impacts upon migratory species, such as considering the use of low power and shut down zones and timing of the activity – with particular attention to managing the risk to turtle foraging and internesting locations. [**REQUEST 004**].
- The DNP requests notification to marineparks@awe.gov.au if the EP is approved by NOPSEMA. If the EP is approved, the DNP also requests notification at least 10 days prior to all activities occurring within the marine park (excluding transiting) and at the conclusion of that activity. Notification information should be consistent with the guidance note. [REQUEST 002].

DNP was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021.

Santos considers the level of consultation to be adequate and will address any additional comments from this stakeholder should they arise in the future.

Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests
[INFORMATION 001] Noted.	Santos responded to Marine Parks and acknowledged their comment.
[INFORMATION 002] Santos notes the planned activities do not overlap any Australian Marine Parks (noting follow up clarification communications with DNP addressed in **REQUEST 002** and **REQUEST 004**].	Santos responded to Marine Parks and acknowledged their comment.
[**INFORMATION 003**] Noted	Santos responded to Marine Parks and acknowledged their comment.
[REQUEST 001] Santos is following the NOPSEMA guidance note Petroleum activities and Australian Marine Parks (N-04750-GN1785 A620236) in preparation of the EP and OPEP, where relevant.	Santos responded to Marine Parks and confirmed the guidance note was being followed in preparation of the EP and OPEP where relevant.
[REQUEST 002] Notification requirements are addressed in **Table 8-4.**	Santos responded to Marine Parks and acknowledged their notification requirements

	[REQUEST 003] The Oil Pollution Emergency Plan (OPEP) for the activity will include DNPs notification requirements. These can be found in Section 7 of the OPEP.	Santos responded to Marine Parks and confirmed the required notification requirements would be included in Section 7 of the OPEP.
	[REQUEST 004] Santos has considered the relevant values of the Montebello Marine Parks when preparing the EP, in particular the presence of habitat important to marine turtles, seabirds, migrating humpback whales and foraging whale sharks as well as the presence of the Ancient Coastline at 125m depth contour Key Ecological Feature (KEF). Neither of the operational areas overlap the Ancient Coastline at 125 m depth KEF. Control measures adopted to manage interactions with fauna and the KEF are described in **Section 8** of the EP.	Santos responded to Marine Parks and confirmed Control measures adopted to manage interactions with fauna and the KEF are described in **Section 8** of the EP.
State Government agencies/departments		
Department of Biodiversity and Conservation Attractions (DBCA)	DBCA was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via email on 21 July 2021. DBCA responded on 30 July 2021 and provided the following feedback in relation to its responsibilities under the Biodiversity Conservation Act 2016 and the Conservation and Land Management Act 1984: + DBCA has previously provided comment to Santos in relation to petroleum production activities in proximity to ecologically sensitive receptors including marine parks and other reserves managed by DBCA under the CALM Act. In particular, DBCA's comments relate to the need for comprehensive baseline monitoring of these receptors and oil spill response preparedness. Noting that DBCA has received responses from Santos in relation to this advice, DBCA would like to reiterate its comments in this instance in relation to the Montebello Islands Conservation Park and Marine Park, Lowendal Islands Nature Reserve, and Barrow Island Nature Reserve, Marine Park and Marine Management Area, which are located in proximity to the proposed decommissioning activities. **[INFORMATION 001]** + Should Santos Limited have any additional information in relation to its monitoring or oil spill response preparedness for these decommissioning activities for DBCA's information, this would be welcome. Santos should be aware that any activities requiring access to reserves managed by DBCA under the CALM Act or requiring the taking / disturbance of threatened fauna listed under the BC Act in State waters may require additional approvals under this legislation, and early consultation with DBCA is recommended. **[INFORMATION 002]** + Please continue to provide all notifications to EMBadmin@dbca.wa.gov.au. **[REQUEST 001]**	

	Santos responded to DBCA on 4 August 2021 and addressed each of the matters raised in their correspondence of 30 July 2021 (refer assessment of stakeholder objections, claims, information and requests below). Santos provided this stakeholder with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* on 9 March 2022 advising of changes in scope of the activities. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA. Santos considers the level of consultation to be adequate and will address any additional comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	[INFORMATION 001] Santos notes DBCA response.	Santos responded to DBCA and acknowledged their comments.
	[INFORMATION 002] Santos clarified that the proposed activity under the EP is drilling activity and not decommissioning. The EP will include detailed descriptions of the various sensitivities described, and risks will be to as low as reasonably practicable. The WA-499-P, WA-208-P and WA-546-P Exploration Drilling OPEP will be available on the NOPSEMA website once it has been accepted by NOPSEMA.	Santos responded to DBCA and clarified their comments.
	[REQUEST 001] Santos will continue to provide all future notifications to the required email address. Notification requirements are addressed in **Table 8-4**	Santos responded to DBCA and acknowledged their comments.
Department of Mines, Industry Regulation and Safety (DMIRS)	DMIRS was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via email on 21 July 2021. DMIRS responded on 27 August 2021 and provided the following comments:	

	+ DMIRS notes that the proposed activity will be assessed under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 and regulated by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) [**INFORMATION 001**] + DMIRS has reviewed the notification and does not require any further information at this stage **[INFORMATION 002].** + Subsequently, please: – provide pre-start notification confirming the start date of the proposed activity and a cessation notification to inform DMIRS upon completion of the activity to petroleum.environment@dmirs.wa.gov.au. **[REQUEST 001]** – ensure the environment plan/s include 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. **[REQUEST 002]** Santos responded to DMIRS on 30 August 2021 and addressed each of the matters raised in their correspondence of 27 August 2021 (refer assessment of stakeholder objections, claims, information and requests below). DMIRS was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021. Santos provided this stakeholder with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* on 9 March 2022 advising of changes in scope of the activities. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA. Santos considers the level of consultation to be adequate and will address any additional comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	[INFORMATION 001] Santos notes DMIRS response.	Santos responded to DMIRS and acknowledged their comments.

	[INFORMATION 002] Santos notes DMIRS response.	Santos responded to DMIRS and acknowledged their comments.
	[REQUEST 001] Santos will provide pre-start notification confirming the start date of the proposed activity and a cessation notification to inform DMIRS upon completion of the activity to petroleum.environment@dmirs.wa.gov.au. Notification requirements will be contained in **Section 8** of the EP.	Santos responded to DMIRS and confirmed their notification requirements would be addressed in **Section 8** of the EP
	[REQUEST 002] Santos will ensure the environment plan 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. Notification requirements will be contained in **Section 8** of the EP.	Santos responded to DMIRS and confirmed their notification requirements would be addressed in Section 8 of the EP.
Department of Primary Industries & Regional Development (DPIRD)	DPIRD was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via email on 21 July 2021. DPIRD was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021. No comments received to date. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA. Santos has assessed the impact to fish and commercial fisheries in **Section 6.1 and 6.2**. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required.	No response required.
	DoT was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via email on 21 July 2021.	

<table>
<tr><td rowspan="3">Department of Transport (DoT)</td><td colspan="2">DoT responded on 28 July 2021 advising:
+ if there is a risk of a spill impacting State waters from the activity, please ensure that the department is consulted as outlined in the Department of Transport Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (July 2020). [REQUEST 001]
Santos responded to DoT on 6 August 2021 and addressed each of the matters raised in their correspondence of 28 July 2021 (refer assessment of stakeholder objections, claims, information and requests below).
DoT was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021.
This stakeholder is listed as a recipient of Santos’ Quarterly Consultation Update for WA.
Santos considers the level of consultation to be adequate and will address any additional comments from this stakeholder should they arise in the future.</td></tr>
<tr><td>Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
<tr><td>[REQUEST 001] Santos will provide the department a copy of the WA-499-P, WA-208-P and WA-546-P Exploration Drilling OPEP for review, upon submission to NOPSEMA.</td><td>Santos responded to DoT and acknowledged their request.</td></tr>
<tr><td>Pilbara Ports Authority</td><td colspan="2">The Pilbara Ports Authority was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via email on 21 July 2021.
The Pilbara Ports Authority was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021.
No response received to date.
This stakeholder also receives Santos’ Quarterly Consultation Update for WA. Since July 2021 this update has provided information on the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Program.
Santos provided this stakeholder with the Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters on 9 March 2022 advising of changes in scope of the activities.</td></tr>
</table>

	Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required.	No response required.
Representative organisations		
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	ASBITA was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via email on 21 July 2021. ASBTIA was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021. No response received to date. Santos provided this stakeholder with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* on 9 March 2022 advising of changes in scope of the activities. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA. All listed fisheries are described in **Section 3.2.4.1**, and potential impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.1** and **6.2**. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	

	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required	No response required
Commonwealth Fisheries Association (CFA)	The CFA was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via email on 21 July 2021. The CFA was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021. No response received to date. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA. All fisheries are described in **Section 3.2.4.1**, and potential impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.1** and **6.2**. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests**
	No assessment required	No response required
Conservation Council of WA	CCAW was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via email on 21 July 2021. CCWA was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021. No response received to date. Santos provided this stakeholder with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* on 9 March 2022 advising of changes in scope of the activities.	

	Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required.	No response required.
Marine Tourism WA (MTWA)	MTWA was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via email on 21 July 2021. MTWA was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021. No response received to date. Santos provided this stakeholder with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* on 9 March 2022 advising of changes in scope of the activities. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required.	No response required.

<table>
<tr><td rowspan="3">Pearl Producers Association (PPA)</td><td colspan="2">The PPA was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via email on 21 July 2021.
The PPA was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021.
No response received to date.
All fisheries (include pearl oysters) are described in Section 3.2.4.1, and potential impact to fisheries, fish habitat and commercial fishers are discussed in Section 6.1 and 6.2.
Santos provided this stakeholder with the Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters on 9 March 2022 advising of changes in scope of the activities.
Santos provided this stakeholder with Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022 advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement.
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.</td></tr>
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<tr><td>No assessment required.</td><td>No response required.</td></tr>
<tr><td>Recfishwest</td><td colspan="2">Recfishwest was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via email on 21 July 2021.
Recfishwest was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021.
No response received to date.
Santos provided this stakeholder with the Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters on 9 March 2022 advising of changes in scope of the activities.</td></tr>
</table>

<table>
<tr><td rowspan="3"></td><td colspan="2">Santos provided this stakeholder with Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022 advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement.
This stakeholder is listed as a recipient of Santos’ Quarterly Consultation Update for WA.
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.</td></tr>
<tr><td>Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
<tr><td>No assessment required.</td><td>No response required.</td></tr>
<tr><td rowspan="3">Tuna Australia</td><td colspan="2">Tuna Australia was provided WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via email on 21 July 2021.
Tuna Australia was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021.
No response received to date.
Santos provided this stakeholder with Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022 advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement.
All listed fisheries are described in Section 3.2.4.1, and potential impact to fisheries, fish habitat and commercial fishers are discussed in Section 6.1 and 6.2
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.</td></tr>
<tr><td>Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
<tr><td>No assessment required.</td><td>No response required.</td></tr>
</table>

Western Australian Fishing Industry Council (WAFIC)	WAFIC was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via email on 21 July 2021. WAFIC responded on 18 August 2021 and provided the following comments: + In the Oil Pollution Emergency plan can Santos confirm they have the following: – Baseline scientific data on aquatic organisms and the aquatic environment **[REQUEST 001].** – Detailed post spill scientific monitoring of aquatic organism and aquatic environment **[REQUEST 002].** – Communication strategy that considers the commercial fishing industry in the event of a spill event **[REQUEST 003].** – Support to the commercial fishing industry with regards to traceability of fish products to manage tainting risks, if required. **[REQUEST 004].** – Financial assistance to the commercial fishing industry in the event of a spill event. **[REQUEST 005].** Santos responded to WAFIC on 24 August 2021 and addressed each of the matters raised in their correspondence of 18 August 2021 (refer assessment of stakeholder objections, claims, information and requests below). WAFIC responded on 10 September 2021 thanking Santos for providing an update and stated that WAFIC had no additional comments regarding these activities. WAFIC was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021. Santos provided this stakeholder with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* on 9 March 2022 advising of changes in scope of the activities. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. On 23 March 2022 WAFIC responded by email thanking Santos for the activity update. WAFIC raised no claims or objections. **[INFORMATION 001].** This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**

	[REQUEST 001] The OPEP includes an overview of Santos' Scientific Monitoring Plans which includes a description of the approach to collecting baseline.	Santos responded to WAFIC and addressed each of the matters raised.
	[REQUEST 002] The OPEP includes an overview of the process for scientific monitoring post spills.	Santos responded to WAFIC and addressed each of the matters raised.
	[REQUEST 003] In the event of a major spill, notifications to state and commonwealth government fisheries agencies, including the Australian Fisheries Management Authority and WA Department of Primary Industries and Regional Development (Fisheries) will be made if applicable. Although WAFIC is not in the list of agencies notified by the Incident Management Team (IMT), WAFIC is listed as a key stakeholder in Santos' communications register and would be contacted in the event of an oil spill.	Santos responded to WAFIC and addressed each of the matters raised.
	[REQUEST 004] There is a dedicated Scientific Monitoring Plan for Seafood Quality which aims to identify potential human health risks due to the presence of hydrocarbon concentrations in the flesh of targeted seafood species for consumption.	Santos responded to WAFIC and addressed each of the matters raised.
	[REQUEST 005] These matters are not addressed in an OPEP. Santos responded to a similar query from WAFIC in January 2021 and provided WAFIC a copy of that response.	Santos responded to WAFIC and addressed each of the matters raised.
	[INFORMATION 001] No assessment required.	No response required.
State managed fisheries		
Mackerel Managed Fishery (Area 2)	These licence holders were provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via post on 22 July 2021. The Licence holders were provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via post on 26 October 2021.	

<table>
<tr><td rowspan="3"></td><td colspan="2">No comments received to date from individual fishers in this fishery.
Santos provided this stakeholder group with the Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters by post on 10 March 2022 advising of changes in scope of the activities.
Santos provided this stakeholder with Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022 advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement.
These stakeholders are listed as recipients of Santos' Quarterly Consultation Update for WA.
All fisheries are described in Section 3.2.4.1, and potential impacts to fisheries, fish habitat and commercial fishers are discussed in Section 6.1 and 6.2.
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.</td></tr>
<tr><td>Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests</td><td>Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests</td></tr>
<tr><td>No assessment required.</td><td>No response required.</td></tr>
<tr><td>Nichol Bay Prawn Fishery</td><td colspan="2">These licence holders were provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via post on 22 July 2021.
The Licence holders were provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via post on 26 October 2021.
No comments received to date from individual fishers in this fishery.
Santos provided this stakeholder group with the Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters by post on 10 March 2022 advising of changes in scope of the activities.
Santos provided this stakeholder with Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022 advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement.
These stakeholders are listed as recipients of Santos' Quarterly Consultation Update for WA.</td></tr>
</table>

<table>
<tr><td rowspan="3"></td><td colspan="2">All fisheries are described in Section 3.2.4.1, and potential impacts to fisheries, fish habitat and commercial fishers are discussed in Section 6.1 and 6.2.
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.</td></tr>
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<tr><td>No assessment required.</td><td>No response required.</td></tr>
<tr><td rowspan="3">Onslow Prawn Fishery</td><td colspan="2">These licence holders were provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via post on 22 July 2021.
The Licence holders were provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via post on 26 October 2021.
No comments received to date from individual fishers in this fishery.
Santos provided this stakeholder group with the Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters by post on 10 March 2022 advising of changes in scope of the activities.
Santos provided this stakeholder with Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022 advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement.
These stakeholders are listed as recipients of Santos' Quarterly Consultation Update for WA.
All fisheries are described in Section 3.2.4.1, and potential impacts to fisheries, fish habitat and commercial fishers are discussed in Section 6.1 and 6.2.
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.</td></tr>
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<tr><td>No assessment required.</td><td>No response required.</td></tr>
</table>

<table>
<tr><td rowspan="3">Pearl Oyster Managed Fishery</td><td colspan="2">The PPA was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via email on 22 July 2021.
The PPA was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021.
No comments received to date from individual fishers in this fishery.
Santos provided this stakeholder group with the Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters by post on 10 March 2022 advising of changes in scope of the activities.
Santos provided this stakeholder with Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022 advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement.
These stakeholders are listed as recipients of Santos’ Quarterly Consultation Update for WA.
All fisheries (including pearl oysters) are described in Section 3.2.4.1 and potential impacts to fisheries, fish habitat and commercial fishers are discussed Section 6.1 and 6.2.
Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.</td></tr>
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<tr><td>No assessment required.</td><td>No response required.</td></tr>
<tr><td>Pilbara Crab Fishery</td><td colspan="2">These licence holders were provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation package via post on 22 July 2021.
The Licence holders were provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via post on 26 October 2021.
No comments received to date from individual fishers in this fishery.
Santos provided this stakeholder group with the Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters by post on 10 March 2022 advising of changes in scope of the activities.</td></tr>
</table>

	Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. These stakeholders are listed as recipients of Santos' Quarterly Consultation Update for WA. All fisheries are described in **Section 3.2.4.1**, and potential impacts to fisheries, fish habitat and commercial fishers are discussed in **Section 6.1** and **6.2**. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required.	No response required.
Pilbara Fish Trawl Interim Managed Fishery	The Licence holders were provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update* via post on 26 October 2021. No comments received to date from individual fishers in this fishery. The Licence holders were provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update* via post on 26 October 2021. Santos provided this stakeholder group with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* by post on 10 March 2022 advising of changes in scope of the activities. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. These stakeholders are listed as recipients of Santos' Quarterly Consultation Update for WA. No comments received to date from individual fishers in this fishery. All fisheries are described in **Section 3.2.4.1**, and potential impacts to fisheries, fish habitat and commercial fishers are discussed in **Section 6.1** and **6.2**.	

	Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required.	No response required.
Pilbara Line Fishery	These licence holders were provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via post on 22 July 2021. The Licence holders were provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via post on 26 October 2021. No comments received to date from individual fishers in this fishery. Santos provided this stakeholder group with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* by post on 10 March 2022 advising of changes in scope of the activities. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. These stakeholders are listed as recipients of Santos' Quarterly Consultation Update for WA. All fisheries are described in **Section 3.2.4.1**, and potentials impact to fisheries, fish habitat and commercial fishers are discussed in **Section 6.1** and **6.2**. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required.	No response required.

Pilbara Trap Managed Fishery	These licence holders were provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via post on 22 July 2021. The Licence holders were provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via post on 26 October 2021. No comments received to date from individual fishers in this fishery. Santos provided this stakeholder group with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* by post on 10 March 2022 advising of changes in scope of the activities. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. These stakeholders are listed as recipients of Santos' Quarterly Consultation Update for WA. All fisheries are described in **Section 3.2.4.1**, and potential impacts to fisheries, fish habitat and commercial fishers are discussed in **Section 6.1** and **6.2**. Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required.	No response required.
Other stakeholders		
AMOSC	AMOSC was provided the *WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation* package via email on 21 July 2021. AMOSC was provided the WA-499-P, WA-208-P and WA-546-P Exploration Drilling Stakeholder Consultation Update via email on 26 October 2021. No response received to date. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA.	

	Santos considers the level of consultation to be adequate and will address any comments from this stakeholder should they arise in the future.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required.	No response required.
Boating Industry Association of WA (BIAWA)	Santos provided this stakeholder with the *Santos Stakeholder Update - Changes to Exploration Drilling Program in Commonwealth waters* on 9 March 2022 advising of changes in scope of the activities. Santos provided this stakeholder with *Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters on 31 March 2022* advising of estimated duration period being revised from up to 70 days from commencement to up to 100 days from commencement. This stakeholder is listed as a recipient of Santos' Quarterly Consultation Update for WA.	
	Assessment of the merits of objections and claims (OPGGS(E) Regulation 16 (b)(ii)), information and requests	**Statement of response, or proposed response, to the objections and claims (OPGGS(E) Regulation 16 (b)(iii)), and information and requests**
	No assessment required.	No response required.

4.5 Ongoing Consultation

Stakeholder consultation for this activity will be ongoing and Santos will work with stakeholders before, during and after the activity. Should new stakeholders be identified (**Section 4.1**), they will be added to the stakeholder database and included in all future correspondence as required, including activity-specific notifications.

Santos, as a marine user, understands there will be the need to interact and communicate with other marine users to ensure mutual and individual stakeholder goals are met. Santos has identified the need for ongoing engagement with other marine users, including the fishing industry, as outlined in **Section 8.9**.

4.6 Quarterly Consultation Update

Activities covered under this EP will be included in Santos' Quarterly Consultation Update until they can be listed as a 'completed activity', with updates scheduled for approximately March, June, September and December annually.

Stakeholders are invited to contact Santos should they require any further information regarding any activities published in each Quarterly Update.

4.7 Addressing Consultation Feedback

Santos' Consultation Coordinator is available before, during and after the activity to ensure opportunities for stakeholders to provide feedback are available.

Santos will maintain records of all stakeholder consultation related this this EP and activity.

4.8 Stakeholder related Control Measures, Performance Outcomes and Standards

Control measures and performance outcomes and standards for stakeholder consultation are included in **Section 8.4.1**.

If, in stakeholder consultation, a change to any control measure or activity outlined in this EP is required, Santos will undertake an internal assessment using the management of change process (**Section 8.10.2**).

5 Environmental Impact and Risk Assessment

OPGGS(E)R 2009 Requirements
Regulation 13. Environmental assessment
Evaluation of environmental impacts and risks 13(5) The environment plan must include: (a) details of the environmental impacts and risks for the activity; and (b) an evaluation of all the impacts and risks, appropriate to the nature and scale of each impact or risk; and (c) details of the control measures that will be used to reduce the impacts and risks of the activity to as low as reasonably practicable and an acceptable level. 13(6) To avoid doubt, the evaluation mentioned in paragraph (5)(b) must evaluate all the environmental impacts and risks arising directly or indirectly from: (a) all operations of the activity; and (b) potential emergency conditions, whether resulting from accident or any other reason.

Environmental impact and risk assessment refers to a process whereby planned and unplanned events that will or may occur during an activity are quantitatively and/or qualitatively assessed for their impacts on the environment (physical, biological, and socio-economic) at a defined location and specified period of time. In addition, unplanned events are assessed on the basis of their likelihood of occurrence which contributes to their level of risk.

Santos has undertaken environmental impact and risk assessments for the planned events (including any routine, non-routine and contingency activities) and unplanned events in accordance with the OPGGS(E)R.

Provided in this section of the EP is the following information relating to the environmental impact and risk assessment approach:

+ Terminology used
+ Summary of the approach.

A full description of the process applied in identifying, analysing and evaluating the impacts and risks relating to the planned activity is documented in Santos' *Offshore Division Environmental Hazard Identification and Assessment Guideline* (EA-91-IG-00004_5).

5.1 Impact and Risk Assessment Terminology

Common terms applied during the impact and risk assessment process and used in this EP are defined in **Table 5-1**. For a more comprehensive listing of the terms and definitions used in environmental impact and risk assessment, refer to Santos' *Offshore Division Environmental Hazard Identification and Assessment Procedure* (EA-91-IG-00004_5).

Table 5-1: Impact and Risk Assessment Terms

Name	Definition
Acceptability	Determined for both impacts and risks. Acceptability of events is in part determined by the consequence of the impact following management controls. Acceptability of unplanned events is in part determined from its risk ranking following management controls. For both impacts and risks, acceptability is also determined from a demonstration of the ALARP principle, consistency with Santos Policies, consistency with all applicable legislation and consideration of relevant stakeholder consultation when determining management controls.
Activity	Specific tasks and actions undertaken throughout the life cycle of oil and gas exploration, production and decommissioning.
ALARP	As Low As Reasonably Practicable The term refers to reducing risk to a level that is As Low As Reasonably Practicable. In practice, this means showing through reasoned and supported arguments, that there are no other practicable options that could reasonably be adopted to reduce risks further.
Authorised Person	Person with authority to make the decision or take the action. Examples are Vessel Master, Field Superintendent, Supervisor, Person-in-charge, Company Authorised Representative, and Project Manager.
Control Measure	Means a system, an item of equipment, a person or a procedure, that is used as a basis for managing environmental impacts and risks[1].
DMIRS	Department of Mines, Industry Regulation and Safety
Environment	Includes the natural and socio-economic values and sensitivities which will or may be affected by the activity. Is defined by NOPSEMA and DMIRS as: (a) ecosystems and their constituent parts, including people and communities (b) natural and physical resources (c) the qualities and characteristics of locations, places and areas (d) the heritage value of places (e) the social, economic and cultural features of the matters mentioned in paragraphs (a), (b), (c) and (d).
Environmental consequence	A consequence is the outcome of an event affecting objectives. Note 1 An event can be one or more occurrences and can have several cases. Note 2 An event can consist of something not happening. (Reference ISO 73:2009 Risk Vocabulary)
Environmental impact	Defined by NOPSEMA[1] as any change to the environment, whether adverse or beneficial, wholly or partly resulting from a planned or unplanned event[1]. Defined by DMIRS as any change to the environment, whether adverse or beneficial, that wholly or partly results from a petroleum activity of an operator.
ENVID	Environmental hazard identification workshop

[1] Defined by the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009

Environmental risk	Applies to unplanned events. Risk is a function of the likelihood of the unplanned event occurring and the consequence of the environmental impact that arises from that event.
Hazard	A situation with the potential to cause harm
Grossly disproportionate	Where the sacrifice (cost and effort) of implementing a control measure to reduce impact or risk grossly exceeds the environmental benefit to be gained.
Impact assessment	The process of determining the consequence of an impact (in terms of the consequence to the environment) arising from a planned or unplanned event over a specified period of time.
Likelihood	The chance of an unplanned event occurring.
Non-routine planned event	An attribute of the planned activity that may occur or will occur infrequently during the planned activity. A non-routine planned event is intended to occur at the time.
Planned activity	A description of the activity to be undertaken, including the services, equipment, products, assets, personnel, timing, duration and location and aspect of the activity.
Planned event	An event arising from the activity which is done with intent (i.e. not an unplanned event) and has some level of environmental impact. A planned event could be routine (expected to occur consistently throughout the activity) or non-routine (may occur infrequently if at all). Air emissions, bilge water discharge and drill cuttings discharge would be examples of planned events.
Receptor	A feature of the environment that may have environmental, social and/or economic values.
Risk	The effect of uncertainty on objectives.
Risk assessment	The process of determining the likelihood of an unplanned event and the consequence of the impact (in terms of economic, human safety and health, or ecological effects) arising from the event over a specified period of time.
Routine planned event	An attribute of the planned activity that results in some level of environmental impact and will occur continuously or frequently through the duration of the planned activity.
SLT	Senior Leadership Team
Unplanned event	An event that results in some level of environmental impact and may occur despite preventive safeguards and control measures being in place. An unplanned event is not intended to occur during the activity.

5.2 Summary of the Environmental Impact and Risk Assessment Approach

5.2.1 Overview

Santos operates under an overarching Risk Management Policy (QE-91-IF-10050). The company Risk Procedure (SMS MS1 ST01) underpins the Risk Management Policy and is consistent with the requirements of AS/NZS ISO 31000:2018, Risk Management – Guidelines (ISO, 2018).

The key steps to risk management are illustrated in **Figure 5-1**. The forum used to undertake the assessment is the environmental hazard workshop, referred to as an ENVID, which is described in Section 4 of Santos' *Offshore Division Environmental Hazard Identification and Assessment Guideline* (EA-91-IG-00004_5).

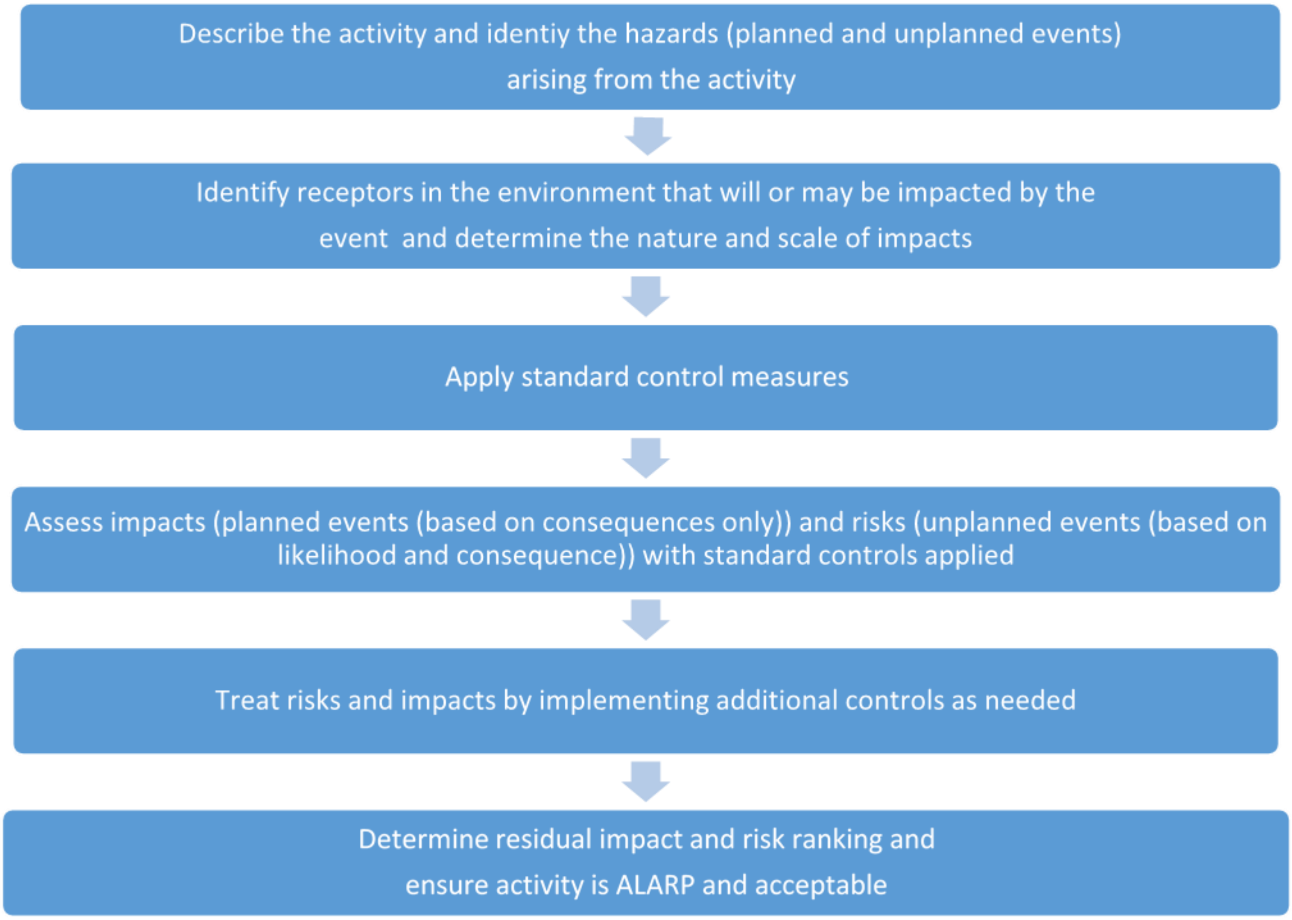

Figure 5-1: Environmental Impact and Risk Assessment Process

Santos’ Environmental Hazard Identification and Assessment Guideline (EA-91-IG-00004) includes consideration of the following key areas in an impact and risk assessment:

+ Description of the activity (including location and timing)
+ Description of the environment (potentially affected by both planned and unplanned activities)
+ Identification of relevant persons
+ Identification of legal requirements (‘legislative controls’) that apply to the activity
+ Santos policy and SMS requirements
+ Principles of Ecologically Sustainable Development (ESD)
+ Santos acceptable levels of impact and risk.

These factors were considered in an environmental impact and risk assessment workshop held in September 2020 in which environmental hazards were identified and assessed (ENVID workshop). The workshop involved participants from Santos' Health, Safety and Environment (HSE), Projects and Operations departments and specialist environmental consultants.

5.2.2 Describe the Activity and Hazards (planned and Unplanned Events)

A description of the activity is required in order to determine the planned events that will take place and the credible unplanned events that may occur. The location, timing and scope of the activity must be described in order to determine the impacts from planned events, and the impacts and risks from unplanned events since these have a bearing upon the environment that may be affected (EMBA) by the activity.

The outcome of this assessment is detailed in the relevant sub-sections of **Sections 6** and **7**.

5.2.3 Identify Receptors and Determine Nature and Scale of Impacts

A description of the environment (natural and socio-economic) within which hazards from the activity will, or may occur, is required. This constitutes a crucial stage of the risk assessment, as an understanding of the environment that will or may be affected is required to determine the type and consequence of impacts from the activity being assessed. The environment must be understood with respect to the spatial and temporal limits of the activity and key resources at risk that will or could be impacted by planned and unplanned events. Santos has developed a *Values and Sensitivities of the Marine and Coastal Environment (EA-00-RI-10062)* reference document which describes the existing environment that may be affected by Santos activities and is reviewed and updated on an annual basis.

Where the existing environment is being reviewed for regulatory approvals, a comparison shall be made against the *Values and Sensitivities of the Marine and Coastal Environment* (EA-00-RI-10062). A new protected matters search is required to ensure a thorough understanding of the existing environment to ensure all risks are assessed.

The extent of actual impacts from each planned activity or risks from each unplanned activity, are assessed using, where required, modelling (e.g. hydrocarbon spills) and scientific reports. The duration of the event is also described including the potential duration of any impacts should they occur. Receptors identified as potentially occurring within impacted area(s) are detailed in **Section 3** and **Appendix D** – EPBC Protected Matters Search Tool Results.

5.3 Describe the Environmental Performance Outcomes and Control Measures

For each planned and unplanned event, a set of Environmental Performance Outcome(s), Control Measures, Environmental Performance Standards and Measurement Criteria are identified. The definitions of the performance outcomes, control measures, standards and measurement criteria must be consistent with the OPGGS(E)R 2009, and the NOPSEMA EP Content Requirements Guidance Note (NOPSEMA, 2019).

For any hazard, additional controls, must also be considered and either accepted for use or rejected based on whether the standard controls reduce impacts and risks to levels that are ALARP and acceptable (refer **Section 5.5** and **5.6**).

Controls are allocated in order of preference according to **Figure 5-2**.

Control	Effectiveness	Example
Eliminate		*Removal of the risk.* Refueling of vessels at port eliminates the risks of an offshore refueling.
Substitute		*Change the risk for a lower one.* The use of low-toxicity chemicals that perform the same task as a more toxic additive.
Engineering		*Engineer out the risk.* The use of oil-in-water separator to minimise the volume of oil discharged.
Isolation		*Isolate people or the environment from the risk.* The use of bunding for containment of bulk liquid materials.
Administrative		*Provide instructions or training to people to lower the risk.* The use of Job Hazard Analysis to assess and minimise the environmental risks of an activity.
Protective		*Use of protective equipment.* Containment and recovery of spilt hydrocarbons.

Figure 5-2: Hierarchy of Controls

5.4 Determine the Impact Consequence Level and Risk Rankings (on the basis that all control measures have been implemented)

This step looks at the causal effect between the aspect/hazard and the identified receptor. Impact mechanisms and any thresholds for impacts are determined and described, using scientific literature and modelling where required. Impact thresholds for different critical life stages are also identified where relevant.

The consequence level of the impact is then determined for each planned and unplanned event using the Santos Environment Consequence Descriptors (**Appendix G** – Santos Environment Consequence Descriptors).

These detailed environmental consequence descriptions are based on the consequence of the impact to relevant receptors in the following categories:

+ Threatened/migratory/local fauna
+ Physical environment/habitat
+ Threatened ecological communities
+ Protected areas
+ Socio-economic receptors.

This process determines a consequence level, based on set criteria for each receptor category, and takes into consideration the duration and extent of the impact, receptor recovery time and the effect of the impact at a population, ecosystem or industry level.

For unplanned events, a risk ranking is also determined using an assessment of the likelihood (likelihood ranking) of the event as well as the consequence level of the potential impact should that event occur. Likelihood rankings are provided in the Santos risk in **Table 5-3**.

The level of information required to complete the impact or risk assessment depends on the nature and scale of the impact or risk. This process determines a consequence level based on set criteria for each receptor category and takes into consideration the duration and extent of the impact, receptor recovery time and the effect of the impact at a population, ecosystem or industry level. Impacts to social and economic values are also considered based on existing knowledge and feedback from stakeholder consultation. As the result of historic consultation with stakeholders, the social and economic values in the region that are of interest are evident.

As planned events are expected to occur during the activity, the likelihood of their occurrence is not considered during the risk assessment, and only a consequence level is assigned.

Table 5-2: Summary of Environmental Consequence Descriptors

Consequence Level		Consequence Level Description
I	Negligible	No impact or negligible impact.
II	Minor	Detectable but insignificant change to local population, industry or ecosystem factors.
III	Moderate	Significant impact to local population, industry or ecosystem factors.
IV	Major	Major long-term effect on local population, industry or ecosystem factors.
V	Severe	Complete loss of local population, industry or ecosystem factors AND/ OR extensive regional impacts with slow recovery.
VI	Critical	Irreversible impact to regional population, industry or ecosystem factors.

For unplanned events, the consequence level of the impact is combined with the likelihood of the impact occurring (**Table 5-3**), to determine a residual risk ranking using the corporate Santos risk matrix (**Table 5-4**). For oil spill events, potential impacts to environmental receptors are assessed where they occur within the EMBA using results from modelling.

Table 5-3: Likelihood Description

No.	Matrix	Description
f	Almost Certain	Occurs in almost all circumstances OR could occur *within days to weeks*
e	Likely	Occurs in most circumstances OR could occur *within weeks to months*
d	Occasional	Has occurred before in Santos OR could occur *within months to years*
c	Possible	Has occurred before in the industry OR could occur *within the next few years*
b	Unlikely	Has occurred elsewhere OR could occur *within decades*

a	Remote	Requires exceptional circumstances and is unlikely even in the long term

Table 5-4: Santos Risk Matrix

		Consequence					
		I	II	III	IV	V	VI
Likelihood	F	Low	Medium	High	Very High	Very High	Very High
	E	Low	Medium	Medium	High	Very High	Very High
	D	Low	Low	Medium	High	High	Very High
	C	Very Low	Low	Low	Medium	High	Very High
	B	Very Low	Very Low	Low	Low	Medium	High
	A	Very Low	Very Low	Very Low	Low	Medium	Medium

5.5 Evaluating if impacts and Risks are ALARP

For planned and unplanned events, an ALARP assessment is undertaken to demonstrate that the standard control measures adopted reduce the impact (consequence level) or risk to ALARP. This process relies on demonstrating that further potential control measures would require a disproportionate level of cost/effort in order to reduce the level of impact or risk. If this cannot be demonstrated, then further control measures are adopted. The level of detail included within the ALARP assessment is based upon the nature and scale of the potential impact or risk. For example, more detail is required for a risk ranked as `Medium’ compared to a risk ranked as `Low’.

5.6 Evaluating Impact and Risk Acceptability

Santos considers an impact or risk associated with the proposed activity to be acceptable if the following criteria are met:

+ The consequence of a planned event is ranked as I or II; or a risk of impact from an unplanned event is ranked Very Low to Low
+ An assessment has been completed to determine whether further information or studies are required to support or validate the consequence assessment
+ Assessment and management of risks has addressed the principles of ecologically sustainable development

+ That the acceptable levels of impact and risks have been informed by relevant species recovery plans, threat abatement plans and conservation advice can be demonstrated
+ Performance standards are consistent with legal and regulatory requirements
+ Performance standards are consistent with the Santos' Environmental Management Policy
+ Performance standards are consistent with industry standards and best practice guidance (e.g., National Biofouling Management Guidance Guidelines for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee, 2018))
+ Performance outcomes and standards are consistent with stakeholder expectations
+ Performance standards have been demonstrated to reduce the impact or risk to ALARP.

6 Planned Activities Risk and Impact Assessment

6.1 Interaction with Other Marine Users

6.1.1 Description of Event

Event	Interaction with other marine users may occur as a result of: + Vessel Operations The movement of vessels within the OA has the potential to result in interactions with other marine users. The MODU will be supported by approximately two support vessels, however this EP has accounted for a maximum of four support vessels. There will be at least one support vessel with the MODU at all times. The support vessels will be either stationary or operating at slow speeds while undertaking activities within the OA. No vessels will be anchoring within the OA. Vessels transiting to and from the operational areas are not included in the scope of this EP and operate under the *Navigation Act 2012*. + MODU Operations The MODU will be within the vicinity of the OA for up to 100 days, including contingency. While the MODU is in position there will be a 500 m PSZ that will be maintained around the MODU at all times. The Activity could potentially inhibit or be a disturbance to marine user groups including commercial shipping, fishing and other oil and gas activities. For commercial fishing licence holders, the level of interaction could lead to temporary displacement to fishing grounds. The presence of the MODU and support vessels could pose a navigational hazard and a collision risk (refer to **Section 7.2**).
Extent	Within the OA
Duration	For the duration of the Activity, as described in **Section 2.2**.

6.1.2 Nature and Scale of Environmental Impacts

Potential Receptors: Commercial Fishers, Recreational Fishers and Tourism, Commercial Shipping, Petroleum Activity

Santos have identified the following stakeholders as potential marine users of the OA; commercial fishers, recreational fishers, commercial shipping, and other petroleum-related vessels. These users maybe temporarily displaced by the physical presence of the MODU and support vessels. The potential effects of noise from vessels on marine users, specifically commercial fishers, is addressed in **Section 6.4**.

6.1.2.1 Socio-economic

Commercial Fishers

Commercial fishers have been identified as relevant stakeholders and are considered to be the main marine user within the OA. There are three Commonwealth fisheries with activity that may overlap the OA; the Western Tuna and Billfish Fishery, Western Skipjack Tuna Fishery, and Southern Bluefin Tuna Fishery.

There are also seven State fisheries with activity that may overlap with the OA. These are summarised in **Table 3-12**.

An analysis of the historical fishing effort data, current fishery closures, depth range of activity, fishing methods and consultation feedback (refer to **Section 4** and **Table 3-12**) has revealed that there is a low potential for interaction with commercial fisheries. None of the Commonwealth fisheries identified in **Section 4.4** are likely to be active in the OA. For State-managed fisheries the 2010-2020 FishCube data (DPIRD 2019) indicated:

+ The Pilbara Line Fishery has recorded activity between 2010-2020 with FishCube data indicating less than three active vessels regularly and the occasionally three vessels, however this was last noted in October 2017.
+ The Pilbara Trap Managed Fishery has recorded regular activity since 2010-2020 with FishCube data reporting less than three active vessels within the OA. However, May and July 2020 recorded three vessels in the OA.
+ Pilbara Crab Managed Fishery has FishCube data from 2010-2020 indicating activity was last recorded in the OA by this fishing in November 2016.
+ Mackerel Managed Fishery has recorded regular activity of less than three vessels in the OA. August 2013 was the only occasion in the 2010-2020 period where the vessel count was at three active vessels.
+ Nickol Bay Prawn Managed Fishery has recorded limited catch effort with less than three active vessels within the OA on four occasions during 2010-2020.
+ West Australian Sea Cucumber Fishery has recorded no activity within the OA since January 2019. Prior to this, the fishery showed activity in the Spring/Summer periods of less than three active vessels.
+ Onslow Prawn Managed Fishery has no recorded activity within the OA since August 2011 where less than three vessels were recorded.

The loss of fishing grounds due to the presence of the OA will be minimal and temporary due to the short duration of the activity.

Indigenous subsistence fishing and traditional hunting may occur in waters close to shorelines, outside of the OA and therefore interactions with the MODU and support vessels will not occur. Ongoing consultation with indigenous users has raised no concerns about the oil and gas activity occurring in offshore waters.

Recreational Fishers and Tourism

There are various charter fishing companies that operate out of Dampier. The closest coastline to the OA is Trimouille Island (part of the Montebello Islands group), which is approximately 20 km from the OA, with the next closest being Lowendal Island (approximately 39 km).

Recreational fishing activities are primarily based out of the Montebello Islands. Given the distance to the Yoorn-1 well and its water depths (approximately 45 m), recreational fishing activities in the OA is not expected to occur.

Recreational activities such as snorkelling, diving, surfing and fishing activities are more likely to occur in shallow waters around the Dampier Archipelago and off the Dampier coast, however interaction with these activities and the MODU and support vessels are unlikely to occur. As such, impacts to tourism are not expected.

Commercial Shipping

The OA intersects with a shipping fairway from Barrow Island (**Figure 3-39**). Analysis of historical Automatic identification system (AIS) shipping data indicates that vessels operating in the area are in the oil and gas industry. Vessel traffic is largely confined to the two designated shipping fairways servicing Port Hedland. Other vessels within the area are commonly proceeding to and from other major ports in the area (ports of Dampier, Port Walcott, Port Hedland, Barrow Island, Varanus Island and Onslow). Should commercial vessels need to deviate from planned routes to avoid the Activity vessel, this may slightly increase transit times and fuel consumption. As the OA is in open waters with no grounding or navigational hazards, it is not likely that any such deviation would increase the potential for vessel collision or grounding.

Oil and Gas Activities

The North West Shelf (NWS) is a major oil and gas hub in Australia, with several companies operating within the area. The closest is the Campbell platform; operated by Santos. The activity occurs in a particularly dense area of the NWS with respect to the main oil and gas operational and exploratory fields. There is no existing oil and gas facilities or infrastructure within the OA.

6.1.3 Environmental Performance Outcomes and Control Measures

Environmental Performance Outcomes (EPOs) relating to this event include:

+ Reduce impacts on other marine users through the provisions of information to relevant stakeholders such that they are able to plan for their activities and avoid unexpected interference [YO-EPO-01]

The Control Measures considered for this Activity are shown in **Table 6-1** with Environmental Performance Standards (EPS) and Measurement Criteria for the EPOs described in **Section 8.4**.

Table 6-1: Control Measures Evaluation for Interaction with Other Marine Users

Control Measure (CM) Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
Standard Controls				
YO-CM-024	MODU identification system	MODU has an Automatic Identification System (AIS) to aid in its detection at sea. Reduces risk of environmental impact from vessel collisions.	Benefits considered to outweigh negligible costs to Santos WA	**Adopted** – Benefits considered to outweigh negligible costs to Santos.

Control Measure (CM) Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
YO-CM-032	No fishing from MODU and vessel	Personnel are prohibited from recreational fishing activities on MODU or vessels	Negligible costs.	**Adopted** – Benefits considered to outweigh negligible costs to Santos
YO-CM-022	Santos stakeholder consultation strategy	Ensures other marine users, such as commercial fishers, are aware of upcoming installation and commissioning operations so they can plan their business accordingly.	Limited additional costs to Santos. Stakeholders time required to review consultation material and communicate with Santos.	**Adopted** – Benefits considered to outweigh negligible costs. Important control to ensure other marine users are aware of upcoming operations and potential business disruptions. Provides an opportunity for Santos and stakeholders to discuss additional ways of minimising on-water interference and business disruptions.
YO-CM-014	Maritime Notices	Ensures other marine users are aware of the presence of the MODU and support vessels, and static data collection.	Costs associated with the personnel time in issuing notifications and closing out queries and responses.	**Adopted** – Benefits considered to outweigh negligible costs. Maritime requirement to issue marine notices.
YO-CM-038	Petroleum Safety Zone (PSZ) established to reduce potential for collision or interference with other marine user activities.	Requested 500 m exclusion zones around the vessel prevents other vessels from getting too close and causing damage to equipment of either party.	No additional costs to Santos. Other marine users may be temporarily excluded from small areas, disrupting their activities.	**Adopted** – The requested exclusion of other marine users is temporary. Marine users will still be able to access the operational areas. Normal navigation at sea process whereby shipping vessels avoid navigational risks. Hence, the safety benefits to all marine users

Control Measure (CM) Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
				outweighs any potential costs.
YO-CM-031	Lighting will be used as required for safe work conditions and navigational purposes.	Reduces the risk of collisions with other marine users.	Negligible costs of acquiring and operating navigation equipment, as required by maritime law.	**Adopted** – The safety benefits of having navigation equipment and procedures outweighs any cost. This is a maritime requirement.
YO-CM-015	Support vessel(s)	Crew of support vessels will maintain constant bridge watch, including for third party vessels which may be approaching or enter the exclusion zone. AIS Reduces risk of impact from vessel collisions	No additional costs.	**Adopted** – No additional costs. This is a commitment in the Safety Case Revision.
YO-CM-033	MODU positioning	MODU location not within AMSA defined shipping fairway to reduce potential impacts to the marine users transiting the area.	Negligible costs.	**Adopted –** Benefits considered to outweigh negligible costs to Santos without impacting on the drilling location requirements for this activity.
Additional Control Measures				
N/A	Manage the timing of the operational activities to avoid peak marine user periods (e.g., fishing).	Would eliminate potential impacts to other marine users.	High cost in moving schedule due to MODU availability. Not considered feasible as marine users could potentially be in the area all year round. The area that stakeholders are excluded from is small (500 m) when compared to the area available to other marine	**Rejected** – Stakeholders and shipping in the area all year round. Cost grossly disproportionate to low socio-economic benefit given the location of the activity has low-usage by commercial fishers or areas of tourism.

Control Measure (CM) Reference	Control measure	Environmental benefit	Potential cost/issues	Evaluation
			users and there is low marine user activity in the area as evidenced through consultation.	
N/A	Reduce the radius of the exclusion zone around the MODU.	Would reduce the potential impacts to other marine users (shipping and fishing) as they would be excluded from a smaller area.	The increased risk of vessel collision is not acceptable. Cost grossly disproportionate to benefit given the location of the activity has low usage by commercial fishers and does not overlap with any commercial shipping lanes or areas of tourism. The 500 m safety exclusion zone is a proscribed area (AMSA) and therefore cannot be reduced.	**Rejected** – The increased risk of vessel collision is not acceptable. Cost grossly disproportionate to benefit given the location of the activity has low usage by commercial fishers and does not overlap with any commercial shipping lanes or areas of tourism. The PSZ is a proscribed area (AMSA) and therefore cannot be reduced.
N/A	Avoidance of other active marine users, where safe to do so	The MODU doesn't have the ability to avoid others when drilling, in unlikely event that interaction with marine user requires the vessel to avoid other user. Note primary controls around stakeholder engagement and navigational lighting will suffice this control to not be implemented.	The MODU needs to be stationary and is not able to move from its position. If it has to move from it position this will delay drilling.	**Rejected –** Not feasible as the MODU needs to be stationary. However, primary controls to avoid other marine users is thorough stakeholder engagement.

6.1.4 Environmental Impact Assessment

Table 6-2: Impacts and Consequence Ranking – Interaction with Other Marine Users

Receptor	Consequence Level
Interaction with other marine users	
Threatened, migratory or local fauna	Not applicable – related to socio-economic receptors only.
Physical environment or habitat	
Threatened ecological communities	
Protected areas	
Socio-economic receptors	The impact of the MODU and vessel operations on socio-economic receptors are considered to be I (Negligible) due to the fact that: + The OA intersects with a shipping fairway from Barrow Island. Any risk to commercial shipping activities is mitigated through notifications sent to the AMSA's Joint Rescue Coordination Centre (JRCC) for Auscoast warnings and the Australian Hydrographic Service (AHS) for Notices to Mariners, as outlined in **Section 6.1.3.** + Vessels could be expected to divert around the OA, but this would be a temporary exclusion given the duration of the activity – for drilling, a planned duration of up to 100 days including contingency at the OA. + Tourism activities may occur around the Dampier Archipelago and the Montebello Islands. The OA is 20.77 km from the closest Montebello Island but are not expected to occur in the OA given the water depth (approximately 45 m), lack of seafloor features and distance from shore. + The OA is not extensively fished – commercially, traditionally or recreationally. During drilling, an exclusion area (PSZ) is established around the MODU (500 m), for a relatively short duration (between a planned duration of up to 100days). The activity is unlikely to cause any fishing impacts. + There are no oil and gas facilities or infrastructure within the OA, with the closest being the Santos operated Campbell platform approximately 8 km from the OA. + Stakeholder consultation and a review of recent shipping data did not raise any concerns regarding disruptions to commercial shipping or other oil and gas operators. + All equipment will be removed from the seafloor once each well is complete (unless in an emergency such as a cyclone resulting in MODU temporarily departing the OA).
Overall worst-case consequence	I - Negligible

6.1.5 Demonstration of ALARP

There are no alternatives to the use of a MODU and support vessels to undertake the activity. The OPGGS Act requires the presence of a 500 m PSZ. Other navigational controls, as specified in the Navigation Act, will also be implemented (lighting, communication aids and charting). If the management controls are adhered to, then the risk of interacting with other users of the sea will have been reduced to ALARP.

Santos' stakeholder consultation process is described in **Section 4**. Throughout the duration of EP preparation, details of the activity have been communicated to relevant stakeholders as appropriate. In consultation, stakeholders are made aware of the proposed area from which other marine users may be excluded for the duration of the activity, and the potential schedule. Notice to Mariners will be issued detailing the location and nature of activities and the vessels will maintain navigation aids.

During operational activities, support vessels may assist in maintaining the 500 m PSZ around the MODU, to reduce the potential incursion by other marine users. No concerns have been raised by stakeholders regarding the potential exclusion from the proposed operational areas.

With the controls adopted, the assessed residual consequence for this impact is negligible and cannot be reduced further. Additional control measures were considered but rejected since the associated cost / effort was grossly disproportionate to any benefit as detailed in **Section 6.1.3**. Therefore, it is considered that the impact is ALARP.

6.1.6 Acceptability Evaluation

Is the consequence ranked as I (Negligible) or II (Minor)?	Yes – maximum consequence from interaction with other marine users is I (Negligible).
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian Marine Park zoning objectives)?	Yes – management consistent with Safety of Life at Sea (SOLAS) 1974 and *Navigation Act 2012*. The OA intersects the Montebello Marine Park which is categorised as Multiple Use Zone (IUCN Category VI) (**Table 3-4**). The objective of the Multiple Use Zone (VI) is to provide ecologically sustainable use and the conservation of ecosystems, habitats and native species. The management of the activity in relation to other marine users is aligned with this objective through the adoption of YO-EPO-01, and control measures outlined in **Table 6-1**. Offshore petroleum activities authorised under the OPGGS Act (i.e. exploration drilling) are considered

	'mining operations'; which are permitted within a Multiple Use Zone (VI). The objectives and actions of these publications were considered during the assessment of impacts and risks. The controls outlined in **Table 6-1** are consistent with the objectives of the material listed above and Santos considers the impacts of interactions with other marine users to not be inconsistent with these objectives.
Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – WAFIC raised concerns for fishers in relation to the presence of the PSZ and the potential impacts to fishers. Santos responded to WAFIC's concerns during consultation outlining the controls in place to address their concerns, including the provision of additional information during support vessel inductions. AFMA requested Santos consult directly with Commonwealth concession holders in the North West Slope Trawl Fishery and WAFIC, which Santos confirmed was undertaken. AMSA requested that appropriate notifications of activity are made to AMSA's JRCC and the Australian Hydrographic Office (for Notice to Mariners); and that timely and relevant Maritime Safety Information (MSI) is promulgated for the area and nature of operations. DNP requested the EP gives consideration to avoiding impacts upon migratory species – with particular attention to managing the risk to turtle foraging and internesting locations. DNP also requested notifications as per the Petroleum Activity and Australian Marine Park Guidance Note (NOPSEMA, 2020) regarding timing and information provided. Santos considers these concerns to have been addressed or will be addressed as per the Activity Notification and Reporting Requirements (**Table** 8-4).
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

The presence of the MODU and vessels is not expected to significantly affect other marine users, including commercial fishing operations or shipping traffic, given:

+ The PSZ (500 m) is a small exclusion zone in the context of the wide-open ocean environment

- Short duration of the drilling activity – estimated up to 100 days at the OA, depending on weather, equipment and drilling progress
- Absence of any existing navigation hazards within the OA.

A PSZ around the MODU is required under the OPGGS Act, and the controls proposed will ensure that other users are aware of its presence and readily able to navigate accordingly, such that potential impacts are ALARP and are considered to be environmentally acceptable.

6.2 Seabed Disturbance

6.2.1 Description of Event

Event	Potential seabed disturbance (temporary) may occur in the operational areas as a result of: + Drilling activities – Move in and Rig Up – Well design – Plug and Abandonment – Contingency Activities (re-spud and side-track drilling) Positioning of the jack up MODU requires the three MODU legs (spud cans) to be jacked up during rig positioning to avoid contact with the seabed. Once at the desired location and with the MODU stationary, the legs are lowered to be fully in contact with the seabed and the MODU raises itself approximately 20 m above the sea surface and the cantilever will be skidded out. The predicted seabed disturbance from the jacked up MODU legs (spud cans) is estimated to be: + Approximately 260 m^2 per leg, equating to a footprint of approximately 780 m^2 for the well (three legs x 260 m^2) for the well. Contingency activities may require the MODU to move and rig-up in a different location, increasing the seabed disturbance footprint. Should contingency activities be required, the maximum footprint would be the same size, resulting in a doubling of the seabed disturbance area to approximately 1,560 m^2. There will be no anchoring or mooring of support vessels within the OA. Upon commencement of drilling, the conductor hole will have a surface area of <1 m^2 at the drilling location. During the activity, additional potential seabed disturbance may also occur in the OA due to ROV activities and from dropped objects (e.g., riser, tote tanks, etc.). For solid objects that may be accidentally dropped overboard and are heavy enough to sink through the water column and subsequently land on the seabed, see **Section 7.6** (Non-Hydrocarbon Releases – Solids). Seabed disturbance from drilling and cement discharges is discussed in **Section 6.7**.
Extent	All seabed disturbance will occur within the OA. For MODU positioning and drilling activities, the estimated direct physical disturbance of the seabed is approximately 780 m^2 for the well (planned) or <1,560 m^2 (if contingency activities are required.

Duration	Temporary – for the duration of the activity, with recovery within weeks to months following removal of the MODU spud cans from the seabed within the area.

6.2.2 Nature and Scale of Environmental Impacts

<u>Potential receptors: Physical environment (benthic habitats), threatened or migratory fauna (marine mammals, marine reptiles, sharks and rays, fish), protected and significant areas (marine parks) and socio-economic receptors (commercial fishing).</u>

Operational activities may disturb seabed and benthic habitat through the following impacts:

+ Direct physical disturbance of an area of seabed habitat, including benthic fauna, of approximately 780 m^2 (planned) or 1,560 m^2, if contingency activities are required (for drilling the well)
+ Indirect disturbance to benthic habitats and associated marine fauna by sedimentation
+ Increased turbidity of the near-seabed water column.

6.2.2.1 Physical environment

Benthic Habitats

The positioning of the MODU associated with the drilling activity will directly contact the seafloor and will inevitably result in localised impact (direct and indirect) to water quality and benthic habitat (and associated fauna) in the OA.

The OA does not contain any significant or unique areas of benthic habitat. As described in **Section 3.2.1.2**, the benthic environment within the OA consists of flat seabed comprising very fine to fine carbonate sand with varying sizes of shell fragments. 18 shadows were depicted by side scan sonar and have been interpreted as boulders. Sparse benthic and epi-benthic communities are expected with low biodiversity given known uniformity of benthic habitats across the NWS and within this geotechnical province (Middle Shelf 2) (Williams et al. 2010; NGI, 2018).

No significant seabed features or biota have been found in the immediate region surrounding the OA.

Indirect impacts associated with a temporary (several hours) and localised (within tens of metres) decline in water quality due to increased suspended sediments or sedimentation of the seabed are not expected to affect any values and sensitivities of regional importance. It is not considered that localised impacts within the OA will result in significant indirect impacts (i.e. turbidity) to nearby shoals and banks, offshore reefs or islands given their distance from the OA.

The potential impacts of seabed disturbance caused by the planned activities are considered negligible due to the following:

+ Depressions on the seabed left by the MODU spud cans once the MODU has moved off site, and small depressions left by sediment sampling are predicted to infill as a result of movement of sediments by water currents and by the deposition of detrital matter. Given the nature of the habitat and associated benthic communities (**Section 3.2.2**), recolonisation would also be expected to be rapid.

+ No known sensitive seabed features (e.g., reefs, canyons, shipwrecks, KEFs) or benthic primary producer habitat (e.g. areas of hard corals, seagrass, macroalgae or mangroves) are present in the OA. The minor and temporary disturbance to seabed habitat from the placement of the MODU spud cans and survey techniques is not considered to cause any significant effect on ecosystem function given the sparseness of benthic cover.

+ The overall footprint for disturbance within the OA is estimated to be <1,560 m^2 for the well (allowing for contingency activities but will be more likely be <780 m^2) and to involve benthic habitats and fauna assemblages that are considered widespread throughout the region (**Section 3.2.2**) and able to rapidly re-establish following physical disturbance. The scale of disturbance will be insignificant when compared to the vast areas of similar habitat throughout the NWS.

6.2.2.2 Threatened / Migratory Fauna

Habitat modification is identified as a potential threat to a number of marine fauna species in relevant Recovery Plans and Conservation Advice (**Table 3-9**). Disturbance of the seabed is not anticipated to significantly affect mobile marine fauna, such as marine mammals, marine reptiles, fish, sharks and rays. The area of seabed to be disturbed within the OA also represents a negligible portion of the habitat available for these species. No decrease in local population size, area of occupancy of species, loss or disruption of critical habitat or disruption to the breeding cycle of any of these protected matters is expected.

The OA is approximately 20 km to the nearest coastline and intersects with BIAs for the loggerhead turtle (internesting and nesting), and green, flatback and hawksbill turtles (internesting and critical nesting habitat). However, internesting activities typically occur within shallower waters. The habitat present within the OA is representative of habitats within the broader BIA and the region. Permanent displacement of habitat from seabed disturbance is not expected due to the small scale of the activity.

Fish, sharks and rays may also forage in the soft sediments for marine invertebrates. However, given the small scale of the activity (1,560 m^2 for worst case contingency scenario) and the regional availability of habitat, seabed and benthic habitat disturbance is not expected to affect these species.

6.2.2.3 Protected and significant areas and socio-economic receptors

Commercial fisheries that target benthic fauna in the OA are not predicted to be significantly affected due to the short duration of the activity and the area of seabed disturbance is insignificant compared to the total available fishing area. Potential impacts to benthic habitats and subsequently to associated fish species of commercial importance are likely to be localised with the impact to, and displacement of, fish insignificant at a population level.

The OA intersects the Montebello Marine Park (Multiple Use Zone – IUCN Category VI). Conservation values of the marine park (as outlined in **Section 3.2.3**) have the potential to be impacted by seabed disturbance through impacts to the physical environment and marine fauna.

Similarly, the temporary turbidity and sedimentation associated with the placement and retrieval of spud cans is not considered likely to cause a significant environmental impact given the sparseness of benthic cover (**Section 3.2.2**) and the highly localised impact zone. In this context, any potential sediment movement caused by the activity is likely to have minimal impacts.

6.2.3 Environmental Performance Outcomes and Control Measures

The EPO relating to this event is:

+ Seabed disturbance is limited to planned activities and defined locations within the operational areas. [YO-EPO-07]

The control measures considered for this event are shown in **Table 6-3**, and the EPS measurement criteria for the EPOs are described in **Section 8.4**.

Table 6-3: Control Measure Evaluation for Seabed Disturbance

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
YO-CM-003	MODU move procedure	No accidental contact with the seabed and subsea infrastructure during the MODU moves limiting seabed disturbance.	Personnel costs associated with ensuring procedures are in place and implemented during inspections.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweigh the costs of personnel time.
YO-CM-039	Recovery of all deployed equipment	Prevents ongoing impact to the seabed due to equipment being left in situ	Minimal additional cost to recover equipment	**Adopted –** Helps to minimise impacts and extent of seabed disturbance.
Additional Control Measures				
N/A	Use of MODU with Dynamic Positioning (DP) Systems only (i.e. no spud cans or anchors)	Would reduce seabed disturbance as no contact of MODU with the seabed.	Not feasible for jack-up rigs.	**Rejected** – Not technically feasible to use a DP MODU to drill the well.

YO-CM-025	Anchoring	No planned anchoring of MODU and support vessels within operational areas reduces seabed disturbance area as no anchor or anchor chain drag/placement.	Additional fuel costs due to vessels moving or idling.	**Adopted** – MODU does not require anchors. Benefits of ensuring procedure is followed and controls implemented, outweigh the costs of personnel time in implementation of control.

6.2.4 Environmental impact Assessment

Table 6-4: Impacts and Consequence Ranking – Seabed Disturbance

Receptor	Consequence Level
Seabed disturbance	
Threatened, migratory or local fauna	No sensitive seabed features are expected within the permit area based on surveys at similar water depths in adjacent permits. The areas of seabed that will be impacted are expected to include unconsolidated very fine to fine carbonate sand with varying sizes of shell fragments (MMA Offshore, 2021). These sediments are un-vegetated and likely to have sparse benthic and epi-benthic communities with low biodiversity (refer to **Section 3.2.2**) and include species with widespread regional distributions. Therefore, significant loss of habitat is not expected. Marine invertebrates may inhabit soft sediments and can contribute to the diet of some fauna. The area of soft sediment habitat that is potentially impacted is small compared to the amount of habitat available and therefore the disturbance is not expected to affect prey availability, or protected fauna species. Habitat modification is identified as a potential threat to a number of marine fauna species in relevant Recovery Plans and Conservation Advice (**Table 3-9**). However, the area of disturbance has not been identified as a habitat that supports any protected species. Impacts will be temporary, and the area potentially impacted is small compared to the size of the areas used by these species for foraging. Therefore, no long-term impacts to these species are expected. No decrease in local population size, area of occupancy of species, loss or disruption of critical habitat or disruption to the breeding cycle of any of these protected matters is expected. Given the small-scale area of the activity, minor and short-term nature of indirect impacts and the regional availability of the habitats present, seabed and benthic habitat disturbance is not expected to impact threatened or migratory species at a population level. The consequence level is therefore considered to be I (Negligible).

Receptor	Consequence Level
Physical environment or habitat	The area of physical environment and habitat that will be impacted during the proposed activities is small (approximately 1,560 m^2 for the well) compared to the area of similar habitat in the wider environment and is expected to re-establish following disturbance. As such, long-term or significant impacts to habitat values or ecosystem function are not expected. Impacts to the physical environment or habitat are assessed as I (Negligible).
Threatened ecological communities	Not applicable – No threatened ecological communities are identified in the area where seabed disturbance could occur.
Protected areas	The OA intersects the Montebello Marine Park (Multiple Use Zone - IUCN Category VI). The relevant values of the marine park are not anticipated to be significantly affected by seabed distance activities, and therefore the consequence has been assessed as (I) Negligible.
Socio-economic receptors	Not applicable – Disturbance of the seabed and benthic habitat within the OA is highly unlikely to impact socio-economic receptors such as shipping and tourism. Any minor alteration or modification to habitats is not expected to impact commercial fisheries' target species based on the small size of disturbance relative to the available fishing grounds. No stakeholder concerns have been raised regarding this aspect.
Worst-case consequence level	I - Negligible

6.2.5 Demonstration of ALARP

There are no reasonably practicable alternatives to the use of vessels and a jack-up MODU in order to undertake the activity. The use of a MODU with DP systems only, which would eliminate disturbance to the seabed from placement of spud cans, is not feasible for the well as the water depth is too shallow (approximately 45 m). Other MODUs (such as semi-submersible MODUs) require anchoring, which results in a greater area of seabed disturbance than that of a jack-up MODU. Additionally, the water depth within the OA is too shallow for a moored semisubmersible MODU.

Seabed disturbance associated with the activity will be limited to the placement of the MODU spud cans on the seabed when the rig is jacked up, and potentially from ROV activities. The disturbance will involve an area of benthic habitats (i.e., primarily soft sediments with little epifauna) that are widely represented at a regional scale on the NWS. Given the relatively small area (<1,560 m^2 for the well, allowing for contingency activities) and the temporary nature of disturbance from the MODU presence (planned for up to 100days including contingency), the impacts are not considered to be significant. The MODU move procedure is designed to limit the extent of direct seabed disturbance. The MODU will not anchor and the support vessels will not require moorings or anchoring in the OA, further reducing potential impacts to the benthic environment. Impacts will be localised to within the OA and benthic habitat would be expected to recolonise within weeks to months following completion of the activity.

Given the lack of sensitive receptors within the OA and the expected rapid recovery time, negligible environmental impacts are expected.

All practicable control measures have been reviewed (**Section 6.2.3**) and those adopted are considered appropriate to manage the impacts such that the residual consequence is assessed to be negligible and cannot be reduced further. The proposed management controls for seabed disturbance are in accordance with the Santos' risk management criteria and are considered appropriate to manage the risk to ALARP.

6.2.6 Acceptability Evaluation

Is the consequence ranked as I (Negligible) or II (Minor)	Yes – maximum consequence from seabed disturbance is I (Negligible).
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian Marine Park zoning objectives)?	N/A – no relevant requirements regarding this event in this area, given the localised nature and extent of the operational facilities. No plans identified seabed disturbance like those described above as being a threat to marine fauna or habitats. The benthic environment within the OA contains no known seabed features (e.g. shoals, banks) or habitats of high environmental values, including no overlap with KEFs (**Section 3.2.1.1**). Impacts to the marine environment from seabed disturbance will be highly localised. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) identifies habitat modification as a pressure that may impact marine park values. It seeks to minimise the impact of pressures on the marine park values as far as reasonably practicable. The implementation of YO-EPO-01, and control measures outlined in **Table 6-3** will ensure seabed disturbance will not compromise this outcome. The OA intersects the Montebello Marine Park which is categorised as Multiple Use Zone (IUCN Category VI) (**Table 3-4**). The objective of the Multiple Use Zone (VI) is to provide ecologically sustainable use and the conservation of ecosystems, habitats and native species. This objective was considered during the assessment of impacts and risks. The adoption of YO-EPO-01, and control measures outlined in **Table 6-3** ensures the impacts of seabed disturbance are not inconsistent with these objectives.
Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.

Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

6.3 Light Emissions

6.3.1 Description of Event

Event	Light emissions will occur as a result of: + Vessel operations + MODU Operations On the MODU and support vessels they will routinely have external lighting to facilitate navigation and safe operations at night. Lighting typically consists of bright white (i.e., metal halide, halogen, fluorescent) lights, and are not dissimilar to other offshore activities in the region, including fishing and shipping. Lighting levels will be determined primarily by operational safety and navigational requirements under relevant legislation, specifically the *Navigation Act 2012*. The MODU and support vessels will be required to generate navigational lighting at night to indicate their position and they must indicate their limited ability to manoeuvre during operations under the *Navigation Act 2012*. + ROV Operations The ROV will be used during the activity 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. A minimum level of lighting is required for safety and navigational purposes onboard the MODU and support vessels so it cannot be eliminated if the proposed activity is to proceed.
Extent	The light assessment boundary of 20 km from the source will be used as the extent of light exposure, in accordance with National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020). This additional 20 km buffer around the OA is the extent relevant to the impact assessment for planned light emissions. As this extends beyond the described area designated as the OA (**Section 2.1.2**) for other planned activities; the values and sensitivities of this additional 20 km area were identified using PMST reports (**Appendix D** – EPBC Protected Matters Search Tool Results). **Table 3-7** identifies the species identified within the 20 km area; and **Table 3-8** identifies the BIAs intersected by the light assessment boundary.
Duration	Navigational and safety lighting will be required on a 24-hour basis for the duration of the activity as described in **Section 2.2.**

6.3.1.1 Light generated by the MODU and Vessels

External lighting will be required on the MODU and support vessels for safe navigation and to facilitate safe working conditions. Vessel and facility lighting are considered standard practice. Lighting used during offshore operations is generally bright white light such as light emitting diodes, halogens, fluorescent and metal halide lights and would be similar to lighting used by other offshore marine users (e.g. shipping and fishing).

The drilling campaign is planned to take up to 100 days including contingency, and be undertaken 24 hours a day.

There is no flaring proposed, which is typically the greatest source of light emissions at other offshore petroleum facilities (due to factors such as height and wavelength). The height of the MODU is more than the support vessels, so is the worst-case source of light emissions and will determine the spatial extent the light is visible.

Two studies have been used to evaluate the spatial extent of light emissions from the MODU.

Light emissions associated with an FPSO was modelled for the Dorado Development Offshore Project Proposal (Pendoley Environmental, 2020 undertaken for Santos, 2021). The facility's lighting design and luminaire specifications were applied to the ILLUMINA artificial light at night model (Aubé et al. 2005). The ILLUMINA model is a 3-D model that predicts both the extent of visible light and radiance (light received in a specific area).

In the absence of any published or generally accepted units or scale for measuring the impact of radiance on wildlife, moonlight was selected as a proxy (considered representative of ambient light levels marine fauna are adapted to). The light model output (radiance, units of $W/m^2/sr$) was converted to units of full moon equivalents in an attempt to give the radiance output some biological relevance and to aid interpretation in an environmental impact assessment context. The light emissions are considered to have reduced to ambient when radiance is less than the equivalent of 0.01 (1/100th) of one full moon (Pendoley Environmental, 2020).

In the facility lighting scenario (i.e. with no flaring) the model results show that radiance has reduced to ambient (less than 0.01 full moon equivalent) at 17.7 km from the source.

Table 6-5: Distance of equivalent moon radiance for Non-flaring light modelling scenario

Proportion of radiance of a full moon*	Distance from FPSO at which equivalent moon radiance is reached (km)
100	0.18
10	0.55
1	1.79
0.1	5.54
0.01	17.74

*Where 1 equals the radiance of one full moon and 0.01 equals 100th the radiance of one full moon

Source: Pendoley Environmental, 2020

Modelling and measurements of facility lighting have also previously been undertaken by Woodside. Light emissions from the facility lighting on the MODU is expected to be comparable to that of the Woodside-operated Torosa drilling rig used during previous light intensity modelling completed by ERM (2010). The MODU is expected to have a similar lit surface area as the drilling rig modelled, and will be lit to a similar light level required for safe operation of the rig. Therefore, using modelling results from ERM (2010) is considered appropriate for a light intensity assessment for the Yoorn-1 MODU facility lighting.

The ERM (2010) modelling assessment predicted:

+ light intensity levels greater than 0.1 Lux up to 800 m from the rig, comparable to ambient light levels during full moon to twilight.
+ between 800 m and 1.2 km from the drilling rig, the model predicted light intensity levels comparable to ambient light levels during a quarter moon to full moon night sky (0.01 Lux to 0.1 Lux).
+ between 1.2 km and 12.6 km, light intensity levels were predicted to be between 0.01 Lux and 0.001 Lux, which is comparable to ambient light intensity levels between a moonless clear night sky and a quarter moon.
+ beyond 12.6 km there was no measurable change to the ambient light intensity levels (i.e. less than 0.001 Lux).

The above predicted Lux levels from the modelling align with measured Lux levels recorded during a development drilling campaign off the Western Australian coast using a rig similar to the MOPU. The light intensity of the drilling rig lighting was highest at 8.9 Lux, 100 m from the rig, and lowest at 0.03 Lux at the extremities of the survey grid approximately 1.4 km from the rig (Woodside, 2014).

The light intensity assessment indicates that the lighting on the MODU may have a measurable change to ambient light conditions of up to 12.6 km. The closest nesting beaches to the OA are Trimouille Island and the Montebellos which are approximately 20 km away.

Both of these studies indicate that the spatial extent of a change to ambient light are less than the 20 km light assessment boundary used for the purposes of impact assessment, based on the National Light Pollution Guidelines for Wildlife (CoA, 2020).

6.3.2 Nature and Scale of Environmental Impacts

<u>Potential Receptors: Ambient Light, Threatened, migratory or local fauna (marine mammals, marine turtles, sharks, rays, fish and seabirds).</u>

Continuous lighting may result in localised alterations to normal marine fauna behaviours for fish, sharks, marine turtles and seabirds that can alter foraging and breeding activity in marine turtles, seabirds, fish and sharks. The species with greatest sensitivity to light are marine turtles and seabirds.

A PMST search was undertaken for the 20 km light assessment boundary around the OA, recommended in the National Light Pollution Guidelines. **Table 3-7** identifies the species present within the light boundary. Additional to the species found in the OA, five have a threatened species status; Northern Siberian Bar-tailed Godwit, Australian Painted Snipe, Short-nosed Seasnake, Leaf-scaled Seasnake, and Sei Whale. However, the associated Conservation Advice do not identify light emissions as a potential threat for these species.

Additional BIAs within the 20 km light assessment boundary are shown in **Table 3-8**. Of the additional BIAs and habitat critical for survival of the species identified, the three marine turtle species are known to be sensitive to light (Flatback, Hawksbill and Green turtles).

6.3.2.1 Marine Mammals

There is no evidence to suggest that artificial light sources adversely affect the migratory, feeding or breeding behaviours of marine mammals. Marine mammals 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 marine mammal behaviour or survival.

Both the OA and light assessment boundary overlap with the migration BIA for humpback whales and the distribution BIA for pygmy blue whales. The humpback whale does not have a Conservation Advice document or Recovery Plan and light is not listed as a threat in the Blue Whale Conservation Management Plan 2015 – 2025 (2015). Impact from light to these species is not anticipated.

Light sensitive species have been identified by reviewing the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020). The National Light Pollution Guidelines for Wildlife have been published to minimise the adverse impacts on marine fauna from artificial lighting. According to the guidelines, 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 (Commonwealth of Australia 2020).

6.3.2.2 Plankton, Fish (pelagic) and Sharks

Fish at the surface of the water have the potential to be impacted by artificial light. Sharks and rays are not known to be significantly attracted to light sources at sea; however, they may be attracted to the fish that are attracted to the light. Therefore, disturbances to behaviour may occur.

Fishes will likely not be affected by navigational lighting for mariners (Morandi et al. 2018). However, other light emissions from the support vessels and MODU (such as deck lights for operational requirements) in the OA may result in localised aggregation of fish in the immediate vicinity of the vessel and MODU. This may result in an increase in predation on prey species aggregating in the area, or exclusion of nocturnal foragers/predators from the area (Marchesan et al. 2005).

Artificial light can also influence dial vertical migration patterns of plankton (including planktonic life stages of some fish species) in the surface waters and lead to migrations that occur outside of the optimal window for that species (Gibson et al. 2001, cited in Morandi, 2018). The aggregation of plankton from light may result in the presence of whale sharks foraging as they are filter feeders, that primarily feed on plankton and zooplankton. There is a foraging BIA identified for the whale shark that intersects the light assessment boundary, however the Species Profile and Threats

Database and Conservation Advice for the whale shark does not identify light emissions as a threat (TSSC 2015a).

Overall, a short-term localised increase in fish activity is expected to occur as a result of lighting from the MODU and vessels; however, with negligible impacts to the local fish population.

6.3.2.3 Marine Turtles

The National Light Pollution Guidelines states that a 20 km buffer (based on sky glow) to important habitat for turtles should be applied when considering possible impacts (CoA, 2020). However, the demonstrated impacts on which this buffer is based were in response to light emissions associated with a liquified natural gas (LNG) plant. Although details around the individual light sources of the case study and the light sources on the vessels are unknown, it is expected that light emissions associated with a MODU and support vessels will be notably lower compared to an LNG plant.

Two relevant light modelling studies found that the spatial extent of a measurable change in ambient light was 12.6 km from a drilling rig, and 17.4 km from an FPSO (ERM 2010; Pendoley Environmental, 2020) (**Section 6.3.1.1**).

Both of these studies indicate that the spatial extent of a change to ambient light are less than the 20 km light assessment boundary used for the purposes of impact assessment, based on the National Light Pollution Guidelines for Wildlife (CoA, 2020).

The light assessment boundary (20 km buffer from the well location) intersects with the following marine turtle BIAs / habitat critical to the survival of the species as shown in **Table 3-8:**

+ Internesting buffer BIA for flatback, hawksbill, loggerhead and green turtles;
+ Habitat critical for the survival of the species for green, hawksbill and flatback turtles;
+ Additional mating, nesting, interesting and foraging BIA for green turtles.

The closest nesting beach to the OA is Trimouille Island (and the rest of the Montebello Islands), which is approximately 20 km from the OA boundary (and approximately 22 km from the proposed well location); and the Lowendal Islands (approximately 39 km from the OA). Trimouille Island is just within the 20 km light assessment boundary recommended by the National Light Pollution Guidelines (CoA, 2020). Trimoulle Island is a known nesting location for flatback and hawksbill turtles; and green turtles are known to nest on sandy beaches of the Montebello Islands (CoA, 2020).

These internesting areas are around the Montebello Islands (for all turtles) and the Dampier Archipelago (for Flatback turtles).

Internesting areas vary between 20–60 km from a nesting beach for the different turtle species. The Recovery Plan for Marine Turtles 2017-2027 identifies a 20 km internesting buffer for Hawksbill and Green turtles; and 60 km for Flatback turtles (CoA 2020).

The peak time of year identified for nesting and interesting areas identified as habitat critical to the survival of marine turtles is (CoA, 2017a):

+ Flatback turtles, Pilbara genetic stock: Oct-Mar
+ Green turtles, North West Shelf genetic stock: Nov-Mar; Ashmore Reef – All year

+ Loggerhead turtles, Western Australia genetic stock: Nov-May
+ Hawksbill turtle, Western Australia genetic stock: Oct-Feb.

Drilling of Yoorn-1 is proposed for Q2–Q4 2022; which is outside these periods of peak turtle activity. However, for the purposes of impact assessment, the conservative approach has been taken to assume that drilling may occur at any time of year. Even for this worst case, the drilling program will take an estimated 100 days; (including contingency) so would only impact a single season.

The presence of these species nesting and inter-nesting BIAs suggests those turtle species hatchlings may be exposed to increased predation within the light assessment boundary (Thums et al., 2016).

The Recovery Plan for Marine Turtles in Australia: 2017-2027 (Commonwealth of Australia 2017a) highlights artificial light as one of several threats to marine turtles. Specifically, the plan indicates that artificial light may reduce the overall reproductive output of a stock, and therefore recovery of the species, by:

+ inhibiting nesting by females
+ creating pools of light that attract swimming hatchlings and increase their risk of predation
+ disrupting hatchling orientation and sea finding behaviour. Once in the ocean, hatchlings are thought to remain close to the surface, orient by wave fronts and swim into deep offshore waters for several days to escape the more predator-filled shallow inshore waters. During this period, light spill from coastal port infrastructure and ships may ‘entrap’ hatchling swimming behaviour, reducing the success of their seaward dispersion and potentially increasing their exposure to predation via silhouetting (Salmon et al., 1992).

The Recovery Plan for Marine Turtles in Australia: 2017-2027 specifies the following priority actions for the Pilbara genetic stock of flatback turtles in relation to artificial light:

+ Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats.

<u>Foraging and Migration</u>

Foraging adult turtles have been observed feeding on prey presumed to be attracted by lights of oil production platforms in the Gulf of Mexico (Kebodeaux 1994). However, illumination of fishing gear has been shown to reduce the bycatch of green turtles as it is thought that light sources alert them to the presence of a net (Ortiz et al. 2016). This suggests that marine turtles are most likely attracted to increased prey abundance around offshore facilities, rather than the light sources itself. Foraging marine turtles may be observed around the MODU and vessels in response to increase prey abundance, however, this is not expected to result in negative impact at the individual or population level.

Light has not been identified as a threat to adult turtles away from nesting beaches (i.e. there is no inhibition of orientation cues noted in open waters).

<u>Mating, Internesting and Migration</u>

Marine turtles do not forage during the breeding season and light cues are not thought to guide migration, mating or internesting behaviours. Further, to date, there is no evidence to suggest internesting turtles are attracted to light from offshore vessels.

Nesting and Hatchling Emergence

Experienced nesting females are unlikely to be disturbed by light, but first-time nesters may be disturbed by light when they are selecting their first nesting beach (Pendoley, 2014). Given that the closest beach is approximately 20 km from the OA, there is potential that nesting females may be disorientated by light emissions. Once in the water, turtle hatchlings orientate by wave fronts and do not appear to rely on visual cues (Pendoley, 2014); therefore, light emissions should not cause disorientation at that distance from land (i.e., approximately 20 km).

A study conducted by Whittock et al (2014) concluded that flatback turtles may demonstrate internesting displacement at a distance up to 62 km from the nesting beaches, however, these movements were confined to longshore movements in nearshore coastal waters. A study conducted by the same author (Whittock et al 2016) defines a more precise flatback turtle internesting habitats along the NWS, which showed suitable internesting habitat was in waters 0-16 m deep and within 5-10 km of the coastline, while unsuitable internesting flatback turtle habitats was defined as water depth >25 m and >27 km from the coastline.

Although the light assessment boundary overlaps the internesting BIA for the flatback turtle species, the offshore waters of the light assessment areas are unlikely to be suitable internesting habitats due to the water depth (>25 m) and distance from the coastline (with the nearest nesting site approximately 20 km from the OA).

Adult female marine turtles return to land, predominantly at night, to nest on sandy beaches, relying on visual cues to select and orient on nesting beaches and return to the ocean post nesting. Artificial lighting on or near beaches has been shown to disrupt nesting behaviour (see Witherington and Martin 2000 for review). Hatchling turtles emerge from the nest, typically at night, and must rapidly reach the ocean to avoid predation (Salmon 2003). Artificial lights interfere with natural light levels and silhouettes, which disrupts hatchling sea-finding behaviour (Kamrowski et al. 2014; Pendoley and Kamrowski 2015; Witherington and Martin 2000).

Hatchling Dispersal

The most significant risk posed to marine turtles from artificial lighting is the potential disorientation of hatchlings following their emergence from nests by light spill on beaches, although breeding adult turtles can also be disoriented (Longcore and Rich, 2016, in EPA, 2010). This disruption can occur because hatchlings orient themselves to the lowest-elevation light horizon and away from high silhouettes when moving from the nest to the sea. When the direction of the lowest elevation light horizon is not clear, hatchlings move towards the brightest, lowest horizon (Limpus & Kamrowski, 2013).

Therefore, while onshore lights (landward side of dunes) are of particular concern, offshore bright lights also have the potential to attract hatchlings, which have been shown to orient towards light sources close to the horizon (Witherington & Martin, 2003). This generally would not pose a problem if hatchlings are attracted directly to the surf zone, for once in the surf zone, turtle hatchlings are believed to be less influenced by light and to navigate using sea-wave and magnetic cues

(Witherington & Martin, 2003). However, hatchlings may also orient along the beach, depending on the location of the light source relative to the beach. This can lead to fatigue, increase the hatchlings exposure to predators, and reduce the success of hatching turtles entering the ocean. Once in the ocean, hatchlings are thought to remain close to the surface, orient by wave fronts and swim into deep offshore waters for several days to escape the more predator-filled shallow inshore waters. During this period, light spill from coastal port infrastructure and ships may ‘entrap’ hatchling swimming behaviour, reducing the success of their seaward dispersion and potentially increasing their exposure to predation via silhouetting (Salmon et al., 1992).

Once in nearshore waters, artificial lights on land can also interfere with the dispersal of hatchlings. Presence of artificial light can slow down their in-water dispersal (Wilson et al. 2018; Witherington and Bjorndal 1991) or increase their dispersion path, potentially depleting yolk reserves, or even attract hatchings back to shore (Truscott et al. 2017). In addition to interfering with swimming, artificial light can influence predation rates, with increased predation of hatchlings in areas with significant sky glow (Gyuris 1994; Pilcher et al. 2000). Since the nearshore area tends to be predator-rich, hatchling survival may depend on them exiting this area rapidly (Gyuris 1994). Should this be the case, aggregation of predatory fish occurring in artificially lit areas and under artificial structures (Wilson et al. 2019) may further increase predation of hatchlings.

Results of the light modelling undertaken for the Dorado Development suggest that facility light levels may result in a behavioural response within 5.5 km and more likely within 1.8 km (Pendoley Environmental, 2020). At distances between 5.5 km and 17.7 km from the source, radiance is equivalent to between 0.1 and 0.01 radiance of a full moon and, therefore, light may be visible but unlikely to result in a behavioural impact to marine turtles (**Section 6.3.1.1**).

While not tested empirically due to the logistical constraints of tracking large numbers of hatchlings concurrently, the density of hatchlings will decrease with distance from the nesting beach as individuals disperse in open ocean (Pendoley Environmental, 2020). Given the distance between Yoorn-1 and the nearest turtle nesting beaches (approximately 20 km from the boundary of the OA), the density of hatchlings is expected to be relatively low within 5.5 km of the MODU.

Should hatchlings be carried within a distance of light sources where attraction may occur, an increase in energy expenditure could occur in a small number of hatchlings attempting to remain in the areas of light spill. Given that attraction could only occur during hours of darkness, the potential impact at the individual level is temporary only. At the population level, the consequence of increased energy expenditure in a negligible number of hatchlings is not expected to increase mortality above that of natural levels. Due to overlap with the BIAs, it is likely that marine turtles will be encountered in the OA during the nesting and internesting seasons. Impacts to turtles from operational lighting are expected to be restricted to localised attraction and temporary disorientation, but with no long-term or residual impact due to the activity’s short-term nature (i.e., approximately 100 days to drill Yoorn-1). The activity would only have the potential to impact one season of peak turtle activity.

Given the location of the OA, all artificial light sources are distant from nesting beaches and not directly within the nearshore zone. The relatively low predicted light levels from navigation lighting on the MODU and support vessels (and no flaring as part of the activity); and the temporary nature of the artificial light at the nesting and internesting BIAs, disruption to biologically important behaviours or displacement from the area is not predicted to occur at population levels.

It is considered that the activity will not compromise the objectives as set out in the marine turtle recovery plan and impact of lighting associated with the activity to turtles is minor.

The potential impacts of light emissions to marine turtles from the activities are expected to be restricted to localised attraction and temporary disorientation. There will be no long term or residual impacts due to the activity being short-term and the light assessment boundary is within undesirable environments for habitat critical to the survival of flatback turtles. It is considered that the activity will not compromise the objectives as set out in the Recovery Plan for Marine Turtles and the impact of lighting associated with the activity to turtles is II (Minor).

6.3.2.4 Seabirds

Seabirds have been shown to be attracted to artificial light sources. Artificial light can disorient seabirds and potentially cause injury and/or death through collision with infrastructure. Birds may starve as a result of disruption to foraging, hampering their ability to prepare for breeding or migration. High mortality of seabirds occurs through grounding of fledglings as a result of attraction to lights and through interaction with vessels at sea (DoEE, 2020).

Studies conducted between 1992 and 2002 in the North Sea confirmed that artificial light was the reason that birds were attracted to and accumulated around illuminated offshore infrastructure (Marquenie et al., 2008). Birds may either be attracted by the light source itself or indirectly as structures in deep water environments tend to attract marine life at all tropic levels, creating food sources and providing artificial shelter for seabirds (Surman, 2002). The light sources associated with the MODU and vessels may also provide enhanced capability for seabirds to forage at night.

In general, young birds (fledglings) are more likely to become disorientated by artificial light sources. Fledglings have been observed being affected by lights up to 15 km away; and fledgling seabirds may also not take their first flight if their nesting habitat never becomes dark (CoA 2020a). Emergence during darkness is believed to be a predator-avoidance strategy and artificial lighting may make the fledglings more vulnerable to predation (CoA 2020a). It is thought that if artificial lights override the sea-finding cues of a fledgling and initially disorient its path, they may not be able to imprint their natal colony, preventing them from returning to nest when they mature (CoA 2020a).

The National Light Pollution Guidelines for Wildlife recommend using a 20 km threshold, which provides a precautionary limit based on observed effects of sky glow on fledgling seabirds grounded in response to artificial light 15 km away (Commonwealth of Australia 2020). Two relevant light modelling studies found that the spatial extent of a measurable change in ambient light was 12.6 km from a drilling rig, and 17.7 km from an FPSO (ERM 2010; Pendoley Environmental, 2020) (**Section 6.3.1.1**).

Both of these studies indicate that the spatial extent of a change to ambient light are less than the 20 km light assessment boundary used for the purposes of impact assessment, based on the National Light Pollution Guidelines for Wildlife (CoA, 2020).

The light assessment boundary (20 km buffer from the OA boundary) intersects with the following BIAs:

+ Breeding/foraging BIA for Wedge-tailed shearwater
+ Breeding/foraging BIA for the Roseate Tern

+ Breeding/foraging for the Fairy Tern
+ Breeding for the Lesser Crested Tern

The OA boundary is located approximately 20 km from the nearest land mass (Trimouille Island) that may provide seabird roosting or breeding habitat. This is just within the 20 km buffer suggested by the National Light Pollution Guidelines, and breeding behaviour could potentially be affected.

Species with a nocturnal component of their life history, such as procellariforms (albatrosses, petrels and shearwaters), are at greater risk of negative impacts. The bulk of the literature concerning impacts of lighting upon procellariforms relate to the synchronised mass exodus of fledgling seabirds from their nesting sites (Deppe et al. 2017; Le Corre et al. 2002; Raine et al. 2007; Reed et al. 1985, Rodríguez et al. 2015b, 2015a), with fewer investigating the impacts of light at sea. Reports of interactions between seabirds and artificial light at sea is generally anecdotal following significant interaction events or by unsystematic monitoring by oil and gas operators (Glass and Ryan 2013; Ronconi et al. 2015; Wiese et al. 2001). Deck lights and spotlights on fishing vessels have been recorded attracting numerous seabirds at night, particularly on nights with little moon light or low visibility (Merkel and Johansen 2011; Montevecchi 2006). Procellariforms are shown to be attracted to artificial lights on land, and anecdotally to vessels and oil and gas facilities which makes them susceptible to attraction to light sources in the OA.

For wedge-tailed shearwaters at Muiron Islands, Cannell et al. (2019) reported mean foraging trip distances, during different stages of the breeding cycle, as ranging from 183 – 5,113 km. As such, the location of the Yoorn-1 well should not significantly impact foraging behaviour, given the large distances typically covered by breeding individuals.

Diurnal seabird species, such as terns, noddies and boobies, in contrast to procellariforms, are less vulnerable to impacts resulting from nocturnal behaviours. However, the presence of facilities can alter foraging behaviours and provide artificial roosting sites. Presence of light sources in the OA may attract diurnal seabird species via increased prey availability and extended foraging activities. The artificial light emissions from offshore facilities may also have the potential to impact seabirds through collisions with infrastructure due to visual disorientation, particularly during periods of low visibility (e.g. cloudy, overcast or foggy conditions) (Wiese et al., 2001). Newly fledged juvenile birds leaving breeding colonies for the first time are the most prone to disorientation by artificial light (Commonwealth of Australia, 2019). Although such attraction increases the risk of collision with facilities, incidents of collision of diurnal species, or similar taxonomic groups, are few (see Ronconi et al. 2015 for review).

The wedge-tailed shearwater is listed as marine and migratory and does not have a recovery plan or conservation advice. Light has not been identified as a threat to the wedge-tailed shearwater (DAWE, 2020a), or to the Fairy tern in the Approved Conservation Advice on *Sternula nereis nereis* (Fairy Tern). The Roseate tern and Lesser crested tern do not have a recovery plan or conservation advice. However, light pollution is listed as a threat in the Draft Wildlife Conservation Plan for Seabirds (Commonwealth of Australia 2019).

The light sources associated with the MODU and support vessels may also provide enhanced capability for seabirds to forage at night. The MODU and support vessels will be within the OA for up to 100 days including contingency for drilling Yoorn-1 where the MODU will be stationary, and the support vessels will constantly be moving throughout the OA. As a result, they are unlikely to attract large numbers of seabirds.

Consequently, light emissions from the MODU and support vessels are unlikely to attract and/or affect the behaviour of large numbers of seabirds and the impact of lighting associated with the activity to seabirds is minor.

6.3.2.5 Protected and significant areas and socio-economic receptors

The OA intersects the Montebello Marine Park (Multiple Use Zone – IUCN Category VI). Conservation values of the marine park (as outlined in **Section 3.2.2**) have the potential to be impacted by seabed disturbance through impacts to the physical environment and marine fauna.

Therefore, light emissions generated at the OA have the potential to impact the values of the Montebello Marine Park, which includes (relevant to light emissions) nesting, mating and internesting habitat for marine turtles, and breeding and foraging habitat for seabirds. Potential impacts to internesting turtles are not considered likely and nesting turtles are also considered less vulnerable. Therefore, the potential impacts are limited to hatchlings that have left the nesting beaches approximately 20 km away and are within the AMP. Light emissions from the MODU and support vessels are unlikely to attract and/or affect the behaviour of large numbers of seabirds and the impact of lighting associated with the activity to seabirds is minor.

6.3.3 Environmental Performance Outcomes and Control Measures

The EPO relating to this event is:

+ Reduce impacts to marine fauna from lighting through limiting lighting to that required by safety and navigational lighting requirements [YO-EPO-08]
+ Do not displace marine turtles from habitat critical to the survival of the species or disrupt biologically important behaviours from occurring within biologically important areas [YO-EPO-09]

The control measures for this activity are shown in **Table 6-6** with EPS and measurement criteria for the EPOs described in **Section 8.4**.

Table 6-6: Control Measure Evaluation for Light Emissions

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
YO-CM-031	Lighting will be used as required for safe work conditions and navigational purposes	Light spill from unnecessary lighting reduced, even further lowering likelihood of impacts to the	Cost is considered acceptable for the benefit that may be realised from this control.	**Accepted** – Cost is considered acceptable for the benefit that may be realised from this control.

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		fauna from vessel lighting. Lighting is assessed to only provide necessary lighting for safety and navigation during the activity. Reducing the potential for additional light pollution to the environment, thus reducing the potential impacts to fauna.		
YO-CM-045	Implement light management actions recommended in the National Light Pollution Guidelines, including: + Switch off outdoor/deck lights when not in use and safe to do so. + use existing block-out blinds on portholes and windows not necessary for safety and/or navigation at night.	Would result in reduced light spill from internal lighting onto the sea surface, potentially reduce overall light emissions, and reduce the consequence of any impact to marine fauna.	Cost of maintaining records and to train staff.	**Adopted** – Cost is considered acceptable for the benefit that may be realised from this control.
Additional Control Measures				
N/A	Manage the timing of the activity to avoid sensitive periods at the	Reduce risk of impacts from light emissions during environmentally sensitive periods	High cost in moving or delaying activity schedule for operational reasons (schedule dependent	**Rejected** – Given the minimal risk of impacts to listed marine species (e.g. turtles) occurring due

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
	location (e.g. turtle nesting/ hatching).	for listed marine fauna (e.g. turtle nesting/ hatching).	on availability of offshore vessel(s) and MODU). The risk to all listed marine fauna cannot be reduced due to variability in timing of environmentally sensitive periods and unpredictable presence of some species.	to lighting, the financial and environmental costs of extending the activity duration are deemed grossly disproportionate to low environmental benefits. The 20 km light assessment boundary for the Yoorn OA intersects with internesting, nesting and/or mating BIAs for flatback, green and hawksbill turtles around the Montebello Islands. Impacts to turtles from operational lighting are expected to be restricted to localised attraction and temporary disorientation, but with no long-term or residual impact due to the activity's short-term nature (i.e., up to approximately 100 days to drill Yoorn-1). Therefore, impacts are not expected on a population level or to impact on turtle habitat.
N/A	Review lighting to a type (colour, intensity, frequency) that has less impact.	Could reduce potential impacts of artificial light on certain fauna	High cost to complete lighting change-out on MODU and vessels in area of low sensitivity. Navigational lighting colours are stipulated by law.	**Rejected** – Cost outweighs the benefit. The Yoorn OA is approximately 20 km from the nearest turtle nesting beaches. The 20 km light assessment boundary for the

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
				Yoorn OA intersects with internesting, nesting and/or mating BIAs for flatback, green and hawksbill turtles. Impacts to turtles from operational lighting are expected to be restricted to localised attraction and temporary disorientation, but with no long-term or residual impact due to the activity's short-term nature (i.e., up to 100 days to drill Yoorn-1). Therefore, impacts are not expected on a population level or to impact on turtle habitat.
N/A	Limit or exclude night-time operations.	Would eliminate potential impacts of artificial light during hours of darkness when light sources are more apparent and potential impacts are greatest.	Would double duration of activity; increase impacts or potential impacts in other areas, including increase in waste, air emissions, risk of vessel collision etc. A minimal level of artificial lighting will still be required on-board the MODU and vessels on a 24-hour basis for safety reasons.	**Rejected** – Given the minimal risk of impacts to turtles occurring, the financial and environmental costs by requiring all works to be undertaken during daylight hours only are not considered appropriate given the extended duration of the activity that would occur.
N/A	Use of dark, matte surfaces to reduce sky glow across all activities	Reduce potential for impacts on turtles from light emissions during hours of darkness	Additional cost to repaint vessel/MODU surfaces for a short duration activity	**Rejected –** Given the short duration of drilling (100 days), and navigational lighting only (i.e. no

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		when light sources are more apparent and potential impacts are greatest.		flaring), the cost is considered disproportionate to the environmental benefit.

6.3.4 Environmental Impact Assessment

Table 6-7: Impacts and Consequence Ranking – Light Emissions

Receptor	Consequence Level
Light emissions	
Threatened, migratory or local fauna	Artificial lighting may result in behavioural changes to fauna, particularly marine turtles and seabirds. Two relevant light modelling studies found that the spatial extent of a measurable change in ambient light was 12.6 km from a drilling rig, and 17.7 km from an FPSO (ERM 2010; Pendoley Environmental, 2020) (**Section 6.3.1.1**). Both of these studies indicate that the spatial extent of a change to ambient light are less than the 20 km light assessment boundary used for the purposes of impact assessment, based on the National Light Pollution Guidelines for Wildlife (CoA, 2020). The light assessment boundary (20 km buffer from the OA) intersects with the following bird BIAs: + Breeding BIA for Wedge-tailed Shearwater + Breeding BIA for the Roseate Tern + Breeding/foraging for the Fairy Tern + Breeding for the Lesser Crested Tern The OA is located approximately 20 km from the nearest land mass (Trimouille Island) that may provide seabird roosting or breeding habitat. This is just within the 20 km buffer suggested by the National Light Pollution Guidelines, and breeding behaviour could potentially be affected. In general, young birds (fledglings) are more likely to become disorientated by artificial light sources. Fledglings have been observed being affected by lights up to 15 km away; and fledgling seabirds may also not take their first flight if their nesting habitat never becomes dark (CoA 2020a). Diurnal bird species such as terns are less vulnerable to impacts resulting from nocturnal behaviours. Given the large distances typically covered by breeding individuals to forage, light from the OA should not impact foraging behaviour. The light assessment boundary (20 km buffer from the well location) intersects with the following marine turtle BIAs / habitat critical to the survival of the species: + Internesting buffer BIA for flatback, hawksbill, loggerhead and green turtles; + Habitat critical for the survival of the species for green, hawksbill and flatback turtles

Receptor	Consequence Level
	+ Additional mating, nesting, internesting and foraging BIAs for green turtles The closest nesting beach to the OA is Trimouille Island (and the rest of the Montebello Islands); and Lowendale Island (approximately 20 km and approximately 39 km from the OA respectively); which is just within the 20 km light assessment boundary recommended by the National Light Pollution Guidelines (CoA, 2020). Trimouille Island is a known nesting location for flatback and hawksbill turtles; and green turtles are known to nest on sandy beaches of the Montebello Islands (CoA, 2020). The Montebello Islands are a nesting area identified as habitat critical to the survival of the species for flatback and green turtles (CoA, 2017a). Given that the closest beach is approximately 20 km from the OA, there is potential that nesting females may be disorientated by light emissions. Once in the water, turtle hatchlings orientate by wave fronts and do not appear to rely on visual cues (Pendoley, 2014); therefore, light emissions should not cause disorientation at that distance from land (i.e., approximately 20 km). The most significant risk posed to marine turtles from artificial lighting is the potential disorientation of hatchlings following their emergence from nests by light spill on beaches, although breeding adult turtles can also be disoriented. In addition to interfering with swimming, artificial light can influence predation rates. Light cues are not thought to guide migration, mating or internesting behaviours; and light is not identified as threat to adult turtles away from nesting beaches (i.e. during foraging). The drilling of Yoorn-1 is proposed for Q2-Q4 2022 which is outside the periods of peak turtle activity (specifically Oct-Mar and Nov-Mar for flatback and green turtles respectively). However, conservatively it is assumed that drilling may be undertaken at any time of year. Even for this worst case, the drilling program will take an estimated 100 days including contingency; so would only impact a single season. Given the location of the OAs, all artificial light sources are distant from nesting beaches and not directly within the nearshore zone. The relatively low predicted light levels from navigation lighting on the MODU and support vessels (and no flaring as part of the activity); and the temporary nature of the artificial light at the nesting and internesting BIAs, disruption to biologically important behaviours or displacement from the area is not predicted to occur at population levels. Impacts to turtles from operational activity lighting are expected to be restricted to localised attraction and temporary disorientation, but with no long-term or residual impact due to the activity's short-term nature (i.e., up to 100 days including contingency for drilling Yoorn-1). Impacts to marine fauna are expected to be restricted to localised attraction and temporary disorientation but with no long-term or residual impact and no decrease in local population size, area of occupancy of species or loss or disruption of critical habitat/ disruption to the breeding cycle. The potential impacts are therefore considered to be II (Minor). The predicted level of impact described above does not exceed the acceptable level of impact to not displace marine turtles from habitat critical to the survival of the species; or disrupt biologically important behaviours from occurring within biologically important areas.

Receptor	Consequence Level
Physical environment or habitat	Not applicable – No impacts to physical environments and/ or habitats from light emissions are expected.
Threatened ecological communities	Not applicable – No threatened ecological communities identified in the area over which light emissions are expected.
Protected areas	The light assessment boundary intersects the Montebello AMP (Multiple Use Zone - IUCN Category VI). The objective is to provide for ecologically sustainable use and the conservation of ecosystems, habitats and native species. The values of the marine park, with respect to the presence of marine species (receptors) are described above and are assessed as II (Minor).
Socio-economic receptors	Not applicable – Lighting is not expected to cause an impact to socio- economic receptors other than to act as a visual cue for avoidance of the area by other marine users for safety purposes.
Overall worst-case consequence	II - Minor

6.3.5 Demonstration of ALARP

With the described controls, the consequence of artificial light on marine turtles and seabirds is considered to be minor with insignificant impacts to ecological function. No population level impacts are expected, and the consequence is considered environmentally acceptable. Artificial lighting is required 24 hours a day for operational and navigational safety during the activity. A minimum level of artificial lighting is required on a 24-hour basis to alert other marine users of the activity. There are also minimum light requirements that will be necessary to provide safe working conditions. To reduce lighting at night further would restrict the activity hours resulting in the activity taking approximately twice as long to complete. This would increase the period of time the OA would need to be avoided by other marine users and the amount of waste, discharges and emissions produced.

The increased risks/ impacts with potentially larger scale consequences associated with reduced light levels are considered to present a cost that is grossly disproportionate to any environmental benefit. Given that lighting on the MODU and vessels will be consistent with industry standards and will result in minor consequences, and that no reasonably practicable additional controls or alternatives were identified, it is considered that the environmental impacts of using 24-hour artificial lighting at an intensity to allow work to proceed safely are ALARP.

The closest nesting beach to the OA is Trimouille Island (and the rest of the Montebello Islands); and Lowendale Island (approximately 20 and approximately 39 km from the OA respectively); which is just within the 20 km light assessment boundary recommended by the National Light Pollution Guidelines (CoA, 2020). Trimouille Island is a known nesting location for flatback and hawksbill turtles; and green turtles are known to nest on sandy beaches of the Montebello Islands (CoA, 2020).

Given the location of the OA, all artificial light sources are distant from nesting beaches and not directly within the nearshore zone. The relatively low predicted light levels from navigation lighting on the MOPU and support vessels (and no flaring as part of the activity), and the temporary nature of the artificial light means disruption to biologically important behaviours or displacement from the area is not predicted to occur at population levels.

The activity will not compromise the objectives as set out in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a), the Draft Wildlife Conservation Plan for Seabirds (Commonwealth of Australia 2019) or the National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020), as biologically important behaviours of nesting adults and emerging/ dispersing hatchlings can continue given the distance from the nearest nesting beaches. The assessed residual consequence for this impact is minor and cannot be reduced further. Additional control measures were considered but rejected since the associated cost or effort was grossly disproportionate to any benefit, as detailed in **Section 6.3.3**. Therefore, the use of 24-hour per day artificial lighting at an intensity to allow work to proceed safely is considered ALARP.

6.3.6 Acceptability Evaluation

Is the consequence ranked as I (Negligible) or II (Minor)	Yes – maximum consequence from light emissions is II (Minor).
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian Marine Park zoning objectives)?	Yes – management consistent with the Convention of the Safety of Life at Sea (SOLAS) 1974 and the Navigation Act 2012. + The following material published in relation to threatened and migratory species within the light assessment boundary identifies light emissions as a threat (**Table 3-9**): National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DoEE, 2020). The management of artificial light emissions are aligned with the objectives of this plan through the adoption of YO-EPO-08, YO-EPO-09, YO-CM-31 and YO-CM-045. + Recovery Plan for Marine Turtles in Australia (2017). The plan identifies light pollution as a threat to marine turtles. Nesting females and hatchling turtles are at greatest risk of light impacts and the nearest potential nesting habitat is Trimouille Island (approximately 20 km from the OA); which is just within the 20 km light assessment boundary. Nesting, mating, interesting, interesting buffer and foraging BIAs have been identified for green turtles and interesting buffer BIAs for flatback, hawksbill, and loggerhead turtles. Habitat critical to the survival of the species have also been identified for green, hawksbill and flatback turtles. Impacts to turtles from operational activity lighting are expected to be restricted to localised attraction and temporary disorientation, but with no long-term or residual impact due to the activity's short-

	term nature. Action Area A8 of the plan (minimise light pollution) will be managed through YO-EPO-08, YO-EPO-09 and YO-CM-31. + Draft Conservation Plan for Seabirds (2019). This plan identifies light pollution as a minor threat to seabirds. Yoorn-1 is aligned to Objective 2 of the plan by ensuring seabirds and their habitats are protected and managed. + For all the recovery plans identified above, the objectives are achieved through the adoption of YO-EPO-08, YO-EPO-09 and YO-CM-31; and Santos considers the impacts of a light emissions to not be inconsistent with these recovery plans. Recovery Plans / Conservation Advice for other species that may occur in the project area do not identify light emissions as a key threat or have explicit relevant objectives or management actions related to light emissions. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) identifies light pollution as a pressure that may impact marine park values. It seeks to minimise the impact of pressures on the marine park values as far as reasonably practicable. The implementation of YO-EPO-08, YO-EPO-09 and YO-CM-31 will ensure the lighting required for Yoorn-1 activities will not compromise this outcome. + The light assessment boundary intersects the Montebello Marine Park which is categorised as Multiple Use Zone (IUCN Category VI) (**Table 3-4)**. The objective of the Multiple Use Zone (VI) is to provide ecologically sustainable use and the conservation of ecosystems, habitats and native species. The management of artificial light emissions are aligned with this objective through the adoption of YO-EPO-08, YO-EPO-09 and YO-CM-31. The objectives and actions of these publications were considered during the assessment of impacts and risks. The controls outlined in **Table 6-6** are consistent with the objectives of the material listed above and Santos considers the impacts of light emissions to not be inconsistent with these objectives.
Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes. DNP requested the EP gives consideration to avoiding impacts upon migratory species, such as timing of the activity (relevant to light) – with particular attention to managing the risk to turtle foraging and internesting locations.

	DNP also requested notifications as per the Petroleum Activity and Australian Marine Park Guidance Note (NOPSEMA, 2020) regarding timing and information provided. AMSA requested that vessels comply with the International Rules for Preventing Collisions at Sea (COLREGs), in particular, the use of appropriate lights and shapes to reflect the nature of operations. Santos considers these concerns to have been addressed or will be addressed as per the Activity Notification and Reporting Requirements (**Table 8-4).**
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP.

Lighting of the MODU and support vessels is industry standard and required to meet relevant maritime and safety regulations. The potential consequences of the anthropogenic light sources in the OA are considered to be insignificant in nature and restricted to short-term behavioural impacts on individual fauna that may be present in the operational areas during the activity.

The 20 km light assessment boundary intersects with internesting, nesting and/or mating BIAs for flatback, green and hawksbill turtles; and habitat critical for the survival of the species for green, hawksbill and flatback turtles. Light emissions from the MODU and support vessels are unlikely to attract and/or affect the behaviour of large numbers of seabirds and the impact of lighting associated with the activity to seabirds is minor. Significant impacts are not expected on fauna, including nesting turtles or hatchlings. No stakeholder concerns have been raised regarding lighting for the activity.

The potential consequence of light emissions on receptors is assessed as II (Minor). With the control measures in place, including compliance with navigational safety legislation, no significant impacts are expected. Therefore, the impacts of light emissions to the receiving environment are ALARP and considered environmentally acceptable.

6.4 Noise Emissions

6.4.1 Description of Event

Event	The operation of the MODU (including drilling activities) and support vessels will introduce a range of underwater noises into the surrounding water column that will propagate through the water and contribute to and/or exceed ambient noise levels in the area. The main sources of underwater noise during operational activities are from: + Well Evaluation (VSP operations) + MODU Operations (such as drilling and machinery) + ROV Operations + Vessel Operations (e.g., vessel engines, thrusters and other machinery) + Helicopter Operations (crew change requirements)
Extent	Impacts from all potential noise sources will be within 20 km of the noise source. This is based on: + a conservative estimate of how far noise will travel from VSP activities is within thousands of metres (~2.4 km from the MODU).

	+ noise from ROV operations being limited to when ROVs are operating within the OA + a support vessel using main engines and bow thrusters to maintain position will become inaudible above background noise within thousands of metres (~1 km) + noise from helicopters being limited to when they are landing/taking off within the OA + drilling operations. A 20 km radius around the OA has been assumed as a conservative area within which impacts could occur, which includes physiological and behavioural impacts to all marine fauna. Cumulative effects from the activity and from other activities conducted in the vicinity are not expected, due to the short-term nature of the VSP operations, and the low sound levels generated by continuous noise sources.
Duration	For the duration of the Activity, as described in **Section 2.2**.

6.4.1.1 Noise generated by the MODU

The MODU will generate noise from the operation of on-board machinery, including diesel engines, mud pump, ventilation fans (and associated exhaust) and electrical generators, and also from the operation of the drill string and drill bit during operations. McCauley (1998) reported noise levels generated by a semi-submersible rig, during non-drilling periods the typical broadband level encountered was approximately 113 dB (rms) re 1 µPa@125 m with various tones from the machinery observable in the noise spectra. There was a significant variation in the broadband noise during non-drilling periods, attributed to the operation of specific types of machinery. During periods the broadband noise level increased to the order of 177 dB (rms) re 1 µPa@125 m. Studies undertaken in the Arctic on different MODU types (including semi-submersible and drill ships) indicate that noise levels dropped to 117 dB re 1 µPa within 1 km of the MODU and are much lower than those for large commercial vessels operating at normal speeds (Austin *et al.,* 2018).

In general, jack-up MODUs transmit less noise underwater than a semi-submersible platform or a drill vessel due to a smaller surface area being in contact with the water column. Jack-up MODUs have been measured to produce noise between 0.005 and 1.2 kHz during drilling activity with a source level of 59 dB re 1 µPa m (Simmonds *et al*., 2004). A 2001 underwater acoustic survey (Marine Acoustics, 2011) of a jack-up MODU operating in shallow waters (24.4 to 27.4 m water depth) reported non-continuous (less than one second) noise levels exceeding 120 dB re 1 µPa, were measured to a maximum range of 1.17 to 1.4 km from the MODU in a frequency band of 8.9 to 44.7 Hz. Underwater noise measured during this survey was at all times below 160 dB re 1 µPa.

6.4.1.2 Noise generated by vessels

Vessel operational noise consists of machinery noise (such as engine noise) and hydrodynamic noise (such as water flowing past the hull and propeller singing). All machinery on a ship radiates sound through the hull into the water.

For support vessels, the noisiest anticipated activity is when the vessel uses thrusters to maintain its position. McCauley (1998) measured underwater sound pressure levels equivalent to approximately 182 dB re 1 µPa @ 1 m with a frequency range of 20 Hz to 10 kHz from a support vessel holding station in the Timor Sea. The thruster noise dropped below 120 dB re 1 µPa within 3 to 4 km and was audible above ambient noise up to 20 km away (McCauley, 1998). This has been taken as the greatest noise-generating activity for assessment purposes, as other vessel activities will require the vessel to be idle or moving. McCauley (1998) measured underwater sound levels from the Pacific Ariki, a 64 m long support vessel with 8000 HP (6,000 kW) main engines during calm conditions in the Timor Sea in 110 m of water while transiting at 11 knots, and found the distance to 120 dB re 1 µPa to be approximately 1 km.

6.4.1.3 Noise generated by helicopters

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

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

Helicopter activities produces strong underwater sounds for brief periods when the helicopter takes off/lands on the vessel/MODU. Sound from helicopter activities is very localised and infrequent (i.e. for crew change)

6.4.1.4 Noise generated from vertical seismic profile operations

Hydrocarbon-bearing formations identified during drilling may be evaluated using wireline logging tools and VSP before completing the activity. If this is the case, VSP will be performed using geophones (receivers) positioned at different levels inside the wellbore and a seismic source near the ocean surface. The seismic source is typically a three 250 cubic inch air gun configuration deployed approximately 5 m below the water surface from the MODU, or potentially a support vessel. In addition to tying well data to seismic data, the VSP also enables the conversion of seismic data to zero-phase data and distinguishes primary reflections from multiples. VSP typically takes approximately 12 to 18 hours, with approximately 130 shots in total, and is undertaken at the completion of drilling.

VSP generates higher intensity noise than routine drilling operations. Modelling of the VSP sound source (JASCO, 2020) predicts that the maximum sound exposure level (SEL) from VSP activities is around 216 decibels (dB) re 1µPa^{2}m^{2}s. The model predicts a maximum distance to SEL thresholds of 180, 170 and 160 dB re 1µPa^2 as 50 m, 260 m and 970 m respectively.

6.4.1.5 Noise generated from ROV operations

During the activities associated with the drilling, notably inspections of the seabed prior to and/or after drilling, and in the event of dropped objects, ROVs may be used. This will be undertaken from a vessel or MODU and the noise generated will typically be of considerably lower intensity than vessel noise.

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 or MODU, they will make little contribution to the overall noise emissions associated with MODU and/or vessel activities, as described above and are not risk assessed further.

6.4.2 Nature and Scale of Environmental Impacts

Potential Receptors: Threatened/migratory fauna (invertebrates, marine mammals (particularly cetaceans), marine turtles, sharks, rays and fish).

A PMST search was undertaken for the 20 km noise assessment boundary around the OA as a conservative buffer. Of the species identified in addition to those present in the OA, five have a threatened species status; Northern Siberian Bar-tailed Godwit, Australian Painted Snipe, Short-nosed Seasnake, Leaf-scaled Seasnake, and Sei Whale (**Table 3-7**). These species do not have associated Conservation Advice or Recovery Plans.

Additional BIAs within the 20 km noise assessment boundary for each well are shown in **Table 3-8**. Of the additional BIAs identified, the three marine turtle species are known to be sensitive to noise emissions (Flatback, Hawksbill and Green turtles) (CoA, 2020). A whale shark foraging BIA intersects the noise assessment boundary; however, the associated Conservation Advice does not identify noise emissions as a threat (TSSC, 2015a).

Marine fauna use sound in a variety of functions, including social interactions, foraging, orientation and responding to predators. Underwater noise can affect marine fauna in three main ways:

+ Attraction
+ Increased stress levels
+ Disruption to underwater acoustic cues
+ Localised avoidance
+ Injury to hearing or other organs. Hearing loss may be temporary (temporary threshold shift (TTS)) or permanent (permanent threshold shift (PTS))
+ Disturbance leading to behavioural changes or displacement to fauna. The occurrence and intensity of disturbance is highly variable and depends on a range of factors relating to the animal and situation
+ Masking or interfering with other biologically important sounds (including vocal communications, echolocation, signals and sounds produced by predators or prey)
+ Indirectly by inducing behavioural and physiological changes in predator or prey species.

The nature and scale of impacts must be considered in the context of the ambient noise environment. Ambient underwater noise levels are dependent on location, and are often dominated by local wind noise, waves, biological noise and ship traffic. Wind speed and seabed conditions have a clear influence on the ambient noise level. Fish choruses are capable of raising background noise levels to 120 to 130 dB re 1 µPa (McCauley, 2011). Anthropogenic underwater noise sources in the region comprise shipping and small vessel traffic, petroleum-production and exploration-drilling activities and sporadic petroleum seismic surveys.

The extent of the impacts of underwater noise on marine animals will depend upon the frequency range and intensity of the noise produced and the type of acoustic signal (i.e. continuous (MODU, support vessels) or impulsive (VSP). These sound sources are both non-impulsive (vessel) and impulsive (VSP), and thus require the consideration of different criteria to assess their potential impact.

Marine fauna respond variably when exposed to underwater noise from anthropogenic sources, with effects dependent on a number of factors, including distance from the sound source, water depth and bathymetry, the animal's hearing sensitivity, type and duration of sound exposure and the animal's activity at time of exposure. Broadly, the effects of sound on marine fauna can be categorised as:

+ Acoustic masking – anthropogenic sounds may interfere with, or mask, biological signals, therefore reducing the communication and perceptual space of an individual. Auditory masking impacts may occur when there is a reduction in audibility for one sound (signal) caused by the presence of another sound (noise). For this to occur the noise must be loud enough and have a similar frequency to the signal and both signal and noise must occur at the same time.
+ Behavioural response – behavioural impacts will depend on the audible frequency range of each potential receptor in relation to the frequency of the noise, as marine animals will only respond to acoustic signals they can detect, as well as the intensity of the noise. The intensity of behavioural responses of marine mammals to sound exposure ranges from subtle responses, which may be difficult to observe and have little implications for the affected animal, to obvious responses, such as avoidance or panic reactions. The context in which the sound is received by an animal affects the nature and extent of responses to a stimulus. The threshold for elicitation of behavioural responses depends on received sound level, as well as multiple contextual factors such as the activity state of animals exposed to different sounds, the nature and novelty of a sound, spatial relations between a sound source and receiving animals, and the gender, age, and reproductive status of the receiving animal.
+ Physiological impacts – auditory threshold shift (temporary and permanent hearing loss) – marine fauna exposed to intense sound may experience a loss of hearing sensitivity, or even potentially mortal injury. Hearing loss may be in the form of a temporary threshold shift (TTS) from which an animal recovers within minutes or hours, or a permanent threshold shift (PTS) from which the animal does not recover.

Available threshold criteria associated with behavioural and physiological impacts for sensitive receptors have been derived from a number of sources (NMFS, 2018; NMFS, 2014; Popper et al., 2014). These criteria have been compared with measured and predicted sound levels for different sound sources to assess potential impacts.

6.4.2.1 Invertebrates

Underwater noise emissions from the activity are not expected to cause a change in behaviour to benthic invertebrates.

Continuous noise

Benthic invertebrates are unlikely to be negatively impacted from noise generated from vessel operations, there is no convincing scientific evidence for any significant effects induced by non-impulsive noise in benthic invertebrates.

Plankton, including fish eggs and larvae, and pelagic invertebrates could drift into close proximity to high-energy noise sources (for example, bow thrusters). However, any negative impacts that could occur would be restricted to within metres of the sound source. At such a localised extent, impacts would be negligible at an ecosystem or population level.

Impulsive noise

There are no thresholds or information available for the assessment of the potential impacts from VSP on either water column or benthic invertebrates. The activity does not include activities that generate low-frequency noise such as SBP. Therefore, negligible impact is expected to invertebrates from VSP activity.

6.4.2.2 Fish and Sharks

All fish species can detect noise sources, although hearing ranges and sensitivities vary substantially between species (Dale et al., 2015). Sensitivity to sound pressure seems to be functionally correlated in fishes to the presence and absence of gas-filled chambers in the sound transduction system. These enable fishes to detect sound pressure and extend their hearing abilities to lower sound levels and higher frequencies (Ladich and Popper, 2004; Braun and Grande, 2008). Based on their morphology, Popper et al. (2014) classified fishes into three animal groups comprising:

+ Fishes with swim bladders whose hearing does not involve the swim bladder or other gas volumes
+ Fishes whose hearing does involve a swim bladder or other gas volume
+ Fishes without a swim bladder that can sink and settle on the substrate when inactive.

Thresholds for PTS and recoverable injury are between 207 dB PK and 213 dB PK (depending on the presence or absence of a swim bladder), and the threshold for TTS is 186 dB SELcum (Popper et al., 2014). Given there is no exposure criteria for sharks and rays, the same criteria are adopted, though typically sharks and rays do not possess a swim bladder.

The EPBC PMST Report for the noise assessment boundary identified several fish species including the whale shark (listed as Vulnerable and Migratory). The whale shark has a foraging BIA that intersects the noise assessment boundary for the OA (**Table 3-8**). However, the Conservation Advice for the whale shark (*Rhincodon typus*) (TSSC, 2015a) does not identify noise emissions as a threat.

Individual demersal fish may be impacted in the vicinity of the activity and tuna and billfish and other mobile pelagic species may transverse the OA. However, the OA is not known to be an important spawning or aggregation habitat for commercially caught targeted species. Therefore, no impacts to fish stocks are expected.

The criteria defined in Popper et al. (2014) for continuous (**Table 6-8**) and impulsive (**Table 6-9**) noise sources has been adopted.

Table 6-8: Continuous Noise: Criteria for Noise Exposure for Fish

Potential Marine Fauna Receptor	Mortality and Potential mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Fish: No swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: Swim bladder not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: Swim bladder involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB SPL for 48 h	158 dB SPL for 12 h	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Fish eggs and fish larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

Source: Popper et al. (2014)

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

Table 6-9: Impulsive Noise: Criteria for Noise Exposure for Fish

Potential Marine Fauna Receptor	Mortality and Potential mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Fish: No swim bladder (particle motion detection)	> 219 dB SEL24h or > 213 dB PK	> 216 dB SEL24h or > 213 dB PK	>> 186 dB SE L24h	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: Swim bladder not involved in	210 dB SEL24h or > 207 dB PK	203 dB SEL24h or > 207 dB PK	>> 186 dB SE L24h	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low

hearing (particle motion detection)					
Fish: Swim bladder involved in hearing (primarily pressure detection)	207 dB SEL24h or > 207 dB PK	203 dB SEL24h or > 207 dB PK	186 dB SEL24h	(N) Low (I) Low (F) Moderate	(N) High (I) High (F) Moderate
Fish eggs and fish larvae	> 210 dB SEL24h or > 207 dB PK	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Source: Popper et al. (2014)

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

<u>Continuous noise</u>

Based on criteria developed by Popper et al. (2014) for noise impacts on fish, vessel and MODU noise has a low risk of resulting in mortality and a moderate risk of TTS impacts when fish are within tens of metres of a vessel. The most likely impacts to fish from noise will be behavioural responses. Popper et al. (2014) identified a moderate risk of behavioural impacts to fish in near (tens of metres) and intermediate distances (hundreds of metres) from the noise source. Masking could occur within thousands of metres under a worst-case scenario of vessel operations, however typically any effect will be limited to within hundreds of metres.

Whale sharks could potentially be impacted from operational noise if in the area, whale sharks would be expected to show avoidance to vessel noise, although they are likely to tolerate low level noise, because whale sharks have been observed swimming close to oil and gas platforms on the North West Shelf.

<u>Impulsive noise</u>

Based on available criteria from Popper et al (2014), potential impacts of VSP on fish have been assessed. Impulsive noises from VSP could result in physiological impacts to fish located within metres of the sound source considering the results presented in **Section 6.4.1**. The likelihood of fish being close enough to the sound source for physiological impacts to occur is considered remote.

Behavioural impacts to fish from VSP noise will be limited to behavioural responses within metres of the noise source. Fish (including sharks and rays) may be temporarily displaced from the vicinity of the noise emissions.

Impacts to fish and sharks are not considered significant as:

- Noise levels from the MODU, helicopters and vessels that may cause behavioural responses are expected to generally be confined to the OA and concentrated within a radius of a few hundred metres of the noise source.
- Due to the very short duration and infrequent use of VSP, the potential effects are expected to fall off rapidly with distance from the source and be unlikely to cause significant impacts to any marine fauna populations. The noise emissions associated with the activity are not expected to have the intensity to cause physical injury, unless fauna were in very close proximity (tens of metres) to VSP activities.
- Noise effects to fish may result in indirect impacts to fisheries in the OA that are restricted to moderate within hundreds of meters of the MODU/vessels, as detailed above. With the majority of the noise emissions being of short duration and of limited extent, any impact on commercial or recreational fishing is expected to be minimal.
- Implementation of the Environmental Checklist for MODU Seismic Operations [YO-CM-018] during VSP activities, including 'soft starts' of the source, fauna observation prior to and for the duration of VSP operations, and shut-down procedures, will reduce the potential for impacts to marine fauna. Beyond 500 m of the MODU (i.e., the limit of the shut-down zone) there would be a zone of influence in which VSP activities may elicit a behavioural response, most likely to maintain a separation distance from the source, for the short duration of VSP. Based on Santos' calculations the zone of influence could extend out to at least 1,200 m.

6.4.2.3 Marine Mammals

No known aggregation, resting, breeding or feeding areas for cetaceans intersect the 20 km noise assessment boundary for the OA. However, cetaceans may travel through the area, with the noise assessment boundaries overlapping the migration BIA for the humpback whale and the distribution BIA for the pygmy blue whale (**Table 3-8**). The humpback whale is expected to be the most frequently encountered particularly during annual migrations given the overlap area with the migration BIA. The recovery plan for blue whales identify noise interference as a potential threat. Both of these species are low-frequency cetaceans.

To better reflect the auditory similarities between phylogenetically closely related species, but also significant differences between species groups among the marine mammals, Southall et al. (2007) assigned the extant marine mammal species to functional hearing groups based on their hearing capabilities and sound production.

Exposure to intense impulsive noise may be more hazardous to hearing than continuous (non-impulsive) noise. Impulsive sound sources include the VSP which are outside the auditory range of baleen whales (humpback and pygmy blue whales) but within the mid-frequency cetacean auditory range (orca, sperm whales and dolphins). The PTS and TTS thresholds (for impulsive and continuous sources) are from National Marine Fisheries Service (NMFS) (2018) which is the most current technical guidance for assessing the effect of anthropogenic sound on marine mammal hearing. These thresholds are also adopted in the more recent Southall et al. (2019) review. These thresholds that detail receptor noise impacts and behavioural response for continuous noise (MODU, support vessels) and impulsive noises (VSP) are summarised in **Table 6-10** and **Table 6-11**.

Behavioural reactions to acoustic exposure are generally more variable, context-dependent, and less predictable than the effects of noise exposure on hearing or physiology. Hence, it is difficult to determine thresholds for behavioural response in individual cetaceans as the way they respond often varies (Nowacek et al. 2004, Gomez et al. 2016, and Southall et al. 2019) and is influenced by both biological and environmental factors such as age, sex and the activity at the time. Observed disturbance responses to anthropogenic sound in cetaceans include altered swimming direction; increased swimming speed including pronounced 'startle' reactions; changes to surfacing, breathing and diving patterns; avoidance of the sound source area and other behavioural changes.

For non-impulsive noise, NMFS currently uses step function (all-or-none) threshold of 120 dB re 1 µPa SPL (unweighted) to assess and regulate noise-induced behavioural impacts for marine mammals (NOAA, 2019), while for impulsive noise, NMFS uses step function thresholds of 160 dB re 1 µPa SPL (unweighted) (NOAA, 2018; NOAA, 2019). The behavioural disturbance threshold criteria applied is from NMFS (2014) which is the current interim U.S. National Marine Fisheries Service (NMFS) criterion (NMFS 2014) for marine mammals and which summates the most recent scientific literature on the impacts of sound on marine mammal hearing so considered the most relevant to this activity.

Auditory masking impacts may occur when there is a reduction in audibility for one sound (signal) caused by the presence of another sound (noise). For this to occur the noise must be loud enough and have a similar frequency to the signal and both signal and noise must occur at the same time. Therefore, underwater noise produced by VSP may interfere with the ability of marine animals to detect natural sounds. This effect has the potential to interfere with animals' communication and socialisation, the detection of predators and prey, and navigation and orientation. There is little information available regarding auditory masking in whales (Richardson et al., 1995), although it has been suggested that an observed lengthening of calls in response to low-frequency noise in humpback whales and orcas may be a response to auditory masking (Fristrup et al., 2003; Foote et al., 2004).

The EPBC PMST Report for the OA identified several marine mammal species including blue whale (E), fin whale (V), humpback whale and sei whale (V). Noise is not listed as a threat in the Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015b), or Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015c).

Blue Whale Conservation Management Plan 2015 - 2025 (DoE, 2015a) lists noise disturbance as a threat, specifically relating to impulsive sound sources and acute industrial noise such as pile driving. Shipping noise in busy shipping channels is also identified as a potential source of noise emissions, although the risk assessment determines that consequences would be restricted to individuals, and no population level effects expected. The plan requires that anthropogenic noise in distribution areas will be managed such that any blue whale continues to utilise the area without injury. As injury is not expected as a result of continuous or impulsive sound sources resulting from the activity, impacts will be managed in adherence with the Management Plan.

Table 6-10: Continuous Noise: Acoustic Effects of Continuous Noise on Cetaceans: Unweighted SPL and SEL24h Thresholds

Hearing Group	NMFS (2014)	NMFS (2018)	
	Behaviour	PTS onset thresholds (received level)	TTS onset thresholds (received level)

	SPL (Lp; dB re 1 µPa)	Weighted SEL24h (LE,24h; dB re 1 µPa2·s)	Weighted SEL24h (LE,24h; dB re 1 µPa2·s)
Low-frequency cetaceans	120	199	179
High-frequency cetaceans		198	178
Very High-frequency cetaceans		173	153

L_e denotes cumulative exposure over a 24-hour period and has a reference value of 1 µPa2s

Table 6-11: Impulsive Noise: Unweighted SPL, SEL24h and PK Thresholds for Acoustic Effects on Cetaceans

Hearing Group	NMFS (2014)	NMFS (2018)			
	Behaviour	PTS onset thresholds (received level)		TTS onset thresholds (received level)	
	SPL (Lp; dB re 1 µPa)	Weighted SEL24h (LE,24h; dB re 1 µPa2·s)	PK (Lpk; dB re 1 µPa)	Weighted SEL24h (LE,24h; dB re 1 µPa2·s)	PK (Lpk; dB re 1 µPa)
Low-frequency Cetacean	160	183	219	168	213
High-frequency Cetaceans		185	230	170	224
Very High-frequency Cetaceans		155	202	140	196

Continuous noise

Auditory masking impacts may occur when there is a reduction in audibility for one sound (signal) caused by the presence of another sound (noise). For this to occur the noise must be loud enough and have a similar frequency to the signal and both signal and noise must occur at the same time. Therefore, the closer the whale is to the vessel, and the more overlap there is with their vocalisation frequencies, the higher the probability of masking. The potential for masking and communication impacts is therefore classified as high near the vessel (within tens of metres), moderate within hundreds to low within thousands of metres (Clark et al., 2009).

There is a potential for auditory masking impacts to whales due to vessel noise however impacts are considered temporary and localised because the individual and the vessels will be almost constantly moving and therefore no single area will be impacted for any length of time.

The estimated distances to behavioural and physiological thresholds (as listed in **Table 6-10**) for marine mammals from vessels are provided in **Table 6-12**.

Table 6-12: Estimated distances to behavioural and physiological thresholds for marine mammals from vessels

Potential Marine Fauna Receptor	Estimated Distance	Justification
PTS		
Low-frequency (LF) Cetaceans	12 m	Based upon accumulation of unweighted SEL over 24 h for a vessel with a source level of 166.3 dB re 1 µPa (SPL), and applying practical spreading loss
Mid-frequency (MF) Cetaceans and Dugongs	Not predicted to occur	Not predicted to occur for vessels with a significantly greater power output (McPherson et al. 2019)
TTS		
Low-frequency (LF) Cetaceans	266 m	Based upon accumulation of unweighted SEL over 24 h for a vessel with a source level of 166.3 dB re 1 µPa (SPL), and applying practical spreading loss
Mid-Frequency (MF) Cetaceans and dugongs	Not predicted to occur	Not predicted to occur for vessels with a significantly greater power output (McPherson et al. 2019)
Behaviour		
Low-frequency (LF) Cetaceans Mid-frequency (MF) Cetaceans	Within 1200 m	Considering a vessel with a source level of 166.3 dB re 1 µPa (SPL), and applying practical spreading loss, see (McPherson et al., 2019).

In addition to levels where PTS and TSS impacts are observed there have been observations of marine mammals reacting to aircraft and other anthropogenic impacts, specifically:

+ Reactions of cetaceans to circling aircraft (fixed wing or helicopter) are sometimes conspicuous if the aircraft is below an altitude of 300 m, uncommon at 460 m and generally undetectable at 600 m (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 cetaceans seem transient, and occasional overflights probably have no long-term consequences on cetaceans.
+ Observations by Richardson and Malme (1993) indicate that, for bowhead whales, most individuals are unlikely to react significantly to occasional single-pass low-flying helicopters transporting personnel and equipment 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.

This is relevant to understanding the potential impacts of helicopter operations within the noise assessment boundary (primarily during landing and take-off).

<u>Impulsive noise</u>

The Behavioural Response of Australian Humpback Whales to Seismic Surveys (BRAHSS) found short-term changes in the behaviour of migrating humpback whales that were exposed to seismic air guns.

These changes in behaviour included dive behaviour (making less progress southwards) and social behaviour; however, the study noted that no 'abnormal' behaviours were noted (such as groups turning and migrating in the opposite direction, groups ceasing to migrate or moving at high speed, abnormally high or low rates of surface behaviours, cessation of breeding interactions, etcetera (Cato et al., 2019).

Humpback whale populations have increased since being placed on the threatened species list for exploitation from whaling and have recently recovered to levels where the threatened status has been removed. There is a high abundance of humpback whales off our Western Australian coastline with the species able to thrive and increase in numbers despite the heavy oil and gas exploration.

VSP operations conducted over a period of up to 18 hours will result in the thresholds for PTS, TTS and behavioural impacts being exceeded. Impulsive sound sources will decrease quickly with distance from the source, with modelling showing that within 260 m of a VSP source the received level will be below the PTS and TTS onset thresholds. Marine mammals may show behavioural responses to noise emissions; however, this is expected to be localised (approximately 1 km from the MODU / support vessels, approximately 2.4 km from VSP operations). Given the transient and mobile nature of marine mammals, and the short-term nature of the VSP activities, the impact of noise on marine mammals is expected to be limited.

The noise assessment boundary is located within the migration BIA for Humpback Whales and distribution BIA for Pygmy Blue Whales; however behavioural responses will be limited to 1 km from the MODU / support vessels, 2.42 km from VSP operations. This represents a small proportion of the overall BIAs and is unlikely to present a barrier to movement or disrupt migratory pathways or behaviour. Impacts will be managed in adherence with the Blue Whale Conservation Management Plan 2015 - 2025 (DoE, 2015a) and Approved Conservation Advice for Megaptera novaeangliae (humpback whale) (TSSC, 2015d).

6.4.2.4 Marine Turtles

The 20 km noise assessment boundary intersects with the following marine turtle BIAs / habitat critical to the survival of the species as shown in **Table 3-8:**

+ internesting buffer BIA for flatback, hawksbill, loggerhead and green turtles
+ additional mating, nesting, internesting and foraging BIA for green turtles
+ Habitat critical for the survival of the species for green, hawksbill and flatback turtles.

A study that investigated flatback turtle internesting behaviour found that the 30 m depth contour encompassed the vast majority of internesting activities (i.e., resting on the seabed) (Pendoley, 2017). Another study by Whittock et al. (2016) identified suitable internesting habitat for flatbacks to be between 0 and 16 m deep and within 5 to 10 km off the coastline. These studies demonstrate that, while marine turtles may be present in offshore waters during the internesting period, they are typically freely moving through these areas before they return to shallow waters to rest in the days leading up to nesting activity. Therefore, it is possible that marine turtles will traverse through the OA during the peak internesting period.

Turtles have been recorded successfully breeding on Varanus Island over the last 20 years with an estimated survival probability of over 94% (Prince and Chaloupka, 2011). This would indicate that the industrial uses on Varanus Island, inclusive of the operational noise emissions, have had little to no measurable impact on adult turtles nesting on Varanus Island and, to date, have not shown to have led to a long-term decrease in the size of the adult marine turtle nesting population.

In-air and underwater hearing studies in marine turtles indicate that all species tested have poor hearing sensitivity (Lucke and McPherson, 2020; undertaken for Santos 2020). Research on marine turtles suggests that functional hearing is concentrated at frequencies between 100 and 800 Hz (Ketten and Bartol 2006), which is a subset of the low-frequency cetacean functional hearing range.

The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a) highlights noise interference from anthropogenic activities as a threat to marine turtles. The plan refers to vessel noise and the operation of some oil and gas infrastructure as sources of chronic (continuous) noise in the marine environment, exposure to which may lead to avoidance of important turtle habitat. The Recovery Plan notes there is limited information available on the impact of noise on marine turtles and that the impact of noise on turtle stocks may vary depending on whether exposure is short (acute) or long term (chronic). Turtles have been shown to respond to low frequency sound, with indications that they have the highest hearing sensitivity in the frequency range 100 to 700 Hz (Bartol and Musick, 2003).

Finneran et al. (2017) presented revised thresholds for sea turtle injury and hearing impairment (TTS and PTS). Their rationale is that sea turtles have best sensitivity at low frequencies and are known to have poor auditory sensitivity (Bartol & Ketten, 2006; Dow Piniak et al., 2012; Martin et al., 2012). Accordingly, TTS and PTS thresholds for turtles are likely more similar to those of fishes than to marine mammals (Popper et al., 2014).

Studies show that behavioural responses occur to received sound levels of approximately 166 dB re 1 µPa and that avoidance responses occur at around 175 dB re 1 µPa (McCauley et al., 2000). These levels overlap with the sound frequencies produced by vessels and VSP activities. Based on the limited data regarding noise levels that illicit a behavioural response in turtles, the lower level of 166 dB re 1 µPa level drawn from National Science Foundation (NSF, 2011) is typically applied, both in Australia and by NMFS, as the threshold level at which behavioural disturbance could occur.

The recommended criteria for impulsive and continuous sound sources are shown in **Table 6-13** and **Table 6-14**.

Table 6-13: Continuous Noise: Criteria for Vessel Noise Exposure for Turtles

Potential Marine Fauna Receptor	Popper *et al*. 2014		Finneran *et al*. (2017) Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa^2·s)	
	Masking	Behaviour	PTS onset threshold	TTS onset threshold
Marine Turtle	(N) High (I) High (F) Moderate	(N) High (I) Moderate (F) Low	220	200

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

Table 6-14: Impulsive Noise: Criteria for Impulsive Noise Exposure for Turtles: unweighted SPL, SEL24h and PK thresholds

NFS (2011)	Moein *et al.* (1995), McCauley *et al.* (2000b; 2000a)	Finneran *et al.* (2017)			
Behaviour		PTS onset threshold		TTS onset threshold	
SPL (L_p; dB re 1 µPa)		Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 $\mu Pa^2 \cdot s$)	PK (L_{pk}; dB re 1 µPa)	Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 $\mu Pa^2 \cdot s$)	PK (L_{pk}; dB re 1 µPa)
166	175	204	232	189	226

Continuous noise

Based on the criteria detailed within **Table 6-13** there is a low risk of any injury to marine turtles from vessel or MODU noise (**Section 6.4.1**). Behavioural changes, for example, avoidance and diving, are only predicted for individuals in close proximity to the activity vessels (high risk of behavioural impacts within tens of metres of a vessel and moderate risk of behavioural impacts within hundreds of metres of a vessel). There is a high risk of masking within hundreds of metres of the vessel, and a moderate risk of masking within thousands of metres from the vessel. Turtles have not been shown to have a reliance on sound for finding food or avoiding predators. Sounds potentially could be used by turtles in a social manner to synchronise activities during the nesting season (Ferrara et al., 2014); however, this has not been demonstrated for marine turtles. The noises are relatively quiet (Ferrara et al., 2014), and thus would only have a limited range of detection by turtles even in ideal conditions, with masking from natural sounds likely. The impacts from masking are expected to be low.

Impulsive noise

VSP operations conducted over a period of up to 18 hours will result in the thresholds for PTS, TTS and behavioural impacts being exceeded. However, the received levels will decline rapidly from the source and be below thresholds for PTS and TTS within approximately 500 m of the source. Given the transient and mobile nature of marine turtles, effects of noise are expected to be limited to behavioural impacts during VSP activities. No impacts at a population level are anticipated.

In summary, temporary impairment from operational sounds to marine turtles due to TTS is expected to only occur at close ranges (within tens of metres) (JASCO, 2016). Behavioural impacts may occur at close to intermediate ranges (within hundreds of metres).

Considering the open-ocean location of the OA, only individual turtles may be affected as they transit the area, and impacts are not considered significant based on the following:

- The noise assessment boundary for the OA is within an internesting buffer habitat critical to the survival of Flatback, Hawksbill and Green turtles, which is also designated a BIA. Considering the water depths of the OA (45 m) and the distance offshore (approximately 20 km to closest nesting beach) compared to observed water depths and distances of internesting turtles, impacts to turtles are not expected at the individual or population level
- MODU noise emissions that are expected are below the thresholds for behavioural impacts, PTS and TTS.
- Vessel noise is expected to be below the thresholds for PTS and TTS given the typical size vessels used during the activity and the slow vessel speeds within the OA, the received levels may result in behavioural impacts, but for a limited duration and will not result in significant impacts.
- Helicopter noise will be intermittent during the activity, and below the thresholds for behavioural impacts, PTS and TTS. Following guidelines outlined in Popper et al. (2014), marine turtles are at low risk of mortality or permanent injury due to continuous noise sources, even near the source
- Although VSP operations conducted over a period of up to 18 hours will result in the thresholds for PTS, TTS and behavioural impacts being exceeded if they are exposed near the source, however, individuals are expected to display behavioural response to the source, moving away and outside the range at which TTS could occur. Given the transient and mobile nature of marine turtles, effects of noise are expected to be limited to behavioural impacts during VSP activities. No impacts at a population level are anticipated.
- Although behavioural responses are expected to occur near the sources, these will be limited to avoidance or temporary change in swimming behaviour.

6.4.2.5 Protected and significant areas and socio-economic receptors

The Yoorn noise assessment boundary intersects the Montebello Marine Park (Multiple Use Zone – IUCN Category VI). Conservation values of the marine park (as outlined in **Section 3.2.2**) have the potential to be impacted by noise emissions through impacts to marine fauna.

Therefore, noise emissions generated at the OA have the potential to impact the values of the Montebello Marine Park, which includes (relevant to noise emissions) internesting habitat for marine turtles, a migratory pathway for humpback whales and foraging habitat for whale sharks. As described above, worst case noise impacts from the activity will potentially result in:

- PTS or TTS to cetaceans within 12 m and 266 m from the vessel or MODU
- Marine mammals may show behavioural responses to noise emissions; however, this is expected to be localised (approximately 1 km from the MODU / support vessels, approximately 2.4 km from VSP operations).
- Behavioural impacts to turtles within tens of metres of the vessel
- Due to the very short duration and infrequent use of VSP, the potential effects are expected to fall off rapidly with distance from the source and be unlikely to cause significant impacts to any marine fauna populations. The noise emissions associated with the activity are not expected to have the intensity to cause physical injury, unless fauna were in very close proximity (tens of metres) to VSP activities.

6.4.3 Environmental Performance Outcome and Control Measures

The EPOs relating to this event include:

+ No injury or mortality to EPBC Act 1999 and WA Biodiversity Conservation Act 2016 listed marine fauna during operational activities [YO-EPO-05]
+ Do not displace marine turtles from habitat critical to the survival of the species or disrupt biologically important behaviours from occurring within biologically important areas [YO-EPO-09]

The control measures considered for this event are outlined in **Table 6-15**, and the EPS' and measurement criteria for the EPOs are described in **Section 8.4**.

Table 6-15: Control Measure Evaluation for Noise Emissions

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
YO-CM-001	Procedure for interacting with marine fauna	Reduces risk of physical and behavioural impacts to marine fauna from vessels and helicopters because if marine fauna are sighted, then vessels can slow down or move away. Helicopters can increase distances from sighted fauna if required.	Operational costs to adhere to marine fauna interaction restrictions, such as vessel and helicopter speed and direction, are based on legislated requirements and must be accepted.	**Adopted** – Benefits in reducing impacts to marine fauna outweigh the costs incurred by Santos. Procedure aligns with Part 8 of the EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales.
YO-CM-15	Support Vessel	Monitoring of surrounding marine environment to identify potential collision risks (and reducing harm) to cetaceans and other marine fauna.	No additional cost – industry practice.	**Adopted** – industry practice, benefits outweigh cost. Control drives compliance with the EPBC Regulations.
YO-CM-018	MODU seismic survey procedures	Includes controls that reduce the risk of harm to marine fauna. The checklist includes standards for: + Marine fauna observation. + Soft-start, operational and shut-down protocols[1]. + Low visibility and night-time operations.	Some operational costs associated with implementing procedure to VSP activities.	**Adopted** – Benefits in reducing impacts to marine fauna outweigh the costs incurred. Procedure aligns with Part A of the EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales.

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
YO-CM-035	Marine assurance standard	Ensures contracted vessels are operated, maintained and manned in accordance with industry standards (for example, Marine Orders) and regulatory requirements (this EP) and the relevant Santos procedures mentioned in this EP.	Costs are expected as part of standard procedure.	**Adopted –** Benefits in reducing noise impacts.
YO-CM-040	MODU Planned Maintenance System (PMS)	Reduces noise emissions from the MODU because equipment is operating within its parameters	Operational costs and labour or access requirements of undertaking maintenance	**Adopted-** benefits in reducing noise impacts.
YO-CM-041	Vessel Planned Maintenance System (PMS) to maintain vessel DP, engines and machinery	Ensures equipment which generates noise is operating optimally and sound sources levels are appropriately verified and within desired operating range.	Costs are standard for routine PMS	**Adopted-** benefits in reducing noise impacts.
YO-CM-042	Vessel activities environmental awareness and training (inductions) covers protected marine fauna sighting procedure	Project environmental awareness and training (inductions) covers use protected marine fauna sighting procedure. Provides explanation to personnel for Santos WA's Protected Marine	No additional costs associated with inclusion induction content.	**Adopted-** no additional costs to implement procedure

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		Fauna Interaction and Sighting Procedure with aim to increase compliance.		
Additional Control Measures				
N/A	Heterodyne distributed vibration sensing (hDVS) technology	The hDVS can result in a reduction in time spent by the MODU on location undertaking VSP (and subsequent cost reduction), and reduction in the number of air-gun shots required for the activity, therefore decreasing the marine fauna exposure time to underwater noise.	This technology may be feasible for the well but availability cannot be guaranteed until the schedule is confirmed. Only one vender who supplies this technology.	**Rejected** – The worst-case option of using VSP has been retained for this well in the event that this equipment is not available.
N/A	Dedicated Marine Fauna Observer on vessels[1]	Improved ability to spot and identify marine fauna at risk of impact by vessel noise.	Additional cost of contracting several specialist Marine Fauna Observers while the risk to all listed marine fauna cannot be reduced due to variability in timing of environmentally sensitive periods and unpredictable presence of some species.	**Rejected –** Cost disproportionate to increase in environmental benefit and given that crew member will be observing for marine fauna during MODU VSP activities.
N/A	Site specific acoustic modelling[1]	The distance at which fauna could experience behavioural	Additional cost to contract consultant to develop a model	**Rejected** – The cost associated with site specific modelling, outweighs any

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		impacts can be predicted and compared to literary publications. Additional management controls can then be included if required to support an ALARP justification and reduce potential impacts to marine fauna.	and produce predicted noise outputs.	environmental benefit, and no further controls can be implemented to reduce vessel noise or VSP other than not undertaking the activity. Given the potential impacts are expected to be minor and limited to temporary and minor behavioural changes only, and noise levels from vessels, VSP will decay rapidly; site specific modelling will not provide additional information which would alter the current ALARP position. Also, the activity does not occur in a humpback whale resting, foraging, calving or confined migratory pathway, as described in the conservation advice.
N/A	Noise management plan[1]	Impacts are predicted to be minor (e.g. potential temporary and minor behavioural changes) therefore, a management plan, and associated management controls, will have little or no benefit in terms of outcomes i.e. reducing impacts further.	No additional cost other than negligible personnel costs of preparing and reviewing the management plan.	**Rejected** – The activity does not occur in any resting, foraging, calving or confined migratory pathway for protected cetacean species, therefore the cost associated with the development of a management plan outweighs the little or no benefit for a short duration activity which has a minor impact (e.g., potential temporary and minor behavioural changes).

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
N/A	Use of Passive acoustic monitoring (PAM) [1]	Improve detection of some sensitive receptors.	Costs of PAM operators. Operational costs of shutdowns potentially prolonging the activity.	**Rejected** – Cost disproportionate to increase in environmental benefit given the low-level behavioural response expected. Limited ability of PAM to detect cetaceans would provide little benefit to the species expected to be present.
N/A	Verification of noise levels	Allow implementation of adaptive management controls should impact be greater than expected.	Costs of deploying noise monitoring equipment and processing of data.	**Rejected** – Relatively short duration of the activity would prevent noise verification being completed before the activity is finished. Cost disproportionate to increase in environmental benefit given the rapid reduction in noise levels from vessels and the low-level behavioural response expected.
N/A	Operational activities to avoid coinciding with sensitive periods for marine fauna present in the OA.	Reduce risk of impacts from noise emissions during environmentally sensitive periods for listed marine fauna.	High cost in moving or delaying activity schedule for operational reasons (schedule dependent on availability of offshore vessel(s) and MODU. The risk to all listed marine fauna cannot be reduced due to variability in timing of environmentally sensitive periods	**Rejected** – Given the minimal risk of impacts to threatened species (e.g. whales, whale sharks and turtles) occurring, the financial and environmental costs of amending the activity schedule to suit multiple sensitivity windows is deemed grossly disproportionate to low environmental benefits. While the 20 km noise assessment boundary for Yoorn-1 intersects

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
			and unpredictable presence of some species.	BIAs for the humpback whale pygmy blue whale; and marine turtle BIAs/habitat critical for the survival of the species, impacts to all marine fauna are predicted to be localised; with the greatest spatial extent predicted at 2.4 km (from VSP). VSP is only undertaken for 18 hours. Therefore, impacts are not expected on a population level.
N/A	Spotter planes/ vessels sent to spot fauna before use of VSP (EPBC Policy Statement 2.1 – Part B.2 & B.3)	Increase detection of individuals or groups of marine fauna which may be displaced or disturbed, during night-time operations when visibility is low.	Marine fauna may have moved away from the area by the time the vessel arrives. Cost of specialist aircraft with good downward visibility, or cost of an additional spotter vessel additional MFOs required on board aircraft. Additional risks to environment through use of vessels/airplanes, increased safety risks to personnel on board additional vessels/airplanes.	**Rejected –** Cost is disproportionate to increase in environmental benefit.
N/A	Adaptive Management: + Terminating the survey for 24 hours if	Potential reduction in impacts to humpback whales	Impracticable to schedule activities to avoid all listed marine fauna due to variability in timing of	**Rejected –** shut down impractical given the unpredictable presence of marine fauna and the transient

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
	there are 3 or more humpback whale induced shutdowns/ power downs within the previous 24-hour period. + Terminating the survey if there are 3 consecutive days of no collection of survey data due to the presence of migrating humpback whales. (EPBC Policy Statement 2.1 – Part B.6)		environmentally sensitive periods and the constant or unpredictable presence of some species. Short duration activity (i.e. a few days) that is low risk to marine fauna.	nature of humpback whales
N/A	Pre-survey research would involve sending a dedicated research vessel to the survey area ahead of time. Allows for survey planning around areas of peak migration and aggregation, therefore reducing risks to marine fauna (EPBC Policy Statement 2.1 – Part B.2)	Increase knowledge of marine fauna activity in the area.	Long lead time as a research vessel sent out to the field would need to go one year ahead of the survey at the planned time to collect relevant data, survey areas often not defined >1 yr. in advance, further risks from vessel collision and emissions; Cost of research vessel.	**Rejected –** limited benefit for high cost and added risk of vessel collision and emissions associated with a research vessel
N/A	No start up or operations at night-time / low visibility (EPBC Policy	Reduce probability of a cetacean occurring within the low	Increases time of survey. Increase cost due to increased survey	**Rejected** – Cost disproportionate to increase in environmental benefit.

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
	Statement 2.1 – Part B.2)	power/shutdown zone and not being detected.	time. Survey objectives would not be met in available timeframe.	Risks associated with physical presence also increase with the increased survey time.

[1] As recommended in 'Approved Conservation Advice for Megaptera novaeangliae (humpback whale) (2015)'

6.4.4 Environmental Impact Assessment

Table 6-16: Impacts and Consequence Ranking – Noise Emissions

Receptor	Consequence Level
Acoustic Disturbance	
Threatened, migratory or local fauna	The noise assessment boundary (20 km buffer from Yoorn-1) intersects with the following / habitat critical to the survival of the species: + Internesting buffer BIA for flatback, hawksbill, loggerhead and green turtles + Additional mating, nesting, internesting and foraging BIAs for green turtles + Habitat critical to the survival of the species for green, hawksbill and flatback turtles + Humpback whale migration BIA + Whale shark foraging BIA. While the level of noise expected from temporary and intermittent operational activities has the potential to cause physical injury to marine fauna, most species that may transit through the OA are expected to demonstrate avoidance behaviour if noise levels approach those that could cause pathological effects. Avoidance behaviour is likely to be localised (approximately 1 km) within the area of the activity (due to small spatial extent of elevated noise) and temporary, i.e., for the duration of the activity only. The noise assessment boundary overlaps a humpback whale migration BIA. Due to behavioural responses to noise within the OA, humpback whales may be displaced from a small proportion of the BIA. However, the area of overall represents a small proportion of the BIA width, which is unlikely to present a barrier to movement or disrupt migratory pathways or behaviour. The main migration path during the northward migration (July to October) of the humpback whale is centred along the 200 m bathymetric contour (Jenner et al., 2001), which is unlikely to intercept the noise assessment boundary which is approximately 45 m deep. In addition, a pygmy blue whale BIA for distribution overlaps the noise assessment boundary, however displacement of pygmy blue whales and whale sharks is not expected. Some behavioural response to vessel noise could occur to benthic fish communities within the noise assessment boundary. The sand and shell fragment seabed of the OA suggests there are unlikely to be any areas of particularly high abundance or diversity of fishes within this area, although it is likely that there will be some attraction of fishes to the subsea infrastructure.

	Whale sharks may pass through the noise assessment boundary due to an intersecting foraging BIA. Whale sharks would be expected to show a behavioural response only, as it is unlikely that this species would swim within close range (within metres) of high-energy sound sources (for example, bow thrusters) that could result in physiological damage. Potential PTS to low-frequency whales (for example, humpback and blue whales) could occur within 12 m of the centre of the vessel (considering a representative vessel that is 54 m long) if the vessel and the cetacean remained in the same place for 24 hours. However, the vessel will never remain in the one position for this long, and as whales are also always moving, the potential for this impact is extremely low. Behavioural impacts may be expected for marine mammals, that is, humpback whales, from the vessels and equipment. Although BIAs for marine turtles, including green, hawksbill, loggerhead and flatback turtles (internesting buffer, including critical habitat for green, hawksbill and flatback turtles) occur within the noise assessment boundary, impacts are not expected on a population level or on turtle habitat. Individuals may be encountered within the noise assessment boundary but are likely to be internesting adults due to the distance from the closest nesting beaches (approximately 20 km to Trimouillle Island from the OA). The Montebello Islands are a nesting area identified as habitat critical to the survival of the species for flatback and green turtles (CoA, 2017a). Behavioural impacts could occur within the immediate vicinity of the vessel and equipment for a short duration and will likely result in the turtles moving away from the area. As the area within which foraging and distribution of all turtles species is widespread, the minimal disturbance is not expected to significantly impact the critical habitat for turtles, or impact at a population level due to the nature and scale of the activity (temporary, short duration, vessel based activity). In the Recovery Plan for Marine Turtles in Australia, noise interference to marine turtles is separated depending on whether the exposure is short (acute) or long-term (chronic). Activities such as pile driving, seismic activity and some forms of dredging generate acute noise, and sources of chronic noise are identified as including shipping channels and the operation of some oil and gas infrastructure. The level of noise generated by this activity is acute, temporary and may result in behavioural impacts to marine turtles. Given the generally low level of noise expected from the MODU, vessels, helicopters and associated activities, and the relatively short duration of noise emissions, significant impacts to threatened or migratory species are not expected. Some temporary and localised behavioural response may result from the noise levels emitted, but these will not be at levels that could cause mortality or injury to marine fauna or cause a decrease in local population size or area of occupancy of species. The consequence level for fauna is considered to be II - Minor. The predicted level of impact described above does not exceed the acceptable level of impact to not displace marine turtles from habitat critical to the survival of the species; or disrupt biologically important behaviours from occurring within biologically important areas.
Physical environment or habitat	Not applicable – Noise emissions will not impact the physical environment / habitats, apart from increasing ambient noise levels which is considered under other receptors.
Threatened ecological communities	Not applicable – No threatened ecological communities identified in the area over which noise emissions are expected.

Protected areas	The noise assessment boundary intersects the Montebello AMP (Multiple Use Zone - IUCN Category VI). The objective is to provide for ecologically sustainable use and the conservation of ecosystems, habitats and native species. The values of the marine park, with respect to the presence of marine species (receptors) are described above and are assessed as II (Minor). Noise emissions will impact a very small portion of the Montebello Islands AMP in the immediate vicinity of the MODU and vessels with any impacts expected to be restricted to localised and temporary impacts to marine fauna as they transit through the area and at a behavioural level only. Noise levels are not expected to impact on habitats or species at a population or community level.
Socio-economic receptors	Noise levels are not expected to impact on socio-economic receptors due to their low activity level within the vicinity of the OA. Impacts to fish may result in indirect impacts to fisheries in the area given the potential for temporary avoidance behaviour during VSP activities. However, given the short duration of the activity, limited impacts from the noise levels emitted from the activity (excepting VSP), the area available for the respective commercial fisheries and the area over which commercial species spawn, impacts to fisheries are considered negligible. There are no recreation areas within the area expected to be impacted by noise. The nearest recreation area is the Montebello Islands (approximately 22.1 km from the Yoorn-1 well location).
Overall worst-case consequence	II - Minor

6.4.5 Demonstration of ALARP

The use of the MODU, vessels and survey equipment is unavoidable if the operational activities are to proceed as required. Equipment maintenance will keep the vessel noise levels to within normal operating limits, which will also aid in reducing the likelihood of noise impacts to sensitive receptors.

The use of helicopters to transfer personnel to and from the MODU is necessary to allow operational activities to occur safely and effectively, with some personnel required to be rotated to and from other locations, and to provide for a rapid method of transferring to and from the MODU in the case of an emergency. A performance standard prohibiting helicopters from landing or taking-off in the presence of marine megafauna would introduce an unacceptable risk to human life.

The vessel is also expected to produce similar noise emissions to other marine vessels that frequent or transit through the vicinity of the 20 km noise assessment boundary (in other words, oil and gas industry vessels). The vessel will adhere to the EPBC Regulations (Part 8) to ensure that actions are undertaken to avoid marine mammals, turtles and whale sharks within 500 m of a vessel, and all crews will be inducted into these requirements. It is further expected that the vessel will typically emit sufficient noise for sensitive marine fauna to exhibit avoidance behaviour and move away from the activity to avoid physical impact zones.

The VSP activity is short in duration, typically 12 - 18 hours, but cannot be eliminated as it is utilised for obtaining necessary geological data. The use of an alternative technology (heterodyne distributed vibration sensing (hDVS) technology) for undertaking VSP was considered as it can allow a reduction in the number of shots required for the activity therefore decreasing marine fauna exposure to elevated underwater noise. This technology may be feasible for the well but availability cannot be guaranteed, therefore the use of hDVS has to be rejected. Consistent with EPBC Act Policy Statement 2.1 (Part A), Environmental Checklist for MODU Seismic Operations [YO-CM-018] will reduce the risk of impacts to marine fauna from VSP.

Santos have considered the actions prescribed in various recovery plans and conservation advices such as Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017), and Blue Whale Conservation Management Plan 2015–2025 (2015) when developing the controls relevant to potential VBA to minimise noise impacts on marine cetaceans, sharks, fish and marine turtles. Management controls are in place to reduce operating noise, including vessel and helicopter operational protocols and VSP procedures, through adherence to the Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003). This requires compliance with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000 and includes controls to reduce the risk of disturbance to or collision with EPBC Act– listed marine fauna. Santos has considered the actions prescribed in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a) when developing these controls to minimise noise impacts on marine turtles.

Avoiding periods of higher sensitivity such as migration or nesting periods for whales and turtles (for example) is not considered feasible. The noise assessment boundary overlaps a number of BIAs for fauna: humpback and blue whale migration that occurs across the NWS from April to December, and nesting activities for various turtle species from August to April/May (**Table** 3-13**),** this leaves a very small window of opportunity within which to conduct activities. Given the low potential impacts to individual fauna, there is not expected to be an impact at population level or significant impacts on migratory or nesting behaviours.

Significant impacts are not expected on fauna, including cetaceans and turtles, and the assessed residual consequence for this impact is II- Minor. Additional control measures were considered but rejected since the associated cost or effort was grossly disproportionate to any benefit (see **Section 6.4.3**). Therefore, the impact from noise associated with the activities is ALARP.

6.4.6 Acceptability Evaluation

Is the consequence ranked as I (Negligible) or II (Minor)?	Yes – maximum consequence from noise emissions is II (Minor).
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are the risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian marine park zoning objectives)?	The following material published in relation to threatened and migratory species within the noise assessment boundary identifies noise emissions as a threat (**Table 3-9**): + **Conservation Advice:** Conservation Advice *Balaenoptera borealis* sei whale (2015) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015)

	Recovery Plans: + Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017a) identifies noise interference as a threat to marine turtles. The following BIAs and habitat critical to the survival of the species have been identified in the noise assessment boundary: nesting, mating, interesting, interesting buffer and foraging BIAs have been identified for green turtles and interesting buffer BIAs for flatback, hawksbill, and loggerhead turtles. Habitat critical to the survival of the species have also been identified for green, hawksbill and flatback turtles. Action Area B.3 from the management plan: Assessing and addressing anthropogenic noise, will be managed through the adoption of YO-EPO-05, YO-EPO-09 and the control measures outlined in **Table 6-15.** + Conservation Management Plan for Blue Whales (DoE, 2015a) identifies noise interference as a threat to blue whales. A distribution BIA has been identified in the noise assessment boundary however displacement is not expected. Action Area B.3 from the management: assessing and addressing anthropogenic noise, will be managed through the adoption of YO-EPO-05, YO-EPO-09 and the control measures outlined in **Table 6-15.** Recovery Plans / Conservation Advice for other species that may occur in the project area do not identify noise emissions as a key threat or have explicit relevant objectives or management actions related to noise emissions. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) identifies noise pollution as a pressure that may impact marine park values. It seeks to minimise the impact of pressures on the marine park values as far as reasonably practicable. The implementation of YO-EPO-05, YO-EPO-09 and the control measures outlined in **Table 6-15** will ensure the noise emitted during Yoorn-1 activities will not compromise this outcome. + The noise assessment boundary intersects the Montebello Marine Park which is categorised as Multiple Use Zone (IUCN Category VI) (**Table 3-4**). The objective of the Multiple Use Zone (VI) is to provide ecologically sustainable use and the conservation of ecosystems, habitats and native species. The management of noise emissions are aligned with this objective through the adoption of YO-EPO-05, YO-EPO-09 and the control measures outlined in **Table 6-15**. The objectives and actions of these publications were considered during the assessment of impacts and risks. The controls outlined in **Table 6-15** are consistent with the

	objectives of the material listed above and Santos considers the impacts of noise emissions to not be inconsistent with these objectives.
Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes. DNP requested the EP gives consideration to avoiding impacts upon migratory species, such as considering the use of low power and shut down zones and timing of the activity (relevant to noise) – with particular attention to managing the risk to turtle foraging and internesting locations. DNP also requested notifications as per the Petroleum Activity and Australian Marine Park Guidance Note (NOPSEMA, 2020) regarding timing and information provided. Santos considers these concerns to have been addressed or will be addressed as per the Activity Notification and Reporting Requirements (**Table 8-4**).
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

The drilling activities will be conducted over a short period (up to 100 days including contingency) in a remote offshore location with a relatively low probability of encountering significant numbers of noise sensitive fauna.

Minimal behavioural changes are expected from all marine fauna in the noise assessment boundary, and therefore the negligible impacts expected from these noise sources are considered environmentally acceptable. No long-term harm is expected to result to EPBC listed marine fauna during operational activities. Through adherence to Santos' *Protected Marine Fauna Interaction and Sighting Procedure* (EA-91-11-00003), which drives compliance with EPBC Policy Statement Part 8, the Activity is considered acceptable to undertake in the area. In addition, no concerns from stakeholders (including fisheries) have been raised to indicate that the activity will have any unacceptable impacts to socio-economic receptors.

The activity that will generate noise are standard offshore industry practice and the potential impacts well documented. With the controls proposed including Part A of EPBC Act Policy Statement 2.1; EPBC Regulations Part 8 (Vessels and Aircraft), and aligned with the applicable management actions outlined in relevant Recovery Plans and Approved Conservation Advice, the potential consequences of impacts to noise sensitive receptors in the area, including internesting flatback turtles are assessed to be II- Minor and ALARP.

6.5 Atmospheric Emissions

6.5.1 Description of Event

Event	Atmospheric emissions will occur as a result of:

	+ MODU operations + Vessel operations Gaseous greenhouse gas (GHG) emissions, such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), along with non-GHG emissions, such as sulphur oxides (SOX) and nitrogen oxides (NOX), are discharged to the atmosphere during continued operations of the MODU and vessel engines, helicopters, generators, mobile and fixed plant, and equipment. The MODU and support vessels may utilise ozone-depleting substances (ODS) in closed-system rechargeable refrigeration systems. There is no plan to release ODS to the atmosphere. Support vessels may also use an incinerator to manage wastes but will not incinerate inside the 500 m PSZ around the MODU. When transferring dry bulk products used for drilling (e.g. barite, bentonite, cement), tank venting is necessary to prevent tank overpressure. The vent air will contain minor quantities of product particles, which will suspend in the air or settle on the sea surface.
Extent	Localised: The quantities of gaseous and solid (powder) emissions are relatively small and will, under normal circumstances, quickly dissipate into the surrounding atmosphere.
Duration	For the duration of the Activity, as described in **Section 2.2**

6.5.2 Nature and Scale of Environmental Impacts

<u>Potential receptors: Physical environment (air quality and climate).</u>

Hydrocarbon combustion may result in a temporary, localised reduction of air quality in the environment immediately surrounding the discharge point during the activity. Non-GHG emissions, such as NOX and SOX, can lead to a reduction in local air quality. GHG emissions are recognised to also contribute to the greenhouse gas emissions loading globally.

Tank venting is a necessary safety control, and any dust emissions will be negligible and limited to the immediate vicinity of the MODU and support vessels.

As the activity will occur in open-ocean offshore waters, the combustion of fuels and incineration in such remote locations will not impact on air quality in coastal towns, the nearest being Dampier (approximately 102 km south east from the OA). The quantities of gaseous emissions are relatively small and will quickly dissipate into the surrounding atmosphere. Air emissions will be similar to other vessels operating in the region for both petroleum and non-petroleum activities.

Accidental release and fugitive emissions of ODS has the potential to contribute to ozone layer depletion. Maintenance of refrigeration systems containing ODS is on a routine, but infrequent basis, and with controls implemented, the likelihood of an accidental ODS release of material volume is considered rare.

Potential impacts are expected to be short-term, and relate to localised reduction in air quality, limited to the immediate vicinity of the emissions release. Atmospheric emission impacts are not expected to have direct or cumulative impacts on sensitive environmental receptors or be above National Environmental Protection (Ambient Air Quality) measures.

6.5.3 Environmental Performance Outcomes and Control Measures

The EPOs relating to this event include:

+ No unplanned objects, emissions or discharges to sea or air [YO-EPO-04]; and
+ Reduce impacts to air and water quality from planned discharges and emissions from operational activities [YO-EPO-06].

The control measures for this event are shown in **Table 6-17**, and the EPS' and measurement criteria for the EPOs are described in **Section 8.4**.

Table 6-17: Control Measure Evaluation for Atmospheric Emissions

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
YO-CM-021	Air pollution prevention certification	Ensure vessels are operating with acceptable emissions as per international standards.	No additional costs, as this is a regulatory requirement.	**Adopted** – Benefit of ensuring vessel is compliant outweighs the minimal costs and it is a legislated requirement.
YO-CM-020	Fuel oil quality	Ensure vessels are operating with acceptable emissions for vessel class as per Australian standards.	No additional costs, as this is a regulatory requirement.	**Adopted** – no additional costs
YO-CM-035	Marine Assurance Standard	Reduces emissions from vessels because equipment operating within its parameters.	Cost associated with implementing procedures.	**Adopted –** Benefit of ensuring vessel is compliant outweighs the minimal costs and it is a legislated requirement.
YO-CM-043	Ozone-depleting substance (ODS) handling procedures	Where present, ensure vessels ODS are managed in a way that is responsible and as per international standards.	No additional cost	**Adopted** – Benefit of ensuring no ozone-depleting substance release outweighs the negligible costs.
YO-CM-040	MODU Planned Maintenance System (PMS)	Ensure vessel is running efficiency and are per manufacture specifications. As such routine maintenance endeavours to ensure emissions are minimal.	No additional costs, is industry best practice.	**Adopted** – no additional costs
YO-CM-041	Vessel Planned Maintenance System (PMS) to maintain vessel DP, engines and machinery Vessel	Ensure vessel is running efficiency and are per manufacture specifications. As such routine maintenance endeavours to ensure emissions are minimal.	No additional costs, is industry best practice.	**Adopted** – no additional costs

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
	machinery, equipment and maintenance			
YO-CM-011	Bulk transfer procedure –	Nil	Health and safety requirement to prevent tank over-pressure.	**Adopted** – The health and safety requirement outweigh the negligible environmental impact.
YO-CM-019	Waste incinerator	Where present, ensure vessels incinerator are managed in a way that is responsible and as per international standards.	No additional cost	**Adopted** – Negligible environmental impact outweighs the costs associated with transporting waste to shore for landfill.
Additional Control Measures				
N/A	No bulk product (powder) transfers.	Reduces probability of potential impacts to air quality from unintentional release.	Bulk product is required to perform the activity and transfers of bulk product are required. Transfer activities are carried out in accordance with MODU owner's procedures to reduce the risk of an unintentional release.	**Rejected** – Not feasible.
N/A	No incineration during vessel-based operations activities	Removes all emissions associated with incineration activities during the Project	Increase in health risk from storage of wastes. Increase in risk due to transfers (increased fuel usage, potential increase in collision risk, disposal on land).	**Rejected** – Health and safety risks outweigh the benefit given the offshore location. Cost associated with transporting waste to shore for landfill or incineration

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
				outweighs onboard incineration. Incineration on the vessels (outside the 500 m PSZ around the MODU) is a permitted maritime operation.
N/A	Prohibit use of Ozone-depleting Substances (ODS)	Eliminates emissions associated with ODS activities during the project.	Lack of refrigeration systems on board the vessels would lead to unacceptable workplace conditions (i.e., air conditioning) and poor food hygiene standards, limiting the vessel's ability to undertake the activity; therefore, there is no practical solution to the use of refrigeration. It is noted that ozone-depleting substances are rarely found on vessels.	**Rejected** – Based on cost to replace all equipment and there is only a low potential for ozone-depleting substance releases.
N/A	Use incinerators and engines with higher environmental efficiency	Reduces project emissions associated with incinerators and engines.	Significant cost in changing unknown vessel equipment.	**Rejected –** Cost grossly disproportionate to low environmental benefit (impact rated Negligible).

6.5.4 Environmental Impact Assessment

Table 6-18: Impacts and Consequence Ranking – Atmospheric Emissions

Receptor	Consequence Level
Air emissions	

Receptor	Consequence Level
Threatened, migratory or local fauna	Emissions from the Activity are relatively small and will, under normal circumstances quickly dissipate into the surrounding atmosphere. Any potential impacts are not expected to result in a decrease in local population sizes particularly to seabirds or disruption to breeding cycles. The consequence of air emissions to fauna is I (Negligible).
Physical environment or habitat	The activity will occur in the open ocean and offshore waters, the combustion of fuels and venting and rare ODS releases in such a remote location will not impact on air quality in coastal towns. The quantities of gaseous emissions are relatively small and will, under normal circumstances, quickly dissipate into the surrounding atmosphere. The highly dispersive nature of local winds (i.e., strong and consistent) is expected to reduce potentially harmful or 'noticeable' gaseous concentrations within a short distance from the MODU or vessels. Therefore, the consequence level is assessed as I (Negligible).
Threatened ecological communities	Not applicable – No threatened ecological communities present.
Protected areas	Not applicable – Gaseous emissions are relatively small, will quickly dissipate into the surrounding atmosphere, and are not considered to be a potential source of impact for protected areas. The OA intersects the Montebello AMP (Multiple Use Zone - IUCN Category VI). The objective is to provide for ecologically sustainable use and the conservation of ecosystems, habitats and native species. The values of the marine park, with respect to the presence of marine species (receptors) are described above and are assessed as I (Negligible).
Socio-economic receptors	As the activities occur in offshore waters, the combustion of fuels and ODS releases in these remote locations will not impact on air quality in coastal towns. The quantities of gaseous emissions are relatively small and will under normal circumstances, quickly dissipate into the surrounding atmosphere. The highly dispersive nature of local winds (i.e. strong and consistent) is expected to reduce potentially harmful or 'noticeable' gaseous concentrations within a short distance from the vessels. The consequence is assessed as I (Negligible).
Worst-case consequence level	I - Negligible

6.5.5 Demonstration of ALARP

Combustion of fossil fuels is essential to undertaking the activity to power the MODU, vessels, helicopters and equipment. Practical and reliable alternative fuel types and power sources for the MODU, vessels and helicopters have not been identified.

Bulk transfers are necessary to provide drilling materials and tank venting is a necessary safety control. There are no safe and feasible alternatives to venting to complete the activity.

Incineration on the support vessels will not occur within the 500 m PSZ around the MODU. Implementation of a zero-incineration policy on the vessels would result in significant costs associated with the transport of waste to shore for disposal. Further transportation of the waste to shore would increase the environmental impacts and risks associated with the drilling activity through increased vessel movements and generate greater volumes of emissions associated with the vessel movements. Since incineration is a permitted maritime operation in accordance with Marine Order 97 (reflecting International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI requirements) it is considered ALARP.

Lack of refrigeration systems (i.e., air conditioning) on-board the MODU and vessels would lead to unacceptable workplace conditions and poor food hygiene standards, limiting the MODU and/or vessels' ability to undertake the activities, therefore there is no practical alternative to the use of refrigeration.

The assessed residual consequence for this impact is I (Negligible) and cannot be reduced further. Additional control measures were considered but rejected, since the associated cost or effort was grossly disproportionate to any benefit, as detailed in **Section 6.5.3**. Therefore, it is considered that the impact of the activities conducted is ALARP.

6.5.6 Acceptability Evaluation

Is the consequence ranked as I (Negligible) or II (Minor)	Yes – maximum consequence from atmospheric emissions is I (Negligible).
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian Marine Park zoning objectives)?	Yes – pursuant to Marine Order 97 (Marine pollution prevention – air pollution), which gives effect under Australian law to Australian Marine Order 97. The following material published in relation to threatened and migratory species within the OA identifies climate change as a threat (**Table 3-9**): **Conservation Advice:** + Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015) + Approved Conservation Advice for *Calidris canutus* (Red knot) (2016) + Commonwealth Conservation Advice on *Dermochelys coriacea* (2008) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015) **Recovery Plans:** + Recovery plan for the White Shark (*Carcharodon carcharias*) (2013)

	+ Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (2014) + Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015) + Draft Wildlife Conservation Plan for Seabirds (CoA, 2019) + National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011) + Recovery plan for marine turtles in Australia 2017 – 2027 (CoA, 2017a) + Blue Whale Conservation Management Plan 2015 - 2025 (2015) + For all the recovery plans identified above, the objectives are achieved through the adoption of YO-EPO-04, YO-EPO-06 and the control measures outlined in **Table 6-17**; and Santos considers the impacts of atmospheric emissions to not be inconsistent with these recovery plans. Recovery Plans / Conservation Advice for other species that may occur in the project area do not identify climate change as a key threat or have explicit relevant objectives or management actions related to climate change. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) identifies climate change as a pressure that may impact marine park values. It seeks to minimise the impact of pressures on the marine park values as far as reasonably practicable. The implementation of YO-EPO-04, YO-EPO-06 and the control measures outlined in **Table 6-17** will ensure the atmospheric emissions for Yoorn-1 activities will not compromise this outcome. + The OA intersects the Montebello Marine Park which is categorised as Multiple Use Zone (IUCN Category VI) (**Table** 3-4). The objective of the Multiple Use Zone (VI) is to provide ecologically sustainable use and the conservation of ecosystems, habitats and native species. The management of atmospheric emissions is aligned with this objective through the adoption of YO-EPO-04, YO-EPO-06 and the control measures outlined in **Table 6-17**. The objectives and actions of these publications were considered during the assessment of impacts and risks. The controls outlined in **Table 6-17** are consistent with the objectives of the material listed above and Santos considers the impacts of atmospheric emissions to not be inconsistent with these objectives.

Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

Atmospheric emissions from vessels are permissible under the Protection of the Sea (Prevention of Pollution from Ships) Act 1983, which is enacted in Australian waters by Marine Order 97 (Marine pollution prevention – air pollution) (which also reflects MARPOL Annex VI requirements). This is an internationally accepted standard that is utilised industry wide, and compliance with Australian Marine Order standards is considered to be an appropriate management measure in this case.

The overall impacts to the atmosphere and sensitive receptors are expected to be I (Negligible) if the emissions management is adhered to and impacts from emissions that are generated by the various operational activities are considered to be ALARP and environmentally acceptable.

6.6 Planned Operational Discharges

6.6.1 Description of Event

Event	Planned operational discharges will occur as a result of: + Vessel Operations + MODU Operations Discharges will include (refer to **Table 6-19**): + Sewage and grey water disposal + Putrescible waste disposal + Desalination brine disposal + Cooling water disposal + Boiler blowdown water + Deck drainage disposal + Bilge water disposal. Planned operational discharges will be treated in compliance with relevant legislation. Impacts associated with planned operational discharges are typically restricted to the OA, given the low quantities of discharge and the short duration of the activity.
Extent	The small volumes discharged may cause localised nutrient enrichment, organic and particulate loading, toxic impacts to marine fauna, thermal impacts and increased salinity.
Duration	For the duration of the Activity, as described in **Section 2.2**; water quality conditions will return to normal within minutes to hours of cessation of discharges.

6.6.1.1 MODU and Vessel Operations

MODU and support vessels will discharge planned operational discharges within the OA. A description of each discharge stream is provided in **Table 6-19**.

Table 6-19: Planned Operational Discharges from Vessel Operations

Discharge	Description
Sewage and grey water	The volume of sewage is directly proportional to the number of persons on-board the MODU and support vessels. Approximately 0.04 and 0.45 m^3 of sewage/ greywater will be generated per person per day (EMSA, 2016). Treated sewage will be disposed in accordance with Marine Order 96 (Marine pollution prevention – sewage) requirements.
Putrescible waste	Food scraps are generated onboard vessels (approximately 1 L of food waste per person per day). The scraps are macerated and discharged within the OA as permitted under the Marine Order requirements.
Cooling water	Seawater is used as a heat exchange medium for the cooling of machinery engines. Seawater is drawn from the ocean and flows counter-current through closed-circuit heat exchangers, transferring heat from the vessel engines and machinery to the seawater. The seawater is then discharged to the ocean (i.e. it is a once-through system). Cooling water temperatures vary depending upon the vessel's engine workload and activity.
Brine	Brine generated from the water supply systems on-board the MODU and support vessels will be discharged to the ocean at a salinity of approximately 10% higher than seawater. The volume of the discharge is dependent on the requirement for fresh (or potable) water and would vary between vessels and the number of people on-board.
Deck drainage and bilge	Deck drainage from rainfall or wash-down operations would discharge to the marine environment. The deck drainage would contain particulate matter and residual chemicals such as cleaning chemicals, oil and grease. While in the OA, the MODU and support vessels may discharge oily water after treatment to 15 parts per million (ppm) via Australian Marine Orders-approved oily water filter system. Bilge water will be disposed in accordance with Marine Order 91 (Marine pollution prevention – oil, as appropriate to class) requirements. Assessment of the spillage of hydrocarbons and other environmentally hazardous chemicals and liquid waste are discussed in **Section 7.5** and **7.6.**

6.6.2 Nature and Scale of Environmental Impacts

The potential environmental impacts from routine vessel discharges include:

+ temporary localised decline in water quality in the immediate vicinity of the discharge
+ localised increase in Biological Oxygen Demand (BOD)
+ localised increase in turbidity of surrounding waters
+ temporary and localised increase in sea surface water temperature
+ temporary and localised increase in sea surface salinity.

Potential receptors: Physical environment (water quality), threatened or migratory fauna (marine mammals, marine reptiles, sharks and rays, fish, seabirds), protected and significant areas (marine parks)

6.6.2.1 Physical environment

Planned discharges associated with the activity will be small and intermittent, with volumes dependent on a range of variables. The discharge point will be the same discharge point from the MODU for the short-term duration of the drilling activity (up to 100 days including contingency), while the support vessels will be frequently moving, as the vessels will not be stationary for long periods

The discharge of non-hazardous wastes to the marine environment may result in a localised reduction in water quality in the vicinity of the release location. The discharges are expected to be dispersed and diluted rapidly, with concentrations of discharges significantly dropping within a short distance from the discharge point. Changes to ambient water quality outside of the OA is considered unlikely to occur.

Eutrophication

The discharges of treated sewage and grey water may result in localised increases in nutrient concentrations, exert BOD on the receiving waters and may promote localised elevated levels of phytoplankton and bacteria activity due to nutrient inputs. However, dispersion and dilution of discharges is expected to be rapid as the discharges are of low volume and short duration (up to 100 days including contingency), and the OA is located in deep offshore waters dominated by open ocean currents, resulting in short-term changes to the surface water quality within the OA.

Salinity Increases

The desalination of seawater results in a discharge of brine with a slightly elevated salinity (around 10% higher than seawater). Once discharged to the marine environment, the desalination brine, being of greater density than seawater, will sink and disperse in the currents. On average, seawater has a salt concentration of 35 parts per thousand (ppt). The volume of the discharge is dependent on the requirement for fresh (or potable) water and the number of people on board the MODU and support vessels.

Most marine species are able to tolerate short-term fluctuations in salinity in the order of 20–30% (Walker and McComb 1990), and it is expected that most pelagic species would be able to tolerate short-term exposure to the slight increase in salinity caused by the discharged brine.

Given the relatively low volume of discharge, low salinity increases and, open water surrounding the MODU and support vessels, impact on the water quality in the OA is expected to be negligible, temporary and localised.

Changes in Temperature

Cooling water will be discharged at a temperature above ambient seawater temperature. Upon discharge, it will be subjected to turbulent mixing and transfer of heat to the surrounding waters.

A study undertaken by Woodside (2008) detailed temperature dispersion modelling shows that the water temperature of discharged water will decrease rapidly as it mixes with the receiving waters. It identified discharge waters were less than 1°C (degrees Celsius) above background levels within 100 m (horizontally) of the discharge point. Vertically, the discharge will be within background levels within 10 m of the discharge point (Woodside 2008).

Given the relatively short duration of the activity (up to 100 days including contingency), low volume of cooling water, temperature differential, the deep open water surrounding the vessels, impact on water quality is expected to be low and short-term and within the immediate vicinity of the discharge.

Oily Water

Oily water discharged from MODU will be treated to a concentration (<15 ppm of oil content) that will unlikely lead to any impacts to the receiving environment. Modelling by Shell (2010) indicates that upon release, hydrocarbon and other chemical concentrations are rapidly diluted and expected to be below Predicted No Effect Concentration (PNEC) within a relatively short period of time, within less than 100 m of the discharge. That is, the concentration of any bilge or deck drainage discharge will rapidly fall below levels which will adversely affect the marine environment and will most likely not occur during long-term or short-term exposures.

6.6.2.2 Threatened or migratory fauna

As discussed in the sections above, the discharge extent for all planned discharges is localised, and rapid dilution is predicted to occur within the deep waters ranging from 40 - 50 m. Marine fauna within the OA are likely to be transient. If contact does occur with any marine fauna, it will be for a short duration due to the rapid dispersion of the plume and the transient fauna movement, such that any exposure is likely not of sufficient duration to cause a toxic effect.

Given the nature of discharged chemicals, the small volumes that could be released to the marine environment and the nature of the marine environment within the vicinity of the OA, the operational planned discharges are not predicted to have ecologically significant effects.

Changes to Predator-Prey Dynamics

The discharge of sewage and macerated food wastes will create a localised and temporary food source and may attract scavenging marine fauna or seabirds to the source which in turn can attract predatory species. Discharges will be localised and temporary as they will be quickly broken down by a combination of microbial action, consumed by scavenging fauna and/or dispersed by wave action and local ocean currents. This is likely to limit the impacts of putrescible waste discharges to within the vicinity of the discharge and to be temporary in nature.

6.6.2.3 Protected and significant areas

The OA intersects the Montebello AMP (Multiple Use Zone - IUCN Category VI). Conservation values of the marine park (as outlined in **Table 3-4**), have the potential to be impacted by planned operational discharges through impacts to the physical environment and marine fauna.

Impacts to the physical environment and marine fauna are discussed in the sections above. Planned operational discharges are not expected to significantly impact the conservation values of the Montebello AMP.

6.6.3 Environmental Performance Outcomes and Control Measures

The EPOs relating to this event include:

+ No unplanned objects, emissions or discharges to sea or air. [YO-EPO-04]
+ No injury or mortality to EPBC Act and WA Biodiversity Conservation Act 2016 listed marine fauna during operational activities. [YO-EPO-05]
+ Reduce impacts to air and water quality from planned discharges and emissions from operational activities [YO-EPO-06].

The control measures considered for this event are shown in **Table 6-20**, and EPS' and measurement criteria for the EPOs are described in **Section 8.4**.

Table 6-20: Control Measure Evaluation for Planned Operational Discharges

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
YO-CM-004	Waste (garbage) management Plan	Reduces probability of waste being discharged to sea, reducing potential impacts to marine fauna. Ensures food waste is discharged in manner that does not pose risk to the environment. Ensures compliance with Marine Orders (94 and 95) and MARPOL (Annex III and V) requirements as appropriate for vessel class.	Personnel cost of vessel audits and inspections, and in recording and reporting waste management.	**Adopted** – Benefits of ensuring MODU/vessel is compliant outweigh the minimal costs of personnel time and it is a legislated requirement.
YO-CM-007	Chemical Selection Procedure	Ensures that planned discharges to sea meet the criteria for not being harmful to the marine environment according to MARPOL Annex V; or Gold/Silver/D or E rated through OCNS; or have a completed Santos ecotoxicological risk assessment so that only environmentally acceptable products are used.	Personnel time associated with chemical selection and approval as per chemical selection process.	**Adopted** – Environmental benefit of using lower toxicity chemicals outweighs procedural implementation costs.
YO-CM-006	Deck cleaning and product selection.	Reduces potential impacts of inappropriate discharge of water to sea associated with deck cleaning.	Personnel time associated with chemical selection, approval and procurement as per chemical selection process.	**Adopted** – Benefits of ensuring MODU/vessels are compliant and those deck cleaning products planned to be released to sea

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
				meet Australian Marine Orders criteria.
YO-CM-027	Sewage treatment system.	Reduces potential impacts of inappropriate discharge of sewage at sea or additional emissions associated with ship to shore of waste. Ensure compliance with relevant Marine Orders and MARPOL requirements as appropriate for vessel class.	Personnel cost associated with ensuring vessel STP certificates are in place during vessel contracting and in pre-mobilisation audits and inspections, and in reporting discharge levels.	**Adopted** – Benefits of ensuring MODU/vessel is compliant outweigh the minimal costs of personnel time and it is a legislated requirement.
YO-CM-028	Oily water treatment system.	Reduces potential impacts of inappropriate discharge of oily water at sea or additional emissions associated with ship to shore of waste. Ensure compliance with relevant Marine Orders and MARPOL requirements as appropriate for vessel class.	Personnel cost associated with ensuring vessel OWTS certificates are in place during vessel contracting and in pre-mobilisation audits and inspections, and in reporting discharge levels.	**Adopted** – Benefits of ensuring MODU/vessel is compliant outweigh the minimal costs of personnel time and it is a legislated requirement.
YO-CM-008	General chemical management procedures.	Reduces potential for inappropriate discharge of water at sea, through appropriate handling, to maintain planned discharges to sea meet the criteria for not being harmful to the marine environment.	Personnel time associated with vessel inspection and implementation.	**Adopted** – Benefits of ensuring MODU/vessel is compliant outweigh the minimal costs of personnel time and it is a legislated requirement.
Additional Control Measures				

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
N/A	Discharge cooling water above sea level to allow it to cool further before mixing at sea surface.	Reduces temperature gradient between water discharge and ambient waters temperature, resulting in reduced potential environmental impact. However, given depth of OAs, risk of impacting sensitive environmental receptor is unlikely.	High costs to alter all current vessels to allow for discharge of cooling water at different height, not feasible on all vessels, reduction in temperature would be minimal compared to cost of altering the discharge height.	**Rejected** – Cost outweighs the benefit given the low impact expected from planned discharges and high potential impacts from risk transfer. Discharge of cooling water permitted maritime practice.
N/A	Storage of all wastes on-board for disposal onshore.	Eliminates risks to receiving environment associated with deteriorating water quality as a consequence of Project oily water by avoiding requirement to discharge.	This would result in an increase in environmental impacts through increased fuel consumption and increased atmospheric emissions, both by the vessel (or transport vessel) having to return to port a number of times to unload the wastes, and by land transport to the nearest disposal facility. Increased energy consumption and atmospheric emissions would also result from the disposal (e.g. incineration, treatment etc.) of the wastes	**Rejected** – Cost outweighs the benefit given the low impact expected from planned discharges.
N/A	Storage of cooling and brine water	Eliminates risks to receiving environment associated with	This would result in an increase in environmental	**Rejected** – Cost outweighs the benefit given the

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
	onboard, prior to discharge onshore	deteriorating water quality as a consequence of activity cooling water and brine by avoiding requirement to discharge.	impacts through increased fuel consumption and increased atmospheric emissions, both by the vessel (or transport vessel) having to return to port a number of times to unload the wastes, and by land transport to the nearest disposal facility. Increased energy consumption and atmospheric emissions would also result from the disposal (e.g. incineration, treatment etc.) of the wastes	low impact expected from planned discharges.
NA	Mandatory closed drain system to prevent deck drainage discharged overboard.	Eliminates risk of oily water from deck being discharged overboard without treatment. Ensures wastewater is directed to OWTS for treatment prior to discharge.	Increased cost due to treatment system required, modifications to MODU, vessels, storage space required for containment of drained liquids, increase in transfers to vessels resulting in increased potential impacts and risks. Increased transfers results in increased fuel usage, increased safety risks to personnel during transfer (e.g. crushing	**Rejected** – Cost outweighs the benefit given the low impact expected from planned discharges and high potential impacts from risk transfer.

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
			between skips), increase in crane movements.	

6.6.4 Environmental Impact Assessment

Table 6-21: Impacts and Consequence Ranking – Planned Operational Discharges

Receptor	Consequence Level
Operational discharges	
Threatened, migratory or local fauna	Operational discharges in the same location for an extended period of time may result in significant water quality perturbations and alteration to marine fauna behaviour. Sensitive receptors that may be impacted include fish at surface, marine turtles and mammals, and seabirds. Any effects on water quality are expected to be within the surface waters only and have no effect on seabed receptors. Given that the activity will be for a limited duration, and the proposed well is located approximately 22 km from the nearest shoreline (Trimouille Island), impacts will be limited to short-term water quality impacts and temporary behavioural effects observed in fish, marine mammals, sharks and seabirds. Impacts to water quality will be experienced in the discharge mixing zone which will be localised and will occur only as long as the discharges occur (i.e., no sustained impacts), therefore recovery will be measured in hours to days. Consequently, only short-term behavioural impacts are expected with no decrease in local population size / area of occupancy of species / loss or disruption of habitat critical / disruption to the breeding cycle / introduction of disease. Given the nature of the planned operational discharges, the small volumes that could be released to the marine environment, the high levels of dilution and the nature of the marine environment in the vicinity of the OA, impacts to the physical environment and habitat are expected to be I- (Negligible).
Physical environment or habitat	
Socio-economic receptors	Not applicable – planned operational discharges are not expected to impact on socio-economic receptors. No stakeholder concerns have been raised regarding this event.
Threatened ecological communities	Not applicable – No threatened ecological communities identified in the area over which operational discharges are expected.
Protected areas	The OA intersects the Montebello AMP (Multiple Use Zone - IUCN Category VI). The objective is to provide for ecologically sustainable use and the conservation of ecosystems, habitats and native species. The values of the marine park, with respect to the presence of marine species (receptors) and water quality are described above and are assessed as I (Negligible).
Overall worst-case consequence	I - Negligible

6.6.5 Demonstration of ALARP

Santos uses a risk-based approach to select chemical products ranked under the Offshore Chemical Notification Scheme (OCNS). Central to the fluid selection process is the use of the OCNS. This scheme lists and ranks all chemicals used in the exploration, exploitation, and associated offshore processing of petroleum on the United Kingdom (UK) Continental Shelf. Santos uses chemicals with the least environmental impact, as determined under the OCNS ranking as a Gold and Silver for chemicals that can be ranked using the Chemical Hazard and Risk Management (CHARM) model, or E and D for chemicals not applicable to the CHARM model (i.e., inorganic substances, hydraulic fluids or chemicals used only in pipelines).

The OCNS system uses the ecotoxicity data for offshore chemical products to assess the potential environmental risk in the marine environment. The least environmentally hazardous grade is Gold (CHARM assessed) and E (through a non-CHARM assessment). The OCNS system requires bioaccumulation and biodegradation data and aquatic toxicity data from three trophic levels (algae, crustaceans and fish) to predict the potential ecosystem risk and, in turn, rank the product by hazard quotient.

Santos Operations Chemical Selection, Evaluation and Approval Procedure (EA-91-II-10001) requires that chemicals for use and discharge are CHARM rated Gold or Silver, or non-CHARM rated E or D. To achieve these rankings, the chemicals have the least environmental impact in terms of ecotoxicity, biodegradation and bioaccumulation. If they are not highly rated (Gold/Silver/D/E) and no alternative is available, a risk assessment is conducted providing justification for their use. Any chemicals which are not OCNS CHARM or non-CHARM-able rated are risk assessed through the procedure (EA-91-II-00001) to provide for a product that is environmentally acceptable for discharge to the marine environment.

All operations chemicals potentially discharged to sea during the activity will conform to the Santos Operations Chemical Selection, Evaluation and Approval Procedure (EA-91-II-10001) with all chemicals identified and assessed by the Santos Environment Department prior to commencement of the activity.

MODU and vessel presence is required to undertake the activity and the associated generation of operational wastes cannot be eliminated. Onboard treatment of most wastes and their subsequent discharge to the marine environment is considered to be the most environmentally sound method of disposal, considering that the waste streams will either be treated to a level unlikely to cause significant environmental harm or will be of a nature not considered to pose significant risk to the receiving environment. In addition, they will meet legislated requirements, where applicable.

With the control measures adopted, the assessed residual consequence for this impact is I- (Negligible) and cannot be reduced further. Additional control measures were considered but rejected since the associated cost or effort was grossly disproportionate to any benefit, as detailed in **Section 6.6.3**. Therefore, it is considered that the impact of operational discharges is ALARP.

6.6.6 Acceptability Evaluation

Is the consequence ranked as I (Negligible) or II (Minor)	Yes – maximum consequence from planned operational discharges is I (Negligible).
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian Marine Park zoning objectives)?	Yes - management consistent with the Protection of the Sea (Prevention of Pollution from Ships) Act 1983, which in Australian waters is enacted by the Marine Orders. The following material published in relation to threatened and migratory species within the OA identifies habitat degradation / modification as a threat to threatened species: **Conservation Advice:** + Approved Conservation Advice on *Pristis clavate* (Dwarf Sawfish) (2009) + Approved Conservation Advice on *Pristis zijsron* (green sawfish) (2008) + Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015) + Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (2015) + Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (2015) + Approved Conservation Advice for *Calidris canutus* (Red knot) (2016) + Commonwealth Conservation Advice on *Dermochelys coriacea* (2008) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015) **Recovery Plans:** + Sawfish and River Sharks Multispecies Recovery Plan (2015) + Recovery plan for the White Shark (*Carcharodon carcharias*) (2013) + Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (2014) + Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015)

	+ Draft Wildlife Conservation Plan for Seabirds (CoA, 2019) + Recovery plan for marine turtles in Australia 2017 – 2027 (CoA, 2017a) + Blue Whale Conservation Management Plan 2015 – 2025 (2015) + For all the recovery plans identified above, the objectives are achieved through the adoption of YO-EPO-04, YO-EPO-5, YO-EPO-06 and the control measures outlined in **Table 6-20**; and Santos considers the impacts of operational discharges to not be inconsistent with these recovery plans. Recovery Plans / Conservation Advice for other species that may occur in the project area do not identify habitat degradation / modification as a key threat or have explicit relevant objectives or management actions related to habitat degradation / modification. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) identifies habitat modification as a pressure that may impact marine park values. It seeks to minimise the impact of pressures on the marine park values as far as reasonably practicable. The implementation of EPO-04, YO-EPO-5, YO-EPO-06 and the control measures outlined in **Table 6-20** will ensure operational discharges will not compromise this outcome. + The OA intersects the Montebello Marine Park which is categorised as Multiple Use Zone (IUCN Category VI) (**Table** 3-4). The objective of the Multiple Use Zone (VI) is to provide ecologically sustainable use and the conservation of ecosystems, habitats and native species. The management of the activity in relation to operational discharges is aligned with this objective through the adoption of YO-EPO-04, YO-EPO-5, YO-EPO-06 and the control measures outlined in **Table 6-20**. The objectives and actions of these publications were considered during the assessment of impacts and risks. The controls outlined in **Table 6-20** are consistent with the objectives of the material listed above and Santos considers the impacts of operational discharges to not be inconsistent with these objectives.
Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.

Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

Release of non-hazardous discharges into the sea from vessels in Australian waters is permissible under the Protection of the Sea (Prevention of Pollution from Ships) Act 1983, which in Australian waters reflects Australian Marine Orders requirements respectively, and is enacted by:

+ Marine Order 91 (Marine pollution prevention – oil)
+ Marine Order 96 (Marine pollution prevention – sewage)
+ Marine Order 95 (Marine pollution prevention – garbage).

The operational discharges are not expected to significantly impact the receiving environment given the management controls proposed, including compliance with all relevant Marine Orders requirements. The Marine Orders are considered to be the most appropriate standard given that the nature and scale of the events is expected to reduce the potential for environmental impacts to a level that is considered ALARP and environmentally acceptable.

6.7 Planned Drilling Discharges

6.7.1 Description of Event

Event	During drilling operations, drilling discharges including drilled solids or cuttings, drilling fluids and solid additives (e.g., barite), brine and cement chemicals are expected. Depending on the stage of activity, discharges may occur at the sea surface and/or seabed. + Drilling fluids and cuttings The top hole and surface hole sections will be drilled 'riserless' using seawater and pre-hydrated gel (PHG) sweeps to clean the hole. Drilled cuttings and drilling fluid (e.g., seawater and sweeps) will be discharge directly to the seabed while drilling the top hole section and just above the sea surface (from the top of the conductor) while drilling the surface hole section. Once the surface casing is installed, thereby establishing a closed circulating system, the remainder of the well will be drilled with a weighted brine/ shale-inhibited (e.g., Klashield) water-based mud (WBM). The WBM will be discharged from the MODU at sea surface either on cuttings (see below) or from surface storage tanks/ mud pits when no longer required. The water-based drilling fluid will be comprised of water or brine (>90% aqueous) as the major liquid phase. The remainder of the WBM will be made up of low toxicity drilling fluid solid additives (e.g. barite) and chemicals that are either completely inert or additives in such low concentrations they pose little or no risk to the environment. Santos' Drilling Fluids and Chemical Selection in Drilling Activities Procedure (EA-91-II-00007) will ensure that only environmentally acceptable products are used. + Drilling chemicals Chemicals required for drilling operations include, but are not limited to, brines, clays (such as bentonite), acids, weighting materials, water-soluble polymers, pH controllers, alkalinity controllers, defoamers, detergents and contingency lost circulation materials; as well as

cement, cement additives and spacers. Tracer dyes may also be used for leak detection and cementing operations.

Santos' Drilling Fluids and Chemical Selection in Drilling Activities Procedure (EA-91-II-00007) will ensure that only environmentally acceptable products are used.

+ Residual drilling fluid discharges

The top hole and surface hole sections will be drilled with seawater and PHG sweeps. These fluids will be mixed and blended on the MODU and stored in the surface mud storage tanks, or mud pits, until they are pumped downhole and discharged at the seabed (top hole section) or at the top of the conductor. Consumed volume will be replenished as required to reach interval total depth (TD). Once TD is reached, the well will be displaced to a brine and/or pre-hydrated water-based mud to aid wellbore stability. Excess sweeps and mud will be retained in the surface mud pit system in case WBM is required to be pumped while running surface casing.

Once the surface casing is run and cemented, surface residual volumes will be discharged, due to incompatibility with the subsequent fluid system, to marine environment. The fluid would be discharged at the sea surface via the master mud pit dump valve.

Once the surface casing string is installed, a WBM system will be maintained until well TD. This mud system will be mixed and blended on the MODU and stored in the surface mud storage tanks, or mud pits, until pumped downhole and recycled via the casing to the MODU continuously.

Once TD is reached, and the well has been plugged and abandoned, residual drilling fluids will be discharged to sea via the master mud pit dump value, unless reusable at Santos' next drilling location.

+ Tank cleaning

At stages during the activity, tanks may need to be cleaned, including mud pits (i.e. tanks used to mix and hold brine, sweeps or WBM), cement mixing/ holding tanks and bulk storage tanks. Cleaning may be required to remove or flush 'dead' or residual volumes of WBM or settled inert solid material. The cement system will need to be flushed to prevent curing inside the cement unit and pipework after each cement job is completed. In most instances, tanks and pipework would be flushed with seawater or drill water and the diluted fluid discharged to sea surface.

+ Cement operations

Cement will be used to fix casing strings in place, should drilling difficulties occur (e.g., well re-spud, side-track, lost circulation), and to form cement plugs as permanent barriers when abandoning the well.

Minor volumes of cement will be released at the seabed during installation of the main conductor (estimated 30 m^3 maximum overspill). This will harden immediately at the seabed, with no re-suspension expected. Once the main conductor and the surface casing have been installed, all further displaced fluids will be returned to the MODU. During cementing operations, surface cementing equipment and lines will need to be flushed, washed and cleaned with water to prevent hard setting. The residual cement and wash water will be discharged to sea after each cement job. Cement spacer in well returns and residual surface tank volumes will also be discharged to sea during cementing operations.

Excess cement (and dry bulks) will be discharged as a liquid over the edge (i.e. discharged to the surface).

+ Plug and abandonment

	The well will be permanently P&A'd by installing and testing down hole barriers (cement plugs) prior to severing casing below seabed (mudline). + Bulk products Once the well has been P&A'd, or during an emergency (e.g. cyclone avoidance), the unmixed bulk drilling fluid solid additives (barite and bentonite), dry cement, brine and drill water will be managed in accordance with the decision list in **Table 6-22**. During the activity, the following estimated and approximate drilling discharges to the marine environment could be expected from drilling the well: + 100 m^3 of drill cuttings discharged to the seabed (top hole riserless section) + 1,000 m^3 of drill cuttings discharged from top of conductor (surface hole riserless section) + 1,000 m^3 of drill cuttings discharged at sea surface (remaining well sections) + 7,000 m^3 of water-based drilling fluids discharged at sea surface + 250 m^3 of inhibited seawater discharged at seabed (based on surface hole suspensions) + 6,500 m^3 of seawater/ gel sweeps/ mud discharged at seabed (riserless top hole section) + 200 m^3 of brine + 60 m^3 of cement (wet) discharged to seabed + 15 m^3 of cement (wet or set) discharged at sea surface (i.e., cement spacer, flushing tanks and lines) + 30 m^3 of cement (wet) discharged at sea surface or 100 m^3 at the seabed in the event of a cement job not meeting technical and safety standards + 200 m^3 each of stock cement/ barite/ bentonite/ brine at the end of the well in the event the stocks cannot be re-used/ sold Cutting discharge volumes are calculated based on the expected section sizes and lengths. The total volume of drilling fluid and cement is an estimate based on previous drilling and completion programs. In the case of drilling issues (e.g., re-spud, side-tracking, interval length change, etc.) or change to the drilling program, the total volume of drill cuttings, drilling fluid, brine, and/ or cement may decrease or increase. In the event of a re-spud or side-track, the above total volume would likely double. Aqueous-based LCM may also be pumped downhole at times. These materials may be lost to the geological formation, remain downhole, or exit the well at the surface and be discharged from the MODU. Tracer dyes may also be used during cementing operations and for equipment leak detection. Santos intends to keep unmixed bulk cement, barite, bentonite, and brine on-board the MODU at the end of the drilling program. In the event that this activity is the final well in the rig schedule, these substances will be disposed of according to the decision list in .
Extent	The larger drill cuttings are expected to settle directly around the MODU, whereas finer particles associated with the drilling muds and cement discharges would be carried away with the prevailing currents and eventually settle.

	The seabed area affected by drill cuttings is expected to extend up to 1 km from the source, although any environmental effects are expected to be restricted to within 50 m of the well. Turbidity from drilling-related discharges is expected to affect water quality in the vicinity of the MODU, albeit during a relatively short period of time.
Duration	Various drilling and cementing-related discharges will occur intermittently for the duration of the activity, and may last for minutes (e.g., cleaning cement tanks) to several days (e.g., drill cuttings) over the course of the drilling activity.

Table 6-22: Decision List for Management of Bulk Powders and Brines Remaining on the MODU at the end of the Well Exploration

Trigger	Fate of Stock	Reasoning
Well is not the last well in the MODU schedule and ongoing use of the product is anticipated.	**Retain stock** Stock will be retained on-board for use in the next well or may be sent for temporary storage on a supply vessel. This option eliminates overboard disposal.	These products are expensive. Santos' preferred option is to use all stock in subsequent wells in the MODU schedule to minimise activity costs and reduce discharges.
Well is the last well in the MODU schedule and the next Operator is willing to buy the stock.	**Sell stock** Stock will be retained on-board or may be sent for temporary storage on a supply vessel for used by the next Operator. This option eliminates overboard disposal.	It may be possible for Santos and the next Operator using the MODU to transfer ownership of the unmixed stock. The implementation of this option is dependent on demand and commercial agreements.
Well is the last well in the MODU schedule and selling the stock to the next Operator is not an option.	**Minimise stock** Santos will have measures in place to reduce the stock requiring disposal at the end of the activity. This option requires some overboard disposal.	Stock minimisation measures will be put in place without compromising the minimum bulk stock required for well control or dealing with lost circulation.
Well is the last well in the MODU schedule, selling the stock to the next Operator is not an option but another Santos operated MODU is in proximity and can take on stock	**Transfer stock to alternative MODU** This option eliminates overboard disposal.	Stock can be transported to an alternate MODU dependent on: + Santos has another MODU operating in the region; + Alternative MODU can use the product; + Travel distance and cost associated with transporting the stock to

		the alternative MODU are not prohibiting; and + Alternate MODU has the capacity to take on additional stock.
All other disposal options have been exhausted.	**Overboard disposal of stock** Stock will be discharged as wet slurry	Disposal volumes will be minimal due to stock minimisation. Under normal circumstances where the well is the last well in the program and the well drills to plan, the stock cement usually does not exceed 120 m^3. Barite and bentonite stocks are unlikely to exceed 80 m^3 each. A decision log will be prepared demonstrating that this disposal option is ALARP and acceptable.

[1] Bulk powders include any of the following: barite, bentonite and cement.

6.7.1.1 Drilling Fluids and Chemical Selection

The Santos Drilling Fluid and Chemical Selection in Drilling Activities Procedure (EA-91-II-00007) applies to drilling, completion and cement chemicals used downhole during the planned operations. The procedure defines the requirement for chemicals to meet the following criterion at the time of use to reduce environmental risk and impact:

+ Certified Gold, Silver, E or D through the OCNS; or
+ Pose Little or No Risk to the Environment (PLONOR) as listed by the Oslo and Paris Convention for the Protection of the Marine Environment of the Northeast Atlantic (OSPAR); or
+ Risk assessed by Santos and deemed environmentally acceptable using Santos' Santos Drilling Fluid and Chemical Selection in Drilling Activities Procedure (EA-91-II-00007).

The criteria used for environmental acceptability includes aquatic toxicity, biodegradation and bioaccumulation potential data. Where sufficient data is available, the chemical is risk assessed using the OCNS non-CHARM Grouping method and chemicals that meet the selection criteria belonging to the OCNS groups D or E are environmentally acceptable. According to the OCNS guidelines (CEFAS, 2010), the worst-case initial OCNS grouping would be group B based on aquatic toxicity data of LC50 or EC50 > 1 to 10 ppm. To obtain a final OCNS grouping of D, the chemical would need to be readily biodegradable (>60% biodegradation in 28 days) and non-bioaccumulative (Log Pow <3 or BCF ≤100 and molecular weight ≥ 700). The best case initial OCNS grouping would be group E based on aquatic toxicity data of LC50/ EC50 >1,000 ppm. The best case final OCNS grouping would remain E with the chemical readily biodegradable and non-bioaccumulative.

Where insufficient ecotoxicity data is available to assign a pseudo OCNS non-CHARM Group rating, but there is sufficient ecotoxicity data available to determine the environmental hazard of the chemical, environmental acceptability is based on:

+ Volume/ concentration
+ Ultimate fate
+ Ecotoxicity data (aquatic toxicity, biodegradability and/ or bioaccumulation data where applicable, i.e., biodegradation and bioaccumulation potential are not applicable to inorganic substances).

6.7.2 Nature and Scale of Environmental Impacts

Potential receptors: Physical environment (water quality, benthic habitat), fish (benthic & sharks), marine mammals and marine turtles, protected and significant areas, and socio-economic receptors.

6.7.2.1 Physical environment

Drilling and cement-related discharges will be intermittent during the activity, with volumes dependent on a range of variables. Their discharge to the marine environment will result in a localised reduction in water quality. This would be expected to be temporary (minutes to hours) and localised around the discharge point. The discharges are expected to be dispersed and diluted rapidly, with concentrations significantly dropping with distance from the discharge point. Changes to ambient water quality outside of the OA are considered unlikely to occur.

Specifics of potential impacts to water quality from the discharge of drilling fluids, cement, solid additives (e.g., barite, bentonite), residual hydrocarbons and treated seawater are as follows:

Water Quality – Turbidity

Drilling solids (i.e., cuttings), cement and solid additives (e.g., barite, bentonite) will be discharged during the activity. Discharges at the water surface or close to sea level will result in a reduction in water quality from an increase in turbidity.

Once discharged, large particles and flocculated solids form a plume that settles quickly on the seabed. Fine-grained unflocculated clay-size particles and other soluble components form another plume in the water column that drifts with the prevailing currents away from the point source and is diluted rapidly in the receiving waters (Neff, 2005). Turbidity increases from discharges at the seabed will have less of an effect than discharges at the sea surface with little change in ambient light levels since light will already be limited at this depth (approximately 45 m).

Any increases in suspended solids and subsequent decreases in available oxygen surrounding the discharge location may result in a localised impact to organisms present in the water column. Impacts may include obstructions to respiratory processes and other physiological processes as well as behavioural changes due to a reduction in available oxygen or avoidance of the turbidity plume. The increased particle load in the water column could adversely affect respiratory efficiency of small fish species that become entrained in the turbidity plumes. However, large pelagic fish species and megafauna (such as sharks and rays, marine turtles and cetaceans) are unlikely to be affected as these mobile species would avoid the area or simply pass unaffected through turbid waters.

In well-mixed ocean waters, drilling fluids and cuttings are diluted by 100-fold within 10 m of the discharge and by 1000-fold after a transport time of about 10 minutes at a distance of about 100 m. Because of the rapid dilution of the drilling and cement discharges plume in the water column, impacts to water column fauna and flora (e.g., plankton, fish) is unlikely (Neff, 2005). Drilling discharge modelling (RPS-APASA, 2014) undertaken for the Outtrim East-1 drilling campaign (deeper water than Yoorn-1) conservatively predicted total suspended sediments could be detectable at a distance of 933 m from the MODU, with concentrations at 2-3 milligrams per litre (mg/L) above background levels in the region predicted within the immediate vicinity of the MODU (<225 m). Significantly less reach can be expected at Yoorn-1 which is approximately half the water depth of Outtrim East-1.

Given the nature of the discharges and the nature of the marine environment within the vicinity of the OA, the impact on water quality from the discharge of drilling cuttings and fluids, cement and related chemicals from planned cementing activities is expected to be low and short-term and is unlikely to have spatially or ecologically significant effects.

<u>Water Quality – Toxicity</u>

Cementing discharges (cement, cement slurry, additives and spacers, etc.) has the potential to result in toxicity effects. Discharge of cement at the sea surface has not demonstrated significant harm to water column flora and fauna (Neff, 2005).

Components of WBM with potential toxicity to marine flora and fauna include metals associated with inorganic salt components, organic polymers and additional organic additives as well as barite/ bentonite weighting agents. Metals present in drilling fluid generally resemble that of marine sediments, albeit with concentrations of some metals higher than clean marine sediments (Neff, 2005). Metals associated with WBM drill cuttings have been shown to have a low bioavailability as they tend to remain in a non-ionic form, remaining bound to other compounds, presenting a low toxicity risk to marine fauna (Neff, 2005). In general, the acute toxicity of WBM is low (Neff, 2005).

Bioaccumulation is the uptake and retention of xenobiotics (substances that are not natural components of the environment) by organisms from their environment. This process can have significant ecological consequences as pollutants move up the food chain to higher order species. Numerous studies have been carried out in the Gulf of Mexico to test and evaluate a range of biological, biochemical and chemical methodologies to detect and assess chronic sub-lethal biological impacts in the vicinity of long duration activities associated with oil and gas exploration and production. Contaminant concentrations at most locations studied were below levels thought to induce biological responses (Kennicutt et al., 1996). Therefore, discharges associated with this activity are not expected to have long-term effects due to bioaccumulation.

<u>Smothering</u>

The discharge of borehole materials during riserless drilling will occur at the well opening on the seafloor until the conductor is installed. During cementing activities, cement returns to the seabed at the well opening are associated with cementing the conductor. Direct contact with these discharges is expected to smother any habitats, which may include soft sediment benthic invertebrates and sessile epifauna.

Smothering may also occur as the suspended solids from the drilling discharges released at the water's surface settle to the seabed. The depth of accumulated sediments will be greatest close to the well location where the heavier particles are deposited and decrease with increase in distance from the source point.

The effects of drilling discharges on the benthic environment are related to the total mass of drilling solids and drilling fluids discharged; the relative energy of the water column; and benthic habitat at the discharge location (Neff, 2005). The effects of drilling fluids and cuttings piles on seabed communities are caused mainly by burial and low sediment oxygen concentrations caused by organic enrichment (Neff, 2005). With increasing thickness of drill cuttings, the number of taxa, abundance, biomass and diversity of macrofauna has been found to significantly reduce (Trannum et al., 2010).

Recovery of benthic communities from burial and organic enrichment occurs by recruitment of new individuals from planktonic larvae and migration from adjacent undisturbed sediments. Ecological recovery usually begins shortly after completion of drilling and often is well advanced within a year. Hardened cement will provide a surface for colonisation by epifauna. Full recovery may be delayed until concentrations of biodegradable organic matter decrease through microbial biodegradation to the point where surface layers of sediment are oxygenated. Case studies on impacts of water-based muds and drilling discharges on soft sediment and benthic fauna are outlined below:

+ For Santos' East Spar development, the area of impact from water-based mud discharges was not more than 100 m from the drill site and short-lived (recovery in less than 18 months) (Sinclair Knight Merz, 1996, 1997; Kinhill, 1998). The water depth at East Spar was approximately 99 m, so significantly less reach can be expected at the Yoorn-1 water depth.
+ Benthic monitoring at the Stag production platform (water depth approximately 45 m) indicated that drilling-induced impacts had less of an influence on infaunal assemblages through time than small spatial scale natural variability (Kinhill, 1998)
+ Benthic monitoring at the Santos Van Gogh 3 well location (water depth approximately 350 m) reported sediment deposition one month following drilling extended up to 180 m from the well location along the longest axis and 70 m along the shortest axis (Sea Serpent, 2008). Two months later, monitoring confirmed that the extent of deposition had decreased to a uniform distance of 55 m around the well with a total area reduction of approximately one third (Sea Serpent, 2008). The monitoring revealed that burrow-forming worms and crabs still persisted within the area of sediment deposition (Sea Serpent, 2008).

Overall, impacts would likely be temporary, with rapid recolonisation of benthic infauna within the cuttings layer, given the low toxicity of the material. Epifauna is likely to recolonise within weeks to months.

6.7.2.2 Threatened / Migratory Fauna

As discussed in the sections above, the discharge extent for the drilling and cement discharges is localised and temporary. Marine fauna within the OA is likely to be transient. If contact does occur with any marine fauna, it will be for a short duration due to the rapid dispersion of the plume and the transient fauna movement, such that exposure time may not be of sufficient duration to cause a toxic effect. Given the nature of the marine environment within the vicinity of the OA, the drilling and cement discharges are not predicted to have ecologically significant effects.

Habitat modification is identified as a potential threat to a number of marine fauna species in relevant recovery plans and conservation advices (**Table 3-9**). Disturbance of the seabed is not anticipated to significantly affect mobile marine fauna, such as marine mammals, marine reptiles, fish, sharks and rays, given the sparse benthic and epi-benthic communities expected in the OA. Impacts to marine fauna is expected to be localised and while a decrease in local population size may occur, no loss or disruption of habitat critical to the survival of a species or disruption to the breeding cycle of any of these protected matters is expected.

Fish, sharks and rays may also forage in the soft sediments for marine invertebrates; however, given the small scale of the activity and the regionally availability of habitat, seabed and benthic habitat disturbance from drilling and cement discharges is not expected to affect these species.

A humpback whale migration BIA, along with the pygmy blue whale distribution BIA are within the OA. As a result of the activity being only a short duration (up to 100 days including contingency) and a small scale along with both whale species identified above have no threats related to a change in water quality from drilling within their conservation advices and management plans. Therefore, impacts to humpback whales and pygmy blue whales are not expected.

BIAs for the flatback turtle occurs within the OA, including the internesting buffer and critical habitat (**Figure 3-10** and **Table 3-8**). An internesting buffer and critical habitat BIA also exist in the OA for green and hawksbill turtles. However, internesting activities typically occur within shallower waters than those in the OA (as discussed in **Section 3.2.3.4**) (Whittock et al., 2016; Pendoley, 2017). If a marine turtle was displaced from the area of seabed and benthic habitat disturbance, widespread internesting habitat is available in the immediate vicinity that marine turtles could continue to use within the identified habitat critical to the survival of the species, and BIAs.

6.7.2.3 Protected and significant areas

The OA intersects the Montebello Marine Park (Multiple Use Zone – IUCN Category VI). Conservation values of the marine park (**Table 3-4**) through impacts to the physical environment and marine fauna may occur within the marine park. Impacts to the physical environment and marine fauna are discussed in the sections above, are localised and are not expected to significantly impact the conservation values of the Montebello AMP.

6.7.3 Environmental Performance Outcomes and Control Measures

The EPOs relating to this event include:

+ No injury or mortality to EPBC Act 1999 and WA Biodiversity Conservation Act 2016 listed marine fauna during operational activities. [YO-EPO-05]
+ Reduce impacts to air and water quality from planned discharges and emissions from operational activities [YO-EPO-06].

The control measures considered for this activity are shown in **Table 6-23** and EPS' and measurement criteria for the EPOs are described in **Section 8.4**.

Table 6-23: Control Measure Evaluation for Planned Drilling Discharges

Control Measure Reference No	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Control Measures				
YO-CM-007	Chemical selection procedure	Aids in the process of chemical management that reduces the impact of drilling discharges to sea. Only environmentally acceptable products are used.	Cost associated with implementation of procedure. Range of chemicals reduced with potentially higher costs for alternative products.	**Adopted** – Environmental benefit of using lower toxicity chemicals outweigh procedural implementation costs.
YO-CM-029	Cuttings management system	Reduces the concentration of drilling mud on cuttings prior to discharge while drilling with a closed circulating system, thereby reducing the total volume of mud lost to sea.	High cost associated with implementing procedure.	**Adopted** – Benefits of implementing procedure and measures implemented outweigh costs.
YO-CM-030	Inventory control procedure	Restricts the type and volume of drilling discharges, and includes a decision-making framework for managing left-over bulk products.	High cost associated with implementing procedure.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweigh costs.
YO-CM-044	Quality control limits for Barite	Contaminant limit concentrations in barite: + Mercury (Hg) – 1 mg/kg dry weight in stock barite + Cadmium (Cd) – 3 mg/kg dry weight in stock barite + Puts a limit on the contaminants within the barite, therefore reducing	Low cost associated with ensuring the barite selected by the drilling contractor meets the contaminant limits.	**Adopted –** Environmental benefit of using a barite with lower contaminant concentrations outweigh the implementation costs

Control Measure Reference No	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		sediment contamination as a result of cuttings discharge or any future cuttings disturbance.		
Additional Control Measures				
N/A	Early establishment of closed circulating system	Establishes a closed circulating mud system, hence provides an opportunity to re-use drilling fluids, thereby reducing environmental discharges. Does not reduce the volume of drilled cuttings discharged to sea.	A conductor increases risk to well design (additional back-pressure applied by attempting to bring drilling fluid up to rotary table elevation). This has been seen to exacerbate lost circulation and lead to stuck pipe situations.	**Rejected** – Installing extra casing strings early in the well construction adds additional risk to personnel (large OD casing is heavy and difficult to handle) and significant cost and does not guarantee that a closed circulating system can be maintained in shallow formations.
N/A	Riserless mud recovery (RMR)	RMR has the advantage of potentially reducing the volume of WBM discharged to the environment as well as preventing cuttings accumulation at the seabed. RMR system returns top-hole cuttings/WBM from the riserless section of the well to the MODU and provides an opportunity to recover and re-use the WBM drilling fluids.	The planned configuration of the Yoorn-1 well uses a 30” conductor from the mudline back to the MODU. The next 17-1/2” interval is drilled “riserless” i.e. without returns back to the mud-pits and without a BOP in place. The total fluid (seawater/WBM) discharged for the 36” conductor hole and 17-1/2” surface hole volume is approximately 5,500m3 per well. The 17-1/2” surface hole interval, by virtue of the 30” conductor, returns cuttings/seawater/WBM	**Rejected** – The critical path rig time would be affected by the requirement to install RMR equipment, and would also require a bespoke package to be prepared for the well. There is negligible impact of discharging WBM and cuttings to sea due to the low environmental sensitivity of the seabed in the operational area. Additionally, the reduction in seawater/WBM

Control Measure Reference No	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		Recovery of the WBM drilling fluids reduces the fluids on the cuttings prior to disposal to the marine environment and subsequent impacts. As discussed in **Section 6.7.2**, drilling fluids on cuttings increase the toxic effects to marine fauna and reduce the sediment quality over the area in which they are discharged. However, as discussed in **Section 6.7.2**, in general, the acute toxicity of WBM is low (Neff, 2005) and the impact from reduced sediment quality is anticipated to be detectable but insignificant to local population. Disposal of cuttings using RMR from the MODU occurs below the water surface, instead of directly to seabed. Discharging from the MODU rather than at the seabed reduces the consequence of environmental impacts from smothering of surrounding benthic fauna and impact to sediment quality	back up to the sea level whilst drilling the interval (i.e. cuttings are discharged at sea level, not the seabed). RMR is traditionally used on subsea wellhead systems to enable a closed mud system (weighted and/or inhibited) before the subsea BOP and marine riser is installed. In this case, WBM and cuttings go through the rigs solids control system and cuttings are discharged at sea level There are some examples of RMR being used on jack-ups where a closed system is required before the BOP is installed. Implementing RMR on a jack-up MODU on the planned Pavo-1 and Apus-1 wells would require a bespoke system to connect to the 30” conductor at the tension deck level of the MODU and divert the returns back to the solids control system. For these planned jack-up wells, the net benefit would be potentially less WBM discharged to the environment (as a closed system can be used for a period, although the remaining WBM on board would be discharged at the end of the interval). It is estimated that the volume of seawater/WBM discharged in the 36”	discharge is minimal (reduced from 6,500m3 to 5,000m3 per well) and the cuttings discharge volume does not change compared to the base case if RMR is used. Therefore, the cost and effort is considered grossly disproportionate to the environmental benefit.

Control Measure Reference No	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		(refer to **Section 6.7.2**), due to a greater spread of cuttings on the seafloor. However, discharging the cuttings from the MODU results in a localised reduction in water quality from increased turbidity and water toxicity (refer to **Section 6.7.2**).	and 17-1/2” riserless intervals would be reduced to 4,000m3 if RMR were used. Cuttings discharge would be no different as cuttings would both be released at sea level. In the RMR case, cuttings going through the rig’s solids control system would have less WBM entrained on them, but the residual mud recovered in this process would be discharged anyway. The fabrication, rental and installation of a bespoke RMR package on the MODU is estimated to be approximately 1.2MM USD. This accounts for the time to rig up and rig down, rental and interfacing of the package.	
N/A	Cuttings reinjection	Would minimise/ eliminate overall discharges to sea, reducing potential impacts to marine environment.	Significant cost to drill injection well and manage the re-injection process. Additional discharges while drilling the injection well.	**Rejected** – Not justifiable for a single well. Unlikely to realise any net environmental benefit given the need to drill another well (additional discharges).
N/A	Extended cuttings dump chute to below sea surface	Releases drilled solids (cuttings) deeper in the water column, thereby potentially reducing spatial extent and turbidity plume.	Significant cost associated with engineering, fabricating and/ or installing chute. Potential delays if chute becomes blocked. Higher operational risk.	**Rejected** – Chute does not reduce volume of cuttings discharged. Chute system introduces higher costs and operational risk. Given the low

Control Measure Reference No	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
			Increased depth of concentrated cuttings deposition may inhibit infauna recovery at seabed.	environmental impact of the cuttings discharged (due to the chemicals selected) and the short duration of discharge in an area that is not identified as significant habitat for marine fauna, the additional cost is considered disproportionate to the environmental benefit.
N/A	Skip and ship to shore of drilling/ cement waste and bulk product.	Would eliminate discharges to sea, reducing potential impacts to marine environment.	Storage space required for containment of waste; increase in transfers to vessels resulting in increased potential impacts and risks. Increased transfers results in increased fuel usage, increased safety risks to personnel during transfer (e.g. crushing between skips), increase in crane movements; high cost to transport and dispose onshore.	**Rejected** – Cost outweighs the benefit given the low impact expected from drilling and cement discharges and increase in safety risks and additional costs.

6.7.4 Environmental Impact Assessment

Table 6-24: Impact and Consequence Ranking – Planned Drilling Discharges

Receptor	Consequence Level
Drilling and Cement Discharges	
Threatened, migratory or local fauna	No sensitive seabed features are expected within the area potentially impacted by drill cuttings based on detailed surveys conducted in similar water depths within adjacent permit areas.

	Disturbance to the seabed may have indirect impacts to protected fauna if the disturbance leads to a reduction on habitat quality or food availability. The areas of seabed that will be impacted are expected to include soft sediments with scattered epifauna. These sediments are un-vegetated and likely to have sparse benthic and epi-benthic communities with low biodiversity (refer to **Section 3.2.1.1**) and include species with widespread regional distributions. Therefore, significant loss of habitat is not expected. Marine invertebrates may inhabit soft sediments and can contribute to the diet of some fauna. The area of soft sediment habitat that is potentially impacted is small compared to the amount of habitat available. Therefore, the disturbance is not expected to affect prey availability, and protected fauna species, significantly. Recovery of benthic communities from burial and organic enrichment occurs by recruitment of new colonists from planktonic larvae and immigration from adjacent undisturbed sediments. Ecological recovery usually begins shortly after the end of drilling and often is well advanced within a year. Full recovery may be delayed until concentrations of biodegradable organic matter decrease through microbial biodegradation to the point where surface layers of sediment are oxygenated. Mobile marine species are expected either to avoid turbid stretches of water or pass through with no significant impacts. The toxicity of WBM and cement is considered low and the potential for bioaccumulation of any toxic compounds is negligible. As with all chemicals selected for use in drilling operations by Santos, the chemicals chosen for the activity will be either CHARM rated Gold or Silver (or E or D OCNS) or risk assessed through the Chemical Risk Assessment process as being environmentally acceptable, reducing the likelihood of any impacts. The increased particle load in the water column could adversely affect respiratory efficiency of fish, although most visual orientated fish species would likely avoid the affected area. The OA is in a high-energy, well mixed open water environment and significant discharge plumes are not expected to occur outside of the areas directly adjacent to the discharge location. Habitat modification is identified as a potential threat to a number of marine fauna species in relevant Recovery Plans and Conservation Advice (**Table 3-9**). However, the area potentially impacted is small compared to the amount of habitat available and therefore no long-term impacts to humpback whales, pygmy blue whales, whale sharks and flatback turtles is expected. No decrease in local population size, area of occupancy of species, loss or disruption of habitat critical or disruption to the breeding cycle of any of these protected matters is expected. Overall, the consequence to marine fauna from any of the drilling discharges is considered I - Negligible given the low toxicity of the drilling and cement discharges and there are no significant impacts expected to threatened and migratory fauna.
Physical environment or habitat	Local minor changes to soft sediment habitat will result from cuttings and associated drilling mud deposition near the MODU. Effects to benthic infauna communities from sedimentation resulting from drilling discharges have been determined to most likely be a result of a change in sediment texture as opposed to any toxicological effects, with increased clays and larger particles altering the habitat suitability for some species. Given the low toxicity of the materials to be discharged and the relatively small area predicted to be significantly smothered, overall impacts are considered to be minor to this habitat type and due to the loss of epifauna and infauna expected through

	smothering and release of drilling and cement discharges. The impacts are considered recoverable within weeks to months For cement discharges, geomorphology of the habitat would be altered, with cement hardening over time and blanketing the existing habitat. Although impacts on the form of the seabed in the immediate vicinity of the MODU will be longer term, the impacts are low in magnitude owing to the small area that would be affected. Overall, the consequence to the physical environment / habitat from any of the drilling discharges is considered I- Negligible.
Threatened ecological communities	Not applicable – No threatened ecological communities are identified in the area where discharge effects could occur.
Protected areas	The OA intersects the Montebello AMP (Multiple Use Zone – IUCN Category VI). The objective is to provide for ecologically sustainable use and the conservation of ecosystems, habitats and native species. The values of the marine park, with respect to the presence of marine species (receptors) and water quality are described above and are assessed as I (Negligible).
Socio-economic receptors	Not applicable – No stakeholder concerns have been raised regarding this event.
Overall worst-case consequence level	I- Negligible

6.7.5 Demonstration of ALARP

Drilling fluids and cementing are a requirement of the activity, and the resultant fluid and solid by-products cannot be eliminated or avoided. With the control measures adopted to minimise the environmental impact of drilling discharges, the consequence was assessed as I-Negligible. In particular, the application of Santos' Drilling Fluid and Chemical Selection in Drilling Activities Procedure (EA-91-II-00007), so that only environmentally acceptable products are used, ensures the impacts to the environment will not be significant.

If the activity is the last on the MODU schedule there will be discharges of bulk products prior to moving off location. Alternatives to this will be considered first (refer **Table 6-23**), however bulk discharges may be the most appropriate and cost-effective alternative. The discharge of drilling fluids, cement and other chemicals to the marine environment is seen as the most viable management method for this waste stream. In addition, control measures have been adopted to reduce the impact of the waste stream to the marine environment to a minor consequence, including processing the return fluids and on board the MODU prior to disposal, mixing chemicals to further dilute them (e.g. as a slurry) prior to discharge and selecting chemicals using the chemical selection procedure.

The high cost associated with any of the additional management controls that were rejected would impact the financial viability of the activity. For this reason, they were assessed as being 'grossly disproportionate to environmental benefit'. The commitment to not discharge any residual drilling fluids at all during the drilling program was rejected because of the high alternative disposal costs and the low potential for environmental impact in the OA.

With the control and management measures adopted, the assessed residual consequence for this impact is I- Negligible. Additional control measures were considered but rejected since the associated cost or effort was grossly disproportionate to any benefit, as detailed in **Section 6.7.3**. Therefore, it is considered that the impact from drilling and cement discharges is ALARP.

6.7.6 Acceptability Evaluation

Is the consequence ranked as I (Negligible) or II (Minor)	Yes – maximum consequence from drilling and cement discharges is I- Negligible.
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian Marine Park zoning objectives)?	Yes – no legal or regulatory requirements regarding the drilling and cement discharges. No relevant requirements regarding this event in this area, given the localised nature and extent of the operational activity. The benthic environment within the OA contains no known seabed features (e.g. shoals, banks) or habitats of high environmental values, including no overlap with KEFs (**Section 3.2.1.1**). Impacts to the marine environment from drilling discharges will be highly localised. The following material published in relation to threatened and migratory species within the OA identifies habitat degradation / modification as a threat to threatened species: **Conservation Advice:** + Approved Conservation Advice on *Pristis clavate* (Dwarf Sawfish) (2009) + Approved Conservation Advice on *Pristis zijsron* (green sawfish) (2008) + Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015) + Commonwealth Conservation Advice on *Dermochelys coriacea* (2008) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015) **Recovery Plans:** + Sawfish and River Sharks Multispecies Recovery Plan (2015)

	+ Recovery plan for the White Shark (*Carcharodon carcharias*) (2013) + Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (2014) + Recovery plan for marine turtles in Australia 2017 – 2027 (CoA, 2017a) + Blue Whale Conservation Management Plan 2015 - 2025 (2015) + For all the recovery plans identified above, the objectives are achieved through the adoption of YO-EPO-05, YO-EPO-06 and the control measures outlined in **Table 6-23**; and Santos considers the impacts of drilling discharges to not be inconsistent with these recovery plans. Recovery Plans / Conservation Advice for other species that may occur in the project area do not identify habitat degradation / modification as a key threat or have explicit relevant objectives or management actions related to habitat degradation / modification. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) identifies habitat modification as a pressure that may impact marine park values. It seeks to minimise the impact of pressures on the marine park values as far as reasonably practicable. The implementation of YO-EPO-05, YO-EPO-06 and the control measures outlined in **Table 6-23** will ensure drilling discharges will not compromise this outcome. + The OA intersects the Montebello Marine Park which is categorised as Multiple Use Zone (IUCN Category VI) (**Table 3-4**). The objective of the Multiple Use Zone (VI) is to provide ecologically sustainable use and the conservation of ecosystems, habitats and native species. The management of the activity in relation to drilling discharges is aligned with this objective through the adoption of YO-EPO-05, YO-EPO-06 and the control measures outlined in **Table 6-23**. The objectives and actions of these publications were considered during the assessment of impacts and risks. The controls outlined in **Table 6-23** are consistent with the objectives of the material listed above and Santos considers the impacts of drilling discharges to not be inconsistent with these objectives.

Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

The use of drilling fluids and solid additives, and the generation of drilling discharges, is an unavoidable part of the drilling program. It is accepted industry practice to discharge cuttings to sea, along with any associated water-based drilling fluids.

Water quality and benthic impacts will be highly localised and largely concentrated immediately around the surface hole location and MODU. The OA is not located close to any sensitive nearshore habitats; the nearest landmass is approximately 22 km away from the proposed well location.

The seafloor of this area is strongly affected by cyclonic storms, and large tidal energy, which can re-suspend sediments within the water column as well as move sediment across the seafloor. In this context, drilling related discharges (in particular surface discharges) are expected to have minor effect on water quality as the discharge plumes quickly dissipate with the prevailing currents. As such, the potential for impacts from drilling discharges are predicted to be minor.

The drilling activity will only use WBM drilling fluids which are either completely inert or have additives in such low concentrations they pose little or no risk to the environment. The application of the chemical selection procedure for drilling and cementing chemicals is an important control measure for reducing the toxicity of drilling discharges to the marine environment. In accordance with the procedure, CHARM-rated Gold/ Silver and non-CHARM grouped E/ D chemicals managed under the OCNS, or PLONOR substances listed by OSPAR, or chemicals risk assessed by Santos and deemed environmentally acceptable, will be selected for the drilling program.

With control measures in place to minimise the environmental impact of drilling discharges, the consequence was assessed as I- Negligible and ALARP. The managed discharges will not reduce the habitat values of the area potentially affected as described in relevant Recovery Plans or Approved Conservation Advice or be inconsistent with the strategies of these documents. No concerns have been raised regarding this event by stakeholders.

Therefore, the minor impacts expected from proposed drilling discharges are considered to be environmentally acceptable.

6.8 Spill Response Operations

6.8.1 Description of Event

Event	In the event of a hydrocarbon spill, response strategies will be implemented where possible to reduce environmental impacts to ALARP. The selection of strategies will be undertaken through the Net Environmental Benefit Analysis (NEBA) process, outlined in this EP and the Yoorn-1 Exploration Drilling Oil Pollution Emergency Plan (Yoorn-1 OPEP) (SO-00-BI-20003.02). Spill response will be under the direction of the relevant Controlling Agency, as

	defined within the OPEP (Section 4.2), which may be Santos and/or another agency. In all instances, Santos will undertake a 'first-strike' spill response and will act as the Controlling Agency until the designated Controlling Agency assumes control. The response strategies deemed appropriate for the worst-case oil spill scenarios identified for the Activity are detailed in Table 6-5 of the OPEP and comprise: + Source control + Monitor and evaluate (operational monitoring) + Mechanical Dispersion + Protection and Deflection + Shoreline Clean-up + Oiled Wildlife Response + Scientific Monitoring + Waste Management. While response strategies are intended to reduce the environmental consequences of a hydrocarbon spill, poorly planned and coordinated response activities can result in a lack of, or inadequate information being available, upon which poor decisions can be made, exacerbating or causing further environmental harm. An inadequate level of training and guidance during the implementation of spill response strategies can also result in environmental harm over and above that already caused by the spill. The greatest potential for impacts additional to those described for routine operations is from shoreline clean-up and oiled wildlife response operations, where coastal and shoreline habitat damage and fauna disturbance may occur.
Extent	Extent of spill. Spill response could occur anywhere within the MEVA for the worst-case spill scenarios. Some strategies will be concentrated in the vicinity of sensitive receptors in coastal waters and along shorelines.
Duration	As required.

6.8.2 Nature and Scale of the Environmental Impacts and Risks for the Activities

Light emissions	
Spill response activities will involve the use of vessels which are required at a minimum, to display navigational lighting. Vessels may operate in close proximity to shoreline areas during spill response activities. Spill response activities will also involve onshore operations including the use of vehicles and temporary camps which may require lighting.	
Potential receptors	+ Fauna (including Threatened/ Migratory/ Local Fauna) + Protected Areas + Socio-Economic Receptors
Lighting may cause behavioural changes to fish and sharks, birds and marine turtles which can have a heightened consequence during key life-cycle activities, for example turtle nesting and hatching. Turtles and birds, which includes threatened and migratory fauna (**Table 3-7**), have been identified as key fauna susceptible to lighting impacts during spill response activities. **Section 6.3** provides further detail on the nature of impacts to fish and sharks, birds and marine turtles.	

Spill response activities which require lighting may take place in protected areas important to turtles, for example shoreline locations of the Montebello Islands, Barrow Island, the Ningaloo area and the Dampier Archipelago are seasonally important for turtles. During nesting and hatching season (primarily over summer months) lighting may cause behavioural impacts to turtles including aborted nesting attempts and mis-orientation of newly hatched turtles which may increase mortality rates. Spill response activities may also occur on shorelines used by nesting and feeding birds including seabirds and shorebirds. Lighting can cause disorientation in flying birds, disrupting nesting and breeding behaviours and impact on the ability of birds to forage. Disturbance to feeding migratory shorebirds may reduce their ability to replenish energy reserves and alter the timing and success of migratory flights. Because of impacts to fauna, lighting has the potential to impact supported industries such as tourism and indirect impacts on the values of protected areas.	
Noise Emissions	
Spill response activities will involve the use of aircraft and vessels which will generate noise both offshore and in proximity to sensitive receptors in coastal areas. Spill response activities will also involve the use of equipment on coastal areas during clean-up of shorelines (e.g. pumps and vehicles), for accessing shoreline areas (e.g. vehicles) and for supporting temporary camps (e.g. diesel generators).	
Potential receptors	+ Fauna (including Threatened/ Migratory/ Local Fauna) + Protected Areas + Socio-Economic Receptors
Underwater noise from the use of vessels may impact marine fauna, such as fish (including commercial species), marine reptiles and marine mammals in the worst instance causing physical injury to hearing organs, but more likely causing short term behavioural changes, e.g. temporary avoidance of the area, which may impact key life-cycle process (e.g. spawning, breeding, calving). Underwater noise can also mask communication or echolocation used by cetaceans. **Section 6.4** provides further detail on these impacts from vessels and helicopters. Cetaceans have been identified as the key concern for vessel noise within the EMBA. The humpback migration BIA, pygmy blue whale migration, distribution and pygmy blue whale foraging BIAs are all within the EMBA. Spill response activities using vessels have the potential to impact fauna in protected areas. Noise and vibration from terrestrial activities on shorelines has the potential to cause behavioural disturbance to coastal fauna including protected seabirds and turtles. Shoreline activities involving the use of noise generating equipment may take place in important nesting areas for turtles and/or roosting/feeding areas for shorebirds. As a consequence of impacts to fauna (including shorebirds, marine mammals and fish), noise has the potential to impact supported industries such as tourism and commercial fishing.	
Atmospheric emissions	
The use of fuels to power vessel engines, generators and mobile equipment used during spill response activities will result in emissions of greenhouse gases (GHG) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), along with non-GHG such as sulphur oxides (SOx) and nitrous oxides (NOx). Emissions will result in localised decrease in air quality.	
Potential receptors	+ Physical Environment/habitat + Fauna (including Threatened/ Migratory/ Local Fauna) + Protected Areas

Atmospheric emissions from spill response equipment will be localised and while there is potential for fauna and flora impacts, the use of mobile equipment, vessels and vehicles is not considered to create emissions on a scale where noticeable impacts would be predicted. Emissions may occur in protected areas, however, the scale of the impact relative to potential oil spill impacts is not considered great.	
Operational discharges and waste	
Operational discharges include those routine discharges from vessels used during spill response which may include: + Bilge water + Deck drainage + Putrescible waste and sewage + Cooling water from operation of engines + Desalination plant effluent (brine) and backwash water discharge. In addition, there are specific spill response discharges and waste creation that may occur, including: + Cleaning of oily equipment/vessels and vehicles + Flushing water for the cleaning of shoreline habitats + Sewage/putrescible and municipal waste at camp areas + Creation, storage and transport of oily waste and contaminated organics.	
Potential receptors	+ Fauna (including Threatened/ Migratory/ Local Fauna) + Physical Environment/habitat + Protected Areas + Socio-Economic Receptors
Operational discharges from vessels may create a localised and temporary reduction in marine water quality. Effects include nutrient enrichment, toxicity, turbidity, temperature and salinity increases, as detailed in **Section 6.6.2**. These may impact a different set of receptors than previously described in that section given vessel use may occur in shallower coastal waters during spill response activities. Discharge could potentially occur adjacent to marine habitats such as corals, seagrass, macroalgae, and in protected areas (i.e. receptors anywhere within the EMBA), which support a more diverse faunal community, however, discharges will be very localised and temporary. Cleaning of oil contaminated equipment, vehicles and vessels, has the potential to spread oil from contaminated areas to those areas not impacted by a spill, potentially spreading the impact area and moving oil into a more sensitive environment. Flushing of oil from shoreline habitats is a clean-up technique designed to remove oil from the receptor that has been oiled and remobilise back into the marine environment and result in further dispersion of the oil. The process of flushing has the potential to physically damage shoreline receptors such as mangroves and rocky shoreline communities, increase levels of erosion, and create an additional, and potentially higher, level of impact than if the habitat was left to bio-remediate. Sewage, putrescible and municipal waste will be generated from onshore activities at temporary camps which may include toilet and washing facilities. These wastes have the potential to attract fauna, impact habitats, flora and fauna and reduce the aesthetic value the environment areas, which may be within protected areas. The creation, storage and transport of oily waste and contaminated organics has the potential to spread impacts of oil to areas, habitats and fauna not previously contaminated.	

Physical presence and disturbance	
The movement and operation of vessels, vehicles, personnel and equipment, undertaking of clean-up activities and the set-up of temporary camp areas during spill response activities has the potential to disturb the physical environment and marine/coastal habitats and fauna, which may include those habitats and fauna within protected areas. Disturbance may also impact cultural values of an area. The movement of vessels could potentially introduce invasive marine species attached as biofouling to nearshore areas, while vehicle and equipment movement could spread non-indigenous flora and fauna. Oiled wildlife response activities may involve deliberate disturbance (hazing), capture, handling, cleaning, rehabilitation and release of wildlife which could lead to additional impacts to wildlife.	
Potential receptors	+ Fauna (including Threatened/ Migratory/ Local Fauna) + Physical Environment/habitat + Protected Areas + Socio-Economic Receptors
The use of vessels may disturb benthic habitats in coastal waters including corals, seagrass, macroalgae and mangroves. Impacts to habitats from vessels include damage through the deployment of anchor/chain, nearshore booms and grounding. Vessel use in shallow coastal waters also increases the chance of contact or physical disturbance with marine megafauna such as turtles and dugongs. Booms create a physical barrier on the surface waters that has the potential to injure or entangle passing marine fauna that are either surface breathing or feeding. Vehicles, equipment, personnel used and cleaning activities during shoreline response activities have the potential to damage coastal habitats such as dune vegetation, mangroves and habitats important to threatened and migratory fauna including nests of turtles and birds and bird roosting/feeding areas. Shoreline clean-up may involve the physical removal of substrates that could cause impact to habitats and coastal hydrodynamics and alter erosion/accretion rates. The presence of camp areas, although relatively short-term, may disrupt normal behaviour of coastal species such as shorebirds and turtles, and could potentially interfere with nesting and feeding behaviours. Oiled wildlife response may include the hazing, capture, handling, transportation, cleaning and release of wildlife susceptible to oiling such as birds and marine turtles. While oiled wildlife response is aimed at having a net benefit, poor responses can potentially create additional stress and exacerbate impacts from oiling, interfering with life-cycle processes, hampering recovery and in the worst instance increasing levels of mortality. Impacts from invasive marine species are described in **Section 7.7** and are not described further in this section. Impacts from invasive terrestrial species are similar in that the invasive species can out-compete local species (e.g. weeds) and interfere with ecosystem processes. Non-native species may be transported attached to equipment, vehicles and clothing. Such an introduction would be especially detrimental to wilderness areas or protected terrestrial reserves which may have a relatively undisturbed flora and fauna community. The disturbance to marine and coastal natural habitat, as well as the potential for disruption to culturally sensitive areas, which may occur in specially protected areas, may have flow on impacts to socio-economic values and industry (e.g. tourism, fisheries).	
Disruption to other users of marine and coastal areas and townships	
Spill response activities may involve the use of vessels, equipment and vehicles, and the establishment of temporary camps, in areas used by the general public or industry. The mobilisation of spill response	

personnel into an affected area may also place increased demands on local accommodation and other businesses.	
Potential receptors:	+ Socio-Economic Receptors
The use of vessels in the nearshore and offshore environment and the undertaking of spill response activities at shoreline locations may exclude the general public and industry use of the affected environment. As well as impacting leisure activities of the general public, this may impact on revenue with respect to industries such as tourism and commercial fishing. The mobilisation of personnel to small communities has the potential to affect the local community through demands on local accommodation and business, reducing the availability of services to members of the public.	

6.8.3 Environmental Performance and Control Measures – Spill Response Operations

For EPOs, EPS and measurement criteria relating to spill response in event of a spill during this Activity refer to the Yoorn-1 Exploration Drilling OPEP.

Table 6-25: Control Measure Evaluation for Spill Response Operations

Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Competent Incident Management Team (IMT) and oil spill responder personnel.	Ensures that spill response strategy selection and operational activities consider the potential for additional environmental impacts.	Personnel and operational costs associated with maintaining competent IMT team and responder personnel.	**Adopted** – Considered a standard spill response control.
Use of competent vessel crew and personnel.	Reduces potential for environmental impacts from vessel usage.	Personnel and operational costs associated with maintaining contracts with competent vessel crew and personnel.	**Adopted** – Considered a standard spill response control.
Noise Emissions			
Vessels and aircraft compliant with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA- 91-11-00003).	Reduces potential for behavioural disturbance to cetaceans.	No cost/issue associated with this control measure	**Adopted** –Ensures compliance with Part 8 of the EPBC Regulations 2000, which is considered a standard spill response control (regulatory requirement).
Light Emissions			
Select temporary base camps in consultation with Department of	Reduce coastal habitat and fauna disturbance.	No cost/issue associated with this control measure.	**Adopted** – Considered a standard control to be adopted by the

Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Transport (DoT) and Department of Biodiversity, Conservation and Attractions (DBCA).			relevant Control Agency.
Atmospheric Emissions			
International Air Pollution Prevention (IAPP) Certificate	Reduces level of air quality impacts.	Personnel and operational costs associated with maintaining Air Pollution Certificate.	**Adopted** – Considered a standard spill response control (regulatory requirement).
Disruption to Other Marine Users			
Stakeholder consultation	Promotes awareness and reduces potential impacts from response to socio-economic activities	Minimal cost in relation to overall effort/costs in managing incident	**Adopted** – Considered a standard control for incident management
Utility resource assessment and support to be conducted if activity is of significant size in comparison to the size of the coastal community	Reduces potential impact due to higher utility demands causing disruptions to local community.	No cost/issue associated with this control measure.	**Adopted –** Considered a standard control.
Accommodation assessment	Reduces strain on accommodation.	No cost/issue associated with this control measure.	**Adopted –** Considered a standard control.
Transport Management Plan	Reduces potential for traffic disruptions.	No cost/issue associated with this control measure.	**Adopted –** Considered a standard control for large scale deployment in highly populated areas.
Operational Discharges and Waste			
Vessels meet applicable Australian Marine Orders and Marine Park sewage disposal requirements	Reduces potential for water quality impacts.	No cost/issue associated with this control measure.	**Adopted** – Considered a standard spill response control (regulatory requirement).
Vessel meet applicable Australian Marine Orders requirements for oily water (bilge) discharges	Reduces potential for water quality impacts.	No cost/issue associated with this control measure.	**Adopted** – Considered a standard spill response control (regulatory requirement).
Compliance with controlled waste,	Ensures correct handling and disposal of oily wastes.	No cost/issue associated with this control measure.	**Adopted** – Considered a standard spill response control

Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
unauthorised discharge and landfill regulations.			(regulatory requirement).
Physical Presence and Disturbance			
Spill response activities selected on basis of a net environmental benefit analysis.	Provides a systematic and repeatable process for evaluating strategies with net least environmental impact.	No cost/issue associated with this control measure	**Adopted** – Considered a standard spill response control.
Vessels and aircraft compliant with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA- 91-11-00003).	Reduces potential for behavioural disturbance to cetaceans.	No cost/issue associated with this control measure	**Adopted** – Ensures compliance with Part 8 of the EPBC Regulations 2000, which is considered a standard spill response control (regulatory requirement).
Use of shallow draft vessels for shoreline and nearshore operations.	Reduce seabed and shoreline disturbance.	Operational costs associated with operating shallow draft vessels for shoreline and nearshore operations.	**Adopted** – Considered a standard control.
OSR Team Leader assesses and selects vehicles appropriate to shoreline conditions.	Reduce coastal habitat and fauna disturbance.	No cost/issue associated with this control measure.	**Adopted** – Considered a standard control.
Conduct shoreline, nearshore habitat, bathymetry assessment.	Reduce shoreline habitat disturbance.	Operational costs associated with conducting shoreline nearshore habitat assessment.	**Adopted** – Considered a standard control.
Establish demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting and roosting areas and turtle nesting habitat.	Reduce coastal habitat and fauna disturbance.	No cost/issue associated with this control measure.	**Adopted** – Considered a standard control.
Operational restriction of vehicle and personnel movement to limit erosion and compaction.	Reduce coastal habitat erosion and compaction.	No cost/issue associated with this control measure.	**Adopted** – Considered a standard control.
Prioritise use of existing roads and tracks.	Reduce coastal habitat and fauna disturbance.	No cost/issue associated with this control measure.	**Adopted** – Considered a standard control.

Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Select temporary base camps in consultation with DoT and DBCA	Reduce coastal habitat and fauna disturbance.	No cost/issue associated with this control measure.	**Adopted –** Considered a standard control to be adopted by the relevant Control Agency.
Soil profile assessment prior to earthworks.	Reduce habitat disruption and erosion.	Operational costs associated with soil profile assessment.	**Adopted** – Considered a standard control.
Use of Heritage Advisor if spill response activities overlap with potential areas of cultural significance.	Reduce disturbance to culturally significant sites.	No cost/issue associated with this control measure.	**Adopted** – Considered a standard control to be adopted by the relevant Control Agency.
Pre-cleaning and inspection of equipment (quarantine)	Reduces potential for invasive species to offshore islands	Cost/effort in inspecting equipment	**Adopted** – Considered a standard control.
Adhere to WA Oiled Wildlife Response Plan and Pilbara Regional Oiled Wildlife Response Plan	Oiled wildlife hazing, capture, handling and rehabilitation meet minimum standards as outlined within the WA Oiled Wildlife Response Plan.	Operational costs associated with response plan.	**Adopted –** Considered a standard control to be adopted by the relevant Control Agency.

6.8.4 Environmental Impact Assessment

Receptor	Consequence Level
Light Emissions	
+ Threatened, migratory, and local fauna; + Protected Areas. + Socio-economic receptors	The receptors considered most sensitive to lighting from vessel and shoreline operations are seabirds/shorebirds and marine turtles, particularly over summer months with respect to marine turtles where emerging hatchlings are sensitive to light spill onto beaches. Following restrictions on night-time operations by spill response vessels, which will demobilise to mooring areas offshore with safety lighting only, impacts from vessels are considered to be I – Negligible.
	The positioning of temporary camps will be done at direction of DoT/ DBCA and following control measures on lighting colour and direction the consequence of shoreline lighting is considered Negligible.
	Fauna (including Threatened/ Migratory/ Local Fauna): I (Negligible) – Short term behavioural impacts only to small proportion of local population and not during critical lifecycle activity. No decrease in local population size / area of occupancy of species / loss or disruption of habitat critical / disruption to the breeding cycle / introduction of disease.

Receptor	Consequence Level
	Protected areas: I (Negligible) – No or negligible impact on protected area values. No decline of species population within a protected area. No or negligible alteration, modification, obscuring or diminishing of protected area values. Socio-economic receptors: I (Negligible) – no or negligible loss of value of the local industry. No or negligible reduction in key natural features or populations supporting the activity
Overall worst-case consequence level	I – Negligible
Acoustic Disturbance	
+ Threatened, migratory, and local fauna; + Protected Areas. + Socio-Economic Receptors	The receptor considered most sensitive to vessel noise disturbance are humpback whales during migration season, when they come close to the Montebello Islands and Barrow Island during their peak migration (July- October); and populations of marine turtles, whale sharks and pygmy blue whales. However, following the adoption of control measures to limit close interaction with protected fauna (i.e. Santos Protected Marine Fauna Interaction and Sighting Procedure), a temporary behavioural disturbance is expected only with a consequence of Negligible. With respect to noise from onshore operations (mobile equipment and vehicles), nesting, roosting or feeding birds are considered to be the most sensitive to noise, in particular shorebirds may be aggregating at the Dampier Archipelago and surrounding island groups. The equipment used is not considered to have excessive sound levels and following direction by DoT and DBCA on the location of temporary camp areas, the consequence to birds from noise is expected to be Negligible. Shorebirds may be official values of the protected area they occur in, and the impact to the protected area from noise is also considered Negligible.
	Fauna (including Threatened/ Migratory/ Local Fauna): I (Negligible) – Short term behavioural impacts only to small proportion of local population and not during critical lifecycle activity. No decrease in local population size / area of occupancy of species / loss or disruption of habitat critical / disruption to the breeding cycle / introduction of disease. Protected areas: I (Negligible) – No or negligible impact on protected area values. No decline of species population within a protected area. No or negligible alteration, modification, obscuring or diminishing of protected area values. Socio-economic receptors: I (Negligible) – no or negligible loss of value of the local industry. No or negligible reduction in key natural features or populations supporting the activity.
Overall worst-case consequence level	I – Negligible
Atmospheric Emissions	
+ Physical environment and habitat/air quality	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. Because of the localised and low level of emissions, impacts to protected area values, physical environment and socio-economic receptors are predicted to be Negligible.

Receptor	Consequence Level
+ Threatened, migratory, and local fauna; + Protected areas. + Socio-economic receptors	Physical environment/habitat: I (Negligible) – No or negligible reduction in habitat area/function. Fauna (including Threatened/ Migratory/ Local Fauna): I (Negligible) – Short term behavioural impacts only to small proportion of local population and not during critical lifecycle activity. No decrease in local population size / area of occupancy of species / loss or disruption of habitat critical / disruption to the breeding cycle / introduction of disease. Protected areas: I (Negligible) – No or negligible impact on protected area values. No decline of species population within a protected area. No or negligible alteration, modification, obscuring or diminishing of protected area values. Socio-economic receptors: I (Negligible) – no or negligible loss of value of the local industry. No or negligible reduction in key natural features or populations supporting the activity.
Overall worst-case consequence level	I – Negligible
Operational Discharges and Waste	
+ Threatened, migratory, and local fauna; + Physical environment and habitats; + Protected areas. + Socio-economic receptors	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 to habitats, fauna or protected area values. Furthermore, washing of vessels and equipment will take place only in defined offshore hot zones preventing impacts to shallow coastal habitats. Because of impacts to fauna, operational discharges from vessels has the potential to impact supported industries such as tourism and commercial fishing however as impacts to fauna are considered negligible any indirect impacts on socio-economic receptors will also be I -negligible. Onshore, the use of flushing water has the potential to damage sensitive shoreline and intertidal habitats, e.g. mangroves, however low pressure flushing only will be used, preventing further damage to habitats or erosion of sediments. For sensitive habitats the deployment of booms will be considered to retain flushed hydrocarbons, if this presents a net benefit. Following these control measures the use of flushing to clean shorelines and intertidal habitats is seen to have a Negligible additional impact to habitats, fauna or protected area values. 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 in used during the spill response thus containing waste and preventing any secondary contamination. The consequence of cleaning discharges is therefore ranked as Negligible in terms of impacts to habitats, fauna or protected area values. Sewage, putrescible and municipal waste generated onshore will be stored and disposed of at approved locations. The storage, transport and disposal of hydrocarbon contaminated waste arising from spill response operation actions such as shoreline clean up, will be managed by a Santos appointed waste

Receptor	Consequence Level
	management contractor and dedicated waste containment areas will prevent the spreading or leaching of hydrocarbon contamination.
	Physical environment/habitat: I (Negligible) – No or negligible reduction in habitat area/function. Fauna (including Threatened/ Migratory/ Local Fauna): A (Negligible) – Short term behavioural impacts only to small proportion of local population and not during critical lifecycle activity. No decrease in local population size / area of occupancy of species / loss or disruption of habitat critical / disruption to the breeding cycle / introduction of disease. Protected areas: I (Negligible) – No or negligible impact on protected area values. No decline of species population within a protected area. No or negligible alteration, modification, obscuring or diminishing of protected area values. Socio-economic receptors: I (Negligible) – no or negligible loss of value of the local industry. No or negligible reduction in key natural features or populations supporting the activity.
Overall worst-case consequence level	I – Negligible
Physical Presence and Disturbance	
+ Threatened, migratory, and local fauna + Physical environment and habitats + Protected areas.	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. 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. Furthermore, clean-up can 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 under direction of DoT and DBCA with suitable advice sought if access is needed to culturally significant areas. Following these and other control measures the 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. 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

Receptor	Consequence Level
	following compliance with the WA Oiled Wildlife Response Plan and the Pilbara Region Oiled Wildlife Response Plan. These habitats/environments are likely to be values of the protected area they occur in, and the impact to the protected area from physical disturbance is also considered Minor. The disturbance to marine and coastal natural habitat, as well as the potential for disruption to culturally sensitive areas, which may occur in specially protected areas, may have flow on impacts to socio-economic values and industry (e.g. tourism, fisheries). This impact is considered minor (II).
	Fauna (including Threatened/ Migratory Fauna): II (Minor) – Detectable but insignificant decrease in local population size. Insignificant reduction in area of occupancy of species. Insignificant loss/disruption of habitat critical to survival of a species. Insignificant disruption to the breeding cycle of local population Physical environment/habitat: II (Minor) – Detectable but localised and insignificant loss of area/function of habitat. Rapid recovery evident within approximately 1 year (seasonal recovery). Protected Areas: II (Minor) – Detectable but insignificant impact to on one or more of protected areas values. Socio-economic receptors: II (Minor) – Detectable but insignificant short- term loss of value of the local industry. Detectable but insignificant reduction in key natural features or population supporting the local activity.
Overall worst-case consequence level	II – Minor
Disruption to Other Users of Marine and Coastal Areas and Townships	
+ Socio-economic receptors.	The use of vessels in the nearshore and offshore environment and spill response activities at shoreline locations, and within townships, may exclude general public 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 application of control measures it is considered that the additional impact of spill response activities on affected industries would be Minor.
	Socio-economic receptors: II (Minor) - Detectable but insignificant short-term loss of value of the local industry. Detectable but insignificant reduction in key natural features or population supporting the local activity.
Overall worst-case consequence level	II – Minor

6.8.5 Demonstration of ALARP

A NEBA is the primary tool used during spill response to evaluate response strategies with the goal of selecting strategies that result in the least net impact to key environmental sensitivities. The NEBA process conducted as a spill occurs, will identify and compare net environmental benefits of alternative spill response options. The NEBA will effectively determine whether an environmental benefit will be achieved through implementing a response strategy compared to undertaking no response. NEBA will be undertaken by the relevant Control Agency for the activity. For those activities under the control of Santos, the IMT Environmental Team Leader will be responsible for reviewing the priority receptors and selected response strategies identified within this EP and coordinating the NEBA for each operational period. This will ensure that at the strategy level, the response operations reduce additional environmental impacts to ALARP.

Spill response activities will be conducted in offshore and coastal waters using vessels and aircraft. The greatest potential for additional impacts from implementing spill response is considered to be to wildlife in offshore waters from oiled wildlife response activities, and to shoreline habitats and fauna receptors within shallow waters or on shorelines from shoreline clean-up activities.

Given the types of activities considered appropriate to responding to a worse-case spill and the scale of operations, standard control measures adopted by Santos for spill response to reduce the level of additional impacts are considered to reduce these impacts to ALARP. This includes working with the relevant Control Agency for spill response and applying the process and standards e.g. for oiled wildlife response as included within the WA Oiled Wildlife Response Plan.

Santos have considered the actions prescribed in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a) and Approved Conservation Advice for other relevant threatened fauna relevant to spill responses for the activities to minimise noise and light impacts on marine cetaceans, fish, sharks and marine turtles, especially flatback turtles. The proposed activity will not result in significant impacts on these species and implementation of identified control measures is in line with the relevant Conservation Advice and Recovery Plans. Pollution events (such as hydrocarbon spills) could impact on fauna, and the use of vessels and equipment during the spill response could result in potential impacts as described within this EP. Control measures in place for vessel and helicopter use will reduce potential impacts to marine fauna and these are consistent with current conservation advice. The assessed residual consequence for this impact is minor and cannot be reduced further without grossly disproportionate costs. It is considered therefore that the impact of the activities conducted is ALARP.

6.8.6 Acceptability Evaluation

Is the consequence ranked as I (Negligible) or II (Minor)?	Yes – Maximum consequence is II (Minor) from planned events and maximum risk is Medium.
Is further information required to support or validate the consequence assessment?	No – potential impacts and risks well understood through the information available.
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes - Activity evaluated in accordance with the Environmental Hazard Identification and Assessment Procedure which considers principles of ESD.
Are control measures and performance standards consistent with industry standards, legal and regulatory requirements, including protected matters?	Yes – management consistent with OPGGS(E)R 2009 Regulations, including safety case and WOMP. The following material published in relation to threatened and migratory species within the EMBA identifies habitat degradation / modification, pollution or oil spills as a threat (**Table 3-9**):

	Conservation Advice: + Approved Conservation Advice on *Pristis clavate* (Dwarf Sawfish) (2009) + Approved Conservation Advice on *Pristis zijsron* (green sawfish) (2008) + Approved Conservation Advice for *Milyeringa veritas* (Blind Gudgeon) (2008) + Approved Conservation Advice for *Ophisternon candidum* (Blind Cave Eel) (2008) + Approved Conservation Advice for *Pristis pristis* (Largetooth sawfish) (2014) + Approved Conservation Advice for *Glyphis garricki* (northern river shark) 2014 + Approved Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015a) + Approved Conservation Advice for *Aipysurus apraefrontalis* (Short-nosed Sea Snake) (2011) + Approved Conservation Advice for *Aipysurus foliosquama* (Leaf-scaled Seasnake) (2011) + Commonwealth Conservation Advice on Dermochelys coriacea (2008) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015c) + Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (2015d) + Approved Conservation Advice on *Neophoca cinerea* Australian Sea Lion (2020) + and relevant recovery plans and conservation advices for birds **Recovery Plans:** + Sawfish and River Sharks Multispecies Recovery Plan (2015a) + Recovery Plan for the White Shark (*Carcharodon carcharias*) (2013a) + Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (2014) + Wildlife Conservation Plan for Migratory Shorebirds (Commonwealth of Australia 2015) + Draft Wildlife Conservation Plan for Seabirds (Commonwealth of Australia 2019) + National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011) + Recovery Plan for Marine Turtles in Australia (DoEE, 2017)

	+ Blue Whale Conservation Management Plan 2015 - 2025 (DoE, 2015b) + Conservation Management Plan for the Southern Right Whale 2011 – 2021 (2012) + Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (2013) Recovery Plans / Conservation Advice for other species that may occur in the EMBA do not identify pollution or habitat degradation / modification as a key threat or have explicit relevant objectives or management actions. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) + South-west Marine Parks Network Management Plan (2018) + Conservation values of the identified protection priorities (**Section 3.2.2**) have been considered, including the Montebello AMP, the Barrow Island Marine Park and Management Area, Montebello Islands Marine Park (State Marine Park), Muiron Island Marine Management Area, and Ningaloo Marine Park. + Management is also consistent with the zoning of the Australian marine parks, in that risks have been reduced to ALARP, e.g., implementation of spill response activities will limit impacts, thereby conserving the marine park values (described in **Section 3.2.2** and **Table 3-4)**. The objectives of these publications were considered during the assessment of impacts and risks. The activity is not inconsistent with these objectives.
Are control measures and performance standards consistent with the Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are performance outcomes and standards consistent with stakeholder expectations?	Yes – No concerns raised. During any spill response, a close working relationship with relevant regulatory bodies (e.g. DoT, DBCA, AMSA) will occur and thus there will be ongoing consultation with relevant stakeholders on the acceptability of response operations. Wildlife response will be conducted in accordance with the WA Oiled Wildlife Response Plan (WA OWRP) and Pilbara Regional Oiled Wildlife Response Plan.
Are control measures and performance standards such that the impact or risk is considered to be ALARP?	Yes (see ALARP evaluation above).

The implementation of response activities to reduce the potential impacts from a spill are required by legislation. The spill response options selected have been demonstrated to show a net environmental benefit, are standard industry practice and consistent with relevant standards and guidelines, including the NatPlan. No concerns from stakeholders have been raised regarding response activities and the controls proposed reduce the consequences of the potential impacts to minor and ALARP. The controls used during spill response activities are therefore considered to reduce additional impacts and risks to an acceptable level.

7 Environmental Assessment for Unplanned Events

OPGGS(E)R 2009 Requirements
Regulation 13. Environmental assessment.
Evaluation of environmental impacts and risks 13(5) The environment plan must include: (a) details of the environmental impacts and risks for the activity; and (b) an evaluation of all the impacts and risks, appropriate to the nature and scale of each impact or risk; and (c) details of the control measures that will be used to reduce the impacts and risks of the activity to as low as reasonably practicable and an acceptable level. 13(6) To avoid doubt, the evaluation mentioned in paragraph (5)(b) must evaluate all the environmental impacts and risks arising directly or indirectly from: (a) all operations of the activity; and (b) potential emergency conditions, whether resulting from accident or any other reason. *Environmental performance outcomes and standards* 13(7) The environment plan must: (a) set environmental performance standards for the control measures identified under paragraph (5)(c); and (b) set out the environmental performance outcomes against which the performance of the titleholder in protecting the environment is to be measured; and (c) include measurement criteria that the titleholder will use to determine whether each environmental performance outcome and environmental performance standard is being met.

An ENVID workshop (as described in **Section 5**) for unplanned activities was held in July 2021 which identified seven potential sources of environmental risks associated with unplanned events for this activity. The results of the environmental assessment are summarised in **Table 7-1**. A comprehensive risk and impact assessment for each of the unplanned events and subsequent control measures proposed by Santos to reduce the risk and impacts to ALARP are detailed in the following subsections.

The following unplanned event was considered to not be a credible scenario given the water depths in the OA, and is therefore not discussed further in this section:

+ Hydrocarbon spill due to vessel grounding.

Vessel grounding can occur due to a loss of propulsion or to navigational error resulting in the vessel running aground in shallow areas. Vessel grounding and subsequent fuel tank rupture were not considered a credible scenario for this activity because the OA is situated in deep water and there are no charted reefs or islands that could pose a grounding hazard in the OA.

Table 7-1: Summary of the Risk Assessment Ranking for Unplanned Activities

EP Section Reference	Event	Consequence	Likelihood	Residual Risk Level
7.2	Hydrocarbon release (surface and subsea) from Loss of Well Control (LOWC)	IV - Major	B - Unlikely	Low
7.3	Hydrocarbon release (surface) of MDO	III - Moderate	B - Unlikely	Low
7.4	Minor hydrocarbon releases (surface and subsurface)	II - Minor	B - Unlikely	Very Low
7.5	Non-hydrocarbon and chemicals release (surface) - liquids	I- Negligible	C - Possible	Very Low
7.6	Release of Solid Objects	I- Negligible	C - Possible	Very low
7.7	Introduction of invasive marine species	III - Moderate	B - Unlikely	Low
7.8	Marine fauna interaction	II - Minor	B - Unlikely	Very Low

7.1 Overview of Unplanned Release of Hydrocarbons

7.1.1 Credible Release Scenarios

Unplanned events may occur during the activity, resulting in the potential release of hydrocarbons (condensate and Marine Diesel Oil (MDO)) to the marine environment. The release scenarios assessed in **Sections 7.2** to **7.3**.

7.1.2 Release Scenario Selection

To identify the release scenarios that were considered credible for the activity, the following potential scenarios were considered as described below:

- Surface release of MDO from refuelling of the MODU or vessel collision / external impact
- Loss of Well Control (LOWC), resulting in a subsea or surface release of condensate.

Santos have conducted spill modelling for these scenarios:

- Yoorn-1: WA-499-P Exploration Drilling LOWC Spill Modelling (GHD, 2020)
- Yoorn-1 well location: WA-499-P Geophysical and Geotechnical Surveys Diesel Spill Modelling Report (GHD, 2019)

Table 7-2 presents the Maximum Credible Scenario (MCS) for each release scenario.

Table 7-2: Summary of Maximum Credible Spill Scenarios

Maximum Credible Spill Scenario	Hydrocarbon Type	Maximum Credible Volume	Comment	EP Section
Surface release of MDO from refuelling of the MODU or from the MODU or vessel as a result of an external impact (vessel collision) which ruptures an MDO tank.	MDO	329 m^3 released over 0.5 hours	Maximum credible volume based of MDO bunker tanks, with the largest tank having a capacity of 329 m^3.	**7.3**
Subsea release of gas-condensate from a loss of well control	Yoorn condensate analogue (Grader C)	1,998,647 bbl (317,750 m^3) of liquid condensate and 45,892 MMscf of gas	Maximum credible volume modelled – with highest flow potential derived by combining the highest reservoir flow parameters for the well.	**7.2**
Surface release of gas-condensate from a loss of well control		1,990,310 bbl (316,424 m^3) of liquid condensate and 45,696 MMscf of gas		

7.1.2.1 Non-credible Scenarios

Vessel grounding was discussed and considered but determined non-credible given the offshore location of the OA and water depth, and therefore, is not discussed further.

7.1.3 Spill Modelling Overview

Oil 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 to quantitatively assess the fate and transport of hydrocarbons in the marine environment, as well as evaluate the efficacy of response measures. OSCAR provides an integrated hydrocarbon transport and weathering model that accounts for hydrocarbon advection, dispersion, surface spreading, entrainment, dissolution, biodegradation, emulsification, volatilisation and shoreline interaction.

Three-dimensional (3D) OSCAR modelling was undertaken in stochastic mode (total of 150 realisations per scenario) with start dates spaced approximately fortnightly over a five-year period. Inputs into the model were sourced from HYCOM (regional ocean currents, temperature and salinity profiles), TPXO7.2 (tidal currents) and National Centre for Environmental Protection (NCEP)/ National Centre for Atmospheric Research (NCAR) (regional winds).

The justification for the hydrocarbon type modelled is in the Hydrocarbon Specifications for Modelling- Condensate Analogue section below.

Table 7-3 provides details on the model input specifications for the modelled scenarios presented in **Table 7-2**.

Table 7-3: Model Input Specifications

Parameter	Scenarios		
	LOWC- Subsea scenario	LOWC- Surface release	Surface MDO

Yoorn-1			
Location	Yoorn-1 well 20°20'34.09" S, 115°47'25.01" E		
Depth of release	47 m	0 m (surface spill)	0 m (surface spill)
Hydrocarbon type	Yoorn condensate analogue (Linda Condensate) simulated with Rev 2009 Grader C analogue*		Marine Diesel Oil (MDO)
Hydrocarbon discharge rate	32,661 bbl/day week 1; 20,489 bbl/day week 11	32,492 bbl/day week 1; 20,428 bbl/day week 11	-
Gas release volume	45,892 MMscf (1,299,516,880 sm^3)	45,696 MMscf (1,293,966,778 sm^3)	-
Liquid release volume	1.999x10^6 bbl	1.990x10^6 bbl	329 m^3
Average condensate-gas ratio	43.6 bbl/MMscf	43.6 bbl/MMscf	-
Time of the year	All months**		
Spill duration	77 days		0.5 hours
Modelling duration	112 days		35 days
Reference	WA-499-P Exploration Drilling LOWC Spill Modelling (GHD, 2020)		WA-499-P Geophysical and Geotechnical Survey Diesel Spill Modelling Report (GHD, 2019)

* Note. Yoorn-1 LOWC modelling used Linda condensate as an analogue, which was modelled as Rev 2009 13 Grader C (Grader C), selected from within the SINTEF Oil Library .

** The stochastic model was run based on drilling occurring at any time of the year, with 120 realisations per scenario.

7.1.3.1 Weathering Modelling

Weathering modelling was undertaken with the SINTEF Oil Weathering Model (OWM). OWM predicts the weathering (i.e. mass balance partitioning) of hydrocarbons under steady-state met-ocean conditions. OWM simulations were run for sustained wind speeds of 1 m/s (low winds), 5 m/s (moderate winds) and 10 m/s (high winds). The simulations are based on a test case of 100 m^3 of hydrocarbon released instantaneously onto the sea surface.

7.1.3.2 Hydrocarbon Specifications for Modelling – Condensate Analogue

Oil spill modelling in OSCAR is undertaken by selecting a hydrocarbon modelling analogue from within the SINTEF Oil Library that provides the best match to the expected (target) hydrocarbon.

Rev 2009 13 Grader C (Grader C) was selected from within the SINTEF Oil Library as the modelling analogue for Linda condensate, which was the analogue identified for the Yoorn-1 modelling (GHD, 2020).

A comparison of the distillation curves of Grader C and Linda-1 condensate is presented in **Figure 7-1**. Grader C was well matched to the boiling point curve for the condensate type.

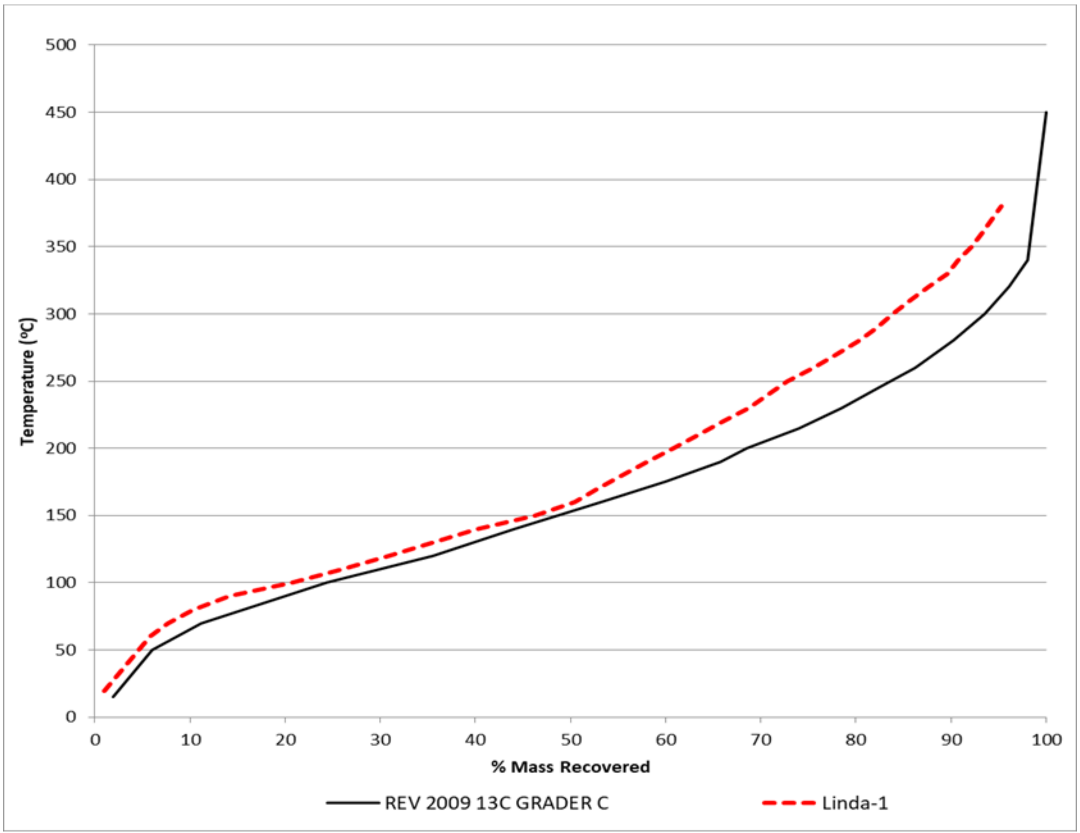

Figure 7-1: Comparison of boiling point curves for Linda-1 and SINTEF's Grader C Condensates

7.1.4 Hydrocarbon Characteristics

7.1.4.1 Condensate

The hydrocarbon type for the LOWC scenarios was identified as Linda-1 condensate for Yoorn-1. Rev 2009 13 Grader C (Grader C) was selected from within the SINTEF Oil Library as the modelling analogue.

Table 7-4 presents the bulk properties of Linda-1 condensate and the SINTEF condensate: Rev Grader C. A comparison of the bulk properties (**Table 7-4**) indicates a close match between Grader C and Linda-1 condensate across all comparisons.

Table 7-4: Comparison of Hydrocarbon Properties of Linda-1 (Yoorn analogue) and SINTEF Grader C Condensates

Parameter	Linda-1 Condensate	SINTEF Rev2009 13 Grader C
Specific Gravity	0.787	0.779

API Gravity	48.2	50.1
Viscosity (cP)	1.33 @ 20°C	1.1 @ 13°C
Wax Content (%)	0.5	0.6
Pour Point (°C)	-27	-21
Asphaltene (%)	<0.05	0.01

7.1.4.2 Marine Diesel

ITOPF (2011) and Australian Maritime Oil Spill Centre-AMOSC (2011) categorises diesel as a light group II hydrocarbon. In the marine environment, a 5% residual of the total quantity of diesel spilt will remain after the volatilisation and solubilisation processes associated with weathering (**Table** 7-5).

Table 7-5: Characteristics of MDO

Oil Type	Initial density g/cm^3 at 15°C	Viscosity (cP) (15°C)	Component	Volatiles (%)	Semi-volatiles (%)	Low Volatility (%)	Residual (%)	Aromatics (%)
			Boiling Points (°C)	<180	180-265	256-380	>380	Of whole oil <380
				NON-PERSISTENT			PERSISTENT	
Marine Diesel Oil	0.8368	4	% of total	6.0	34.6	54.4	<5	3.0

Source: GHD (2020)

7.1.5 Hydrocarbon Exposure Values

To inform the impact assessment it is important to understand the concentrations of hydrocarbons within the EMBA after a spill. To do this NOPSEMA recommends identifying hydrocarbon exposure values that broadly reflect the range of consequences that could occur at certain concentrations (NOPSEMA, 2019). The exposure values that have been applied to this EP are described below.

The EMBA shown in **Figure 3-1** was identified using low exposure values predicted by modelling both scenarios (GHD 2020). These low exposure values are not considered to be representative of a biological impact, but they are adequate for identifying the full range of environmental receptors that might be contacted by surface and/or subsurface hydrocarbons (NOPSEMA, 2019).

To inform impact assessment, exposure values that may be representative of biological impact have also been identified. These are called “moderate exposure values” and “high exposure values”. Moderate and high exposure values are modelled to identify the receptors contacted by surface, subsurface (entrained hydrocarbon and DAH’s), and shoreline accumulation.

Determining exposure values that may be representative of biological impact is complex since the degree of impact will depend on the sensitivity of the receptors contacted, the duration of the exposure and the toxicity of the hydrocarbon type making the contact. The toxicity of a hydrocarbon will also change over time, due to weathering processes altering the composition of the hydrocarbon. To identify appropriate exposure values Santos have considered the advice provided by NOPSEMA Bulletin #1 Oil Spill Modelling (April 2019) and scientific literature. The selected hydrocarbon exposure values are discussed in **Table 7-6, Table 7-7, Table 7-8** and **Table 7-9** below.

Table 7-6: Surface Oil Exposure Values

Surface Oil Concentration (g/m^2)	Exposure Value	Description
1	Low	Risk Evaluation It is recognised that a lower surface oil concentration of 1 g/m^2 (equivalent to a thickness of 0.001 mm or 1 ml of oil per m^2) is visible as a rainbow sheen on the sea surface. Although this is lower than the exposure value for ecological impacts, it may be relevant to socio-economic receptors and has been used as the exposure value to define the spatial extent of the environment that might be contacted (EMBA) from surface oil. Response Planning Contact at 1 g/m^2 (as predicted by oil spill trajectory modelling) is used as a conservative trigger for activating scientific monitoring plans as detailed in the OPEP.
10	Moderate	Risk Evaluation There is a paucity of data on surface oil concentrations with respect to impacts to marine organisms. Hydrocarbon concentrations for registering biological impacts resulting from contact of surface slicks have been estimated by different researchers at about 10–25 g/m^2 (French et al., 1999; Koops et al., 2004; NOAA, 1996). The impact of surface oil on birds is better understood than on other receptors. A conservative exposure value of 10 g/m^2 has been applied to impact assessment from surface oil in **Sections 7.2** to **7.3** of this EP. Although based on birds, this hydrocarbon exposure value is also considered appropriate for turtles, sea snakes and marine mammals (NRDAMCME, 1997). Response Planning Contact at 10 g/m^2 is not specifically used for spill response planning.
50	High	Risk Evaluation At greater thicknesses the potential for impact of surface oil to wildlife increases. All other things being equal, contact to wildlife by surface oil at 50 g/m^2 is expected to result in a greater impact. Response Planning Containment and recovery effectiveness drop significantly with reduced oil thickness (McKinney et al., 2017; NOAA, 2014). McKinney et al. (2017) tested the effectiveness of various oil skimmers at various oil thicknesses. Their results showed that the oil recovery rate of skimmers dropped significantly when oil

Surface Oil Concentration (g/m^2)	Exposure Value	Description
		thickness was less than 50 g/m^2-(less than Bonn Agreement Code 4). Hence, 50g/m^2 has been set as a guide for planning effective containment and recovery operations. Similarly, surface oil >50 g/m^2 (Bonn Agreement Code 4/5 and equivalent to oil observed as discontinuous or continuous true colour) is considered to be a lower limit for effective dispersant operations and is therefore considered for planning. Note that containment and recovery and dispersant application are assessed as not being suitable response strategies for MDO or Reindeer Condensate.

Table 7-7: Shoreline Hydrocarbon Accumulation Exposure Values

Shoreline Accumulation (g/m^2)	Exposure Value	Description
10	Low	<u>Risk Evaluation</u> An accumulated concentration of oil above 10 g/m^2 on shorelines is considered to represent a level of socio-economic effect (NOPSEMA, 2019) e.g. reduction in visual amenity of shorelines. This value has been used in previous studies to represent a low contact value for interpreting shoreline accumulation modelling results (French-McCay, 2005, 2006). <u>Response Planning</u> Not specifically used for response planning because below the limit that can be effectively cleaned.
100	Moderate	<u>Risk Evaluation</u> The impact exposure value concentration for exposure to hydrocarbons stranded on shorelines is derived from levels likely to cause adverse impacts to marine or coastal fauna and habitats. These habitats and marine fauna known to use shorelines are most at risk of exposure to shoreline accumulations of oil, due to smothering of intertidal habitats (such as mangroves and emergent coral reefs) and coating of marine fauna. Environmental risk assessment studies (French-McCay, 2009) report that an oil thickness of 0.1 mm (100 g/m^2) on shorelines is assumed as the lethal exposure value for invertebrates on hard substrates (rocky, artificial or man- made) and sediments (mud, silt, sand or gravel) in intertidal habitats. A conservative exposure value of 100 g/m^2 has been applied for impact assessment from shoreline accumulation of hydrocarbons in **Sections 7.2** to **7.3** of this EP. <u>Response Planning</u> A shoreline concentration of 100 g/m^2, or above, is likely to be representative of the minimum limit that the oil can be effectively cleaned according (AMSA, 2015; NOPSEMA, 2019) and is therefore used as a guide for shoreline clean- up

Shoreline Accumulation (g/m^2)	Exposure Value	Description
		planning. This exposure value equates to approximately ½ a cup of oil per square meter of shoreline contacted.
1,000	High	Risk Evaluation At greater thicknesses the potential for impact of accumulated oil to shoreline receptors increases. All other things being equal, accumulation of oil above 1,000 g/m^2 is expected to result in a greater impact. Response Planning As oil increases in thickness the effectiveness of oil recovery techniques increases. This value can therefore be used to prioritise oil recovery efforts, assuming oil recovery is deemed to have an environmental benefit.

Table 7-8: Dissolved Hydrocarbon Exposure Values

Dissolved hydrocarbons (ppb)	Exposure Value	Description
10	Low	Risk Evaluation Dissolved Hydrocarbons (also referred to as dissolved WAF or DAH) include the monoaromatic hydrocarbons (MAHs) (compounds with a single benzene ring such as BTEX [benzene, toluene, ethyl benzene, and xylenes]) and polycyclic aromatic hydrocarbons (PAHs) (compounds with multiple benzene rings such as naphthalenes and phenanthrenes). These compounds have a greater bioavailability that other components of oil and are considered to be main contributors to oil toxicity. The toxicity of dissolved hydrocarbons is a function of the concentration and the duration of exposure by sensitive receptors with greater concentration and exposure time causing more sever impacts. Typically tests of toxicity done under laboratory conditions measure toxicity as proportion of test organisms affected (e.g. 50% mortality or LC50) at the end of a set time period, often 48 or 96 hours. French-McCay (2002) in a review of literature, reported LC50 for dissolved PAHs with 96 h exposure, range between 30 ppb for sensitive species (2.5th-percentile species) and 2,260 ppb for insensitive species (97.5th-percentile species), with an average of about 250 ppb. The range of LC50s for PAHs obtained under turbulent conditions (this includes fine oil droplets) was 6 ppb to 410 ppb with an average of 50 ppb (French-McCay, 2002). The dissolved hydrocarbon 10 ppb exposure value has been used to inform the EMBA within **Sections 7.2** to **7.3**. An exposure value of 10 ppb is appropriate as it is concentration that could have some potential negative effect on marine organisms. Response Planning Contact at 10 ppb (as predicted by oil spill trajectory modelling) is used as a trigger for activating scientific monitoring plans as detailed in the OPEP.

Dissolved hydrocarbons (ppb)	Exposure Value	Description
		Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers (NOPSEMA, 2019).
50	Moderate	Risk Evaluation Approximates potential toxic effects, particularly sublethal effects to sensitive species (refer to above text). Consistent with NOPSEMA (2019). For most marine organisms, a concentration of between 50 and 400 ppb is considered to be more appropriate for risk evaluation. Response Planning Encompassed by response to 10ppb. There is no different response planning for higher exposure values.
400	High	Risk Evaluation Approximates toxic effects including lethal effects to sensitive species (NOPSEMA, 2019). Response Planning Encompassed by response to 10ppb. There is no different response planning for higher exposure values.

Table 7-9: Entrained Hydrocarbon Exposure Values

Entrained hydrocarbons (ppb)	Exposure Value	Description
10	Low	Risk Evaluation Entrained hydrocarbons (also referred to as total WAF), as opposed to dissolved, are oil droplets suspended in the water column and insoluble. Entrained hydrocarbons are not as bioavailable to marine organisms compared to DAHs and on that basis are considered to be a less toxic, especially over shorter exposure time frames. Entrained hydrocarbons still have potential effects on marine organisms through direct contact with exposed tissues and ingestion (NRC, 2005) however the level of exposure causing effects is considered to be considerably higher than for dissolved hydrocarbons. Much of the published scientific literature does not provide sufficient information to determine if toxicity is caused by entrained hydrocarbons, but rather the toxicity of total oils which includes both dissolved and entrained components. Variations in the methodology of the total water accommodated fraction (TWAF (entrained and dissolved)) may account for much of the observed wide variation in reported exposure values, which also depend on the test organism types, duration of exposure, oil type and the initial oil concentration. Total oil toxicity acute effects of total oil as LC50 for molluscs range from 500 to 2,000 ppb (Clark et al., 2001; Long and Holdway, 2002). A wider range of LC50 values have been reported for species of crustacea and fish from 100 to 258,000,000 ppb (Gulec et

Entrained hydrocarbons (ppb)	Exposure Value	Description
		al., 1997; Gulec and Holdway, 2000; Clark et al., 2001) and 45 to 465,000,000 ppb (Gulec and Holdway, 2000; Barron et al., 2004), respectively. The 10 ppb exposure value represents the very lowest concentration and corresponds generally with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the ANZECC (2018) water quality guidelines. This is consistent with NOPSEMA (2019) guidance. <u>Response Planning</u> Contact at 10 ppb (as predicted by oil spill trajectory modelling) is used as a trigger for activating scientific monitoring plans as detailed in the OPEP. Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers (NOPSEMA, 2019).
100	Moderate	<u>Risk Evaluation</u> The 100 ppb exposure value is considered to be representative of sub-lethal impacts to most species and lethal impacts to sensitive species based on toxicity testing as described above. This is considered conservative as toxicity to marine organisms from oil is likely to be driven by the more bioavailable dissolved aromatic fraction, which is typically not differentiated from entrained hydrocarbon in toxicity tests using water accommodated fractions (WAFs). Given entrained hydrocarbon is expected to have lower toxicity than dissolved aromatics, especially over time periods where these soluble fractions have dissoluted from entrained hydrocarbon, the moderate exposure value is considered appropriate for risk evaluation. The entrained hydrocarbon 100 ppb exposure value has been used to inform the risk assessments within **Sections 7.2** to **7.3**. <u>Response Planning</u> Encompassed by response to 10ppb. There is no different response planning for higher exposure values.

7.1.6 Spill Risk Assessment Approach

A consistent risk assessment approach is applied to each unplanned hydrocarbon release scenario in **Section 7.2** (LOWC) and **Section 7.3** (MDO). The spill risk assessment approach is based on Santos' Oil Spill Risk Assessment and Response Planning Procedure (QE-91-II-20003). The procedure describes the spill risk assessment process as follows:

+ Identify the spatial extent of the EMBA. This has been completed for this EP as part of the assessment of the existing environment and receptors that are known to occur or may occur within the EMBA are described in **Section 3**
+ Identify areas of high environmental value (HEV) within the EMBA (HEVs are described in Areas of High Environmental Value section)
+ Identify and then risk assess hot spots. Hotspots are effectively a subset of HEVs and their determination is described in Areas of High Environmental Value section)
+ Identifies priorities for protection (for consideration of spill response strategies in the OPEP).

7.1.6.1 Spill EMBA

Defining the EMBA by an oil spill is the first step in oil spill risk assessment. For activities where there is the potential for multiple spill scenarios, the spill scenario, or combination of spill scenarios, resulting in the greatest spatial extent of impacts is used to define the overall EMBA for the activity. The EMBA is further described in **Section 3.1**.

7.1.6.2 Areas of High Environmental Value

Santos has predetermined areas of HEV (**Figure 7-2** and **Figure 7-3**) along the Western Australian coastline by ranking these areas based on:

+ Protected area status – This is used as an indicator of the biodiversity values contained within that area, where a World Heritage Area, Ramsar Wetland and Marine Protected Area will score higher than areas with no protection assigned; and
+ BIAs of listed threatened 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 migration. Each one of these within the predefined areas contributes to the score.

Further input to determine areas of HEV included:

+ Sensitivity of habitats to impact from hydrocarbons in accordance with the guidance document Sensitivity Mapping for Oil Spill Response produced by IPIECA, the International Maritime Organisation and International Association of Oil and Gas Producers
+ Sensitivities of receptors with respect to hydrocarbon-impact pathways
+ Status of zones within protected areas (i.e., IUCN (1a) and sanctuary zones compared to IUCN (VI) and multiple use zones)
+ Listed species status and predominant habitat (surface versus subsurface)
+ Social values; i.e., socio-economic and heritage features (e.g., commercial fishing, recreational fishing, amenities, aquaculture).

Tallied scores for each predefined area along the Western Australian coastline were then ranked from 1 to 5, with an assignment of 1 representing areas of the highest environmental value and those with 5 representing the areas of the lowest environmental value.

7.1.6.3 Hot Spots

While the entire EMBA will be considered during risk assessment and spill response planning, it is best practice to concentrate greatest effort and level of detail on those parts of the EMBA that have:

+ The greatest intrinsic environmental value – i.e., HEV areas ranked 1-3
+ The highest probability of contact by oil (either floating, entrained or dissolved aromatic)
+ The greatest potential concentration or volume of oil arriving at the area.

These areas are termed 'Hot Spots'. Defining Hot Spots is typically the first step in undertaking detailed spill risk assessment and spill response planning. Hot Spots are a subset of HEV areas that:

- Have the highest probability of contact (at least higher than 5%) above the impact assessment
- exposure values for surface hydrocarbons and shoreline accumulation based on modelling results
- Receive the greatest concentration or volume of oil, either floating or stranded oil, entrained hydrocarbon or DAHs above contact exposure values described in **Section 7.1.5**.

7.1.6.4 Priorities for Protection

For the purposes of a spill response preparedness strategy, it is not necessary for all Hot Spots to have detailed planning. For example, wholly submerged Hot Spots may only be contacted by entrained hydrocarbon, and the response would be largely to implement scientific monitoring to determine impact and recovery. Hot Spots with features that are not wholly submerged (i.e., emergent features) should have specific spill response planning conducted. This final determination of 'Priority for Protection' sites, for the oil spill response strategy, is based on the worst-case estimate of surface oil concentration, shoreline loading and minimum contact time at exposure value concentrations.

Further detail on the process for selection of Priority for Protection sites is detailed in the Oil Spill Risk Assessment and Response Planning Procedure (QE-91-II-20003).

The oil spill response strategies for Priority for Protection sites are undertaken within the activity OPEP.

An assessment of each protection priority will be undertaken to determine the most appropriate spill response strategies based on the type of oil and the values of the protection priority area. This can be done through a strategic Net Environmental Benefit Analysis (NEBA) approach.

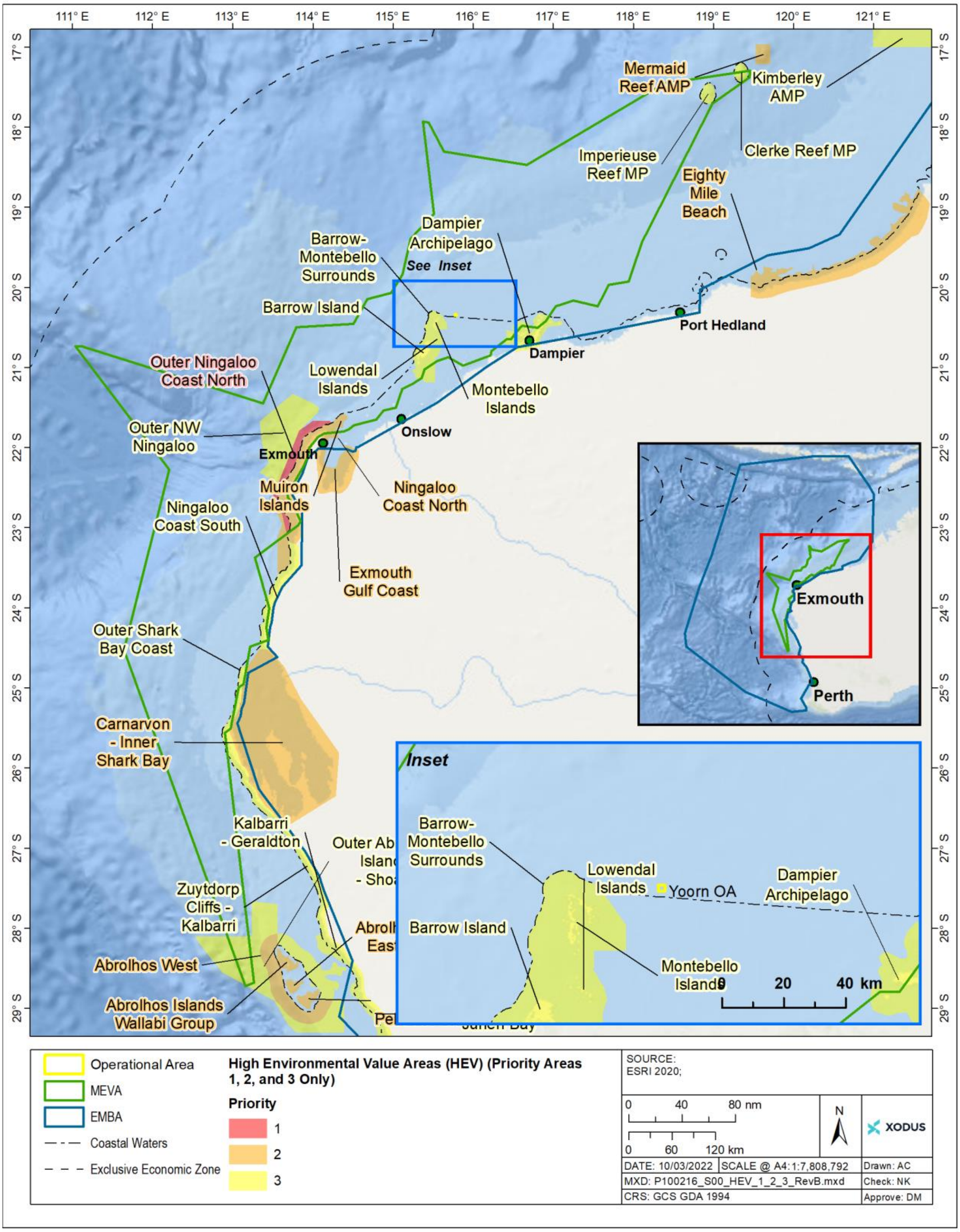

Figure 7-2: High Environmental Values Area Priority 1-3

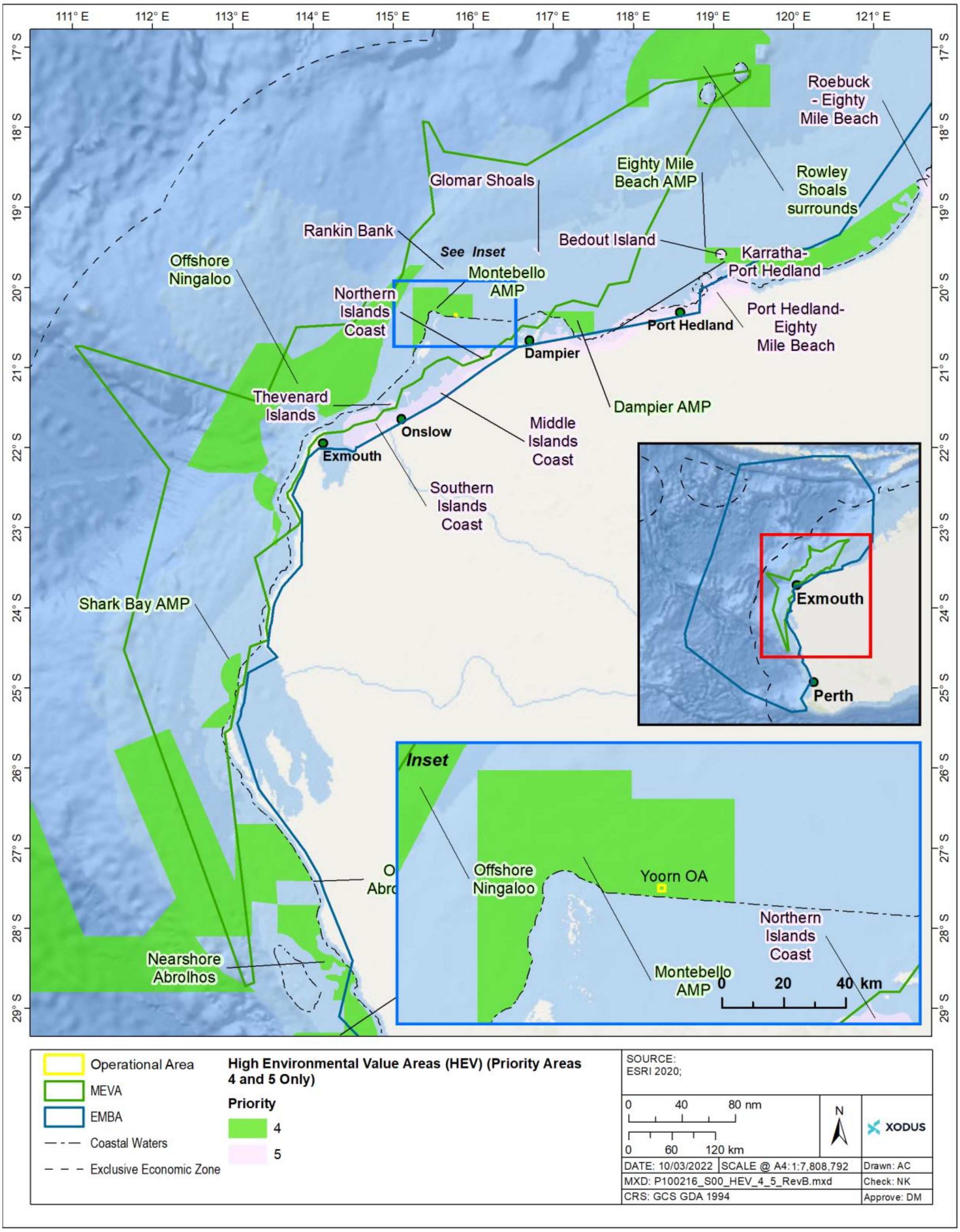

Figure 7-3: High Environmental Values Area Priority 4-5

7.1.6.5 Potential Hydrocarbon Impact Pathways

To help inform the hydrocarbon spill risk assessment receptors within the EMBA, the potential physical and chemical impact pathways have been defined. Physical pathways include contact from surface oil, accumulated shoreline oil, or entrained hydrocarbon droplets from an MDO or LOWC condensate release. Chemical pathways include ingestion, inhalation or contact from any hydrocarbon phase. These are summarised in **Table 7-10** and the information is drawn upon within the hydrocarbon risk assessment for each release scenario (**Section 7.2** and **Section 7.3**). **Table 7-11** further describes the nature and scale of the hydrocarbon spills associated with the Activity on marine fauna and socio-economic receptors found within the MEVA.

Table 7-10: Physical and Chemical Pathways for Hydrocarbon Exposure and Potential Impacts on Receptors

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Rocky shorelines	Shoreline loading and attachment may result in thin and sporadic coating of hydrocarbon residues. Degree of oil coating is dependent upon the energy of the shoreline area, the type of the rock formation and continual biodegradation of the oil.	Impacts to flora (mangroves) and fauna further described below.	Chemical pathway to fauna and flora via adsorption through cellular membranes and soft tissue, ingestion, irritation/ burning on contact and inhalation.	Impacts to flora (mangroves) and fauna further described below.
Sandy beaches	Shoreline loading and water movement may allow hydrocarbon residue to filter down into sediments, continue to biodegrade on the surface or remobilise into surf zone. Degree of loading is dependent upon the energy and tidal reach of the shoreline, the type of the sandy shore and continual weathering of the oil.	Indirect impacts to nesting and foraging habitats for birds and turtles. Direct impacts to infauna.	Chemical pathway to fauna and flora via adsorption through cellular membranes and soft tissue, ingestion, irritation/burning on contact and inhalation.	Indirect impacts to nesting and foraging habitats for birds and turtles. Direct impacts (mortality) to infauna through toxic effects and smothering.
Intertidal platforms	Shoreline loading and water movement may allow hydrocarbon residue to filter down into sediments (e.g. within wetlands) or continue to biodegrade on the surface or remobilise into surf zone. Degree of loading is dependent upon the energy and tidal reach of the shoreline, the type of the substrate and continual weathering of the oil.	Indirect impacts to foraging habitats for birds and turtles. Direct impacts to infauna.	Chemical pathway to fauna and flora via adsorption through cellular membranes and soft tissue, ingestion, irritation/burning on contact and inhalation.	Indirect impacts to foraging habitats for birds. Direct impacts (mortality) to infauna through toxic effects and smothering.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Shallow sub-tidal soft sediments	Hydrocarbon residue in the shallow waters adjacent to shorelines may settle to filter down into sediments. Degree of loading is dependent upon the energy and tidal reach of the shoreline, the type of the substrate and continual weathering of the oil.	Indirect impacts to foraging habitats for turtles and fish. Direct impacts to infauna.	Adsorption via cellular membranes and soft tissue, ingestion, irritation/burning on contact and inhalation.	Indirect impacts to foraging habitats for turtles and fish. Direct impacts (mortality) to infauna through toxic effects and smothering.
Mangroves	Coating of root system reducing air and salt exchange. Degree of coating is dependent upon the energy and tidal reach of the shoreline, the type of the substrate and continual weathering of the oil.	Yellowing of leaves. Defoliation. Increased sensitivity to stressors. Tree death. Reduced growth. Reduced reproductive output. Reduced seed viability.	External contact by oil and adsorption across cellular membranes.	Yellowing of leaves. Defoliation. Increased sensitivity to stressors. Tree death. Reduced growth. Reduced reproductive output. Reduced seed viability. Growth abnormalities.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Seagrasses and macroalgae	Coating of leaves/thalli reducing light availability and gas exchange. Degree of coating depends upon the energy and tidal reach of the shoreline, the type of the receptor and continual weathering of the oil.	Bleaching or blackening of leaves. Defoliation. Reduced growth.	External contact by oil and adsorption across cellular membranes.	Mortality. Bleaching or blackening of leaves. Defoliation. Disease. Reduced growth. Reduced reproductive output. Reduced seed/propagule viability.
Hard corals (coral reefs)	Coating of polyps, shading resulting in reduction on light availability. Degree of coating is dependent upon the metocean conditions, dilution, if corals are emergent at all and continual weathering of the oil.	Bleaching. Increased mucous production. Reduced growth.	External contact by oil and adsorption across cellular membranes.	Mortality. Cell damage. Reduced metabolic capacity. Reduced immune response. Disease. Reduced growth. Reduced reproductive output. Reduced egg/larval success. Growth abnormalities.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Non-coral benthic invertebrates	Coating of adults, eggs and larvae. Degree of coating is dependent upon the energy and tidal reach of the shoreline, the type of the receptor and continual weathering of the oil.	Mortality. Behavioural disruption. Impaired growth.	Ingestion and inhalation. External contact and adsorption across exposed skin and cellular membranes. Uptake of DAH across cellular membranes. Reduced mobility and capacity for oxygen exchange.	Mortality. Cell damage. Reduced metabolic capacity. Reduced immune response. Disease. Reduced growth. Reduced reproductive output. Reduced egg/larval success. Growth abnormalities. Behavioural disruption.
Sharks, rays and fish	Coating of adults but primarily eggs and larvae – reduced mobility and capacity for oxygen exchange.	Mortality. Oxygen debt. Starvation. Dehydration. Increased predation. Behavioural disruption.	Ingestion. External contact and adsorption across exposed skin and cellular membranes. Uptake of DAH across cellular membranes (for example, gills).	Mortality. Cell damage. Flesh taint. Reduced metabolic capacity. Reduced immune response. Disease. Reduced growth. Reduced reproductive output. Reduced egg/larval success. Growth abnormalities. Behavioural disruption.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Birds (seabirds and shorebirds)	Degree of coating is dependent upon the energy and tidal reach of the shoreline, the type of the receptor and continual weathering of the oil.	Feather and skin irritation and damage, with the potential to cause secondary impacts such as: Physical restriction of flight and swimming movement. Mortality. Hypothermia / impairing the waterproofing of feathers. Disruption to feeding / starvation. Disruption to breeding. Disruption to migration.	Ingestion (during feeding or preening). External contact and adsorption across exposed skin and membranes.	Mortality. Cell damage, lesions. Secondary infections. Reduced metabolic capacity. Reduced immune response. Disease. Reduced growth. Reduced reproductive output. Growth abnormalities. Behavioural disruption.
Marine reptiles	Degree of coating is dependent upon the energy and tidal reach of the shoreline, the type of the receptor and continual weathering of the oil.	Irritation of eyes/mouth and potential illness, which may cause secondary impacts such as: Mortality. Disruption to feeding / starvation. Physical restriction. Behavioural disruption.	Inhalation. Ingestion. External contact and adsorption across exposed skin and membranes.	Mortality. Cell damage, lesions. Secondary infections. Reduced metabolic capacity. Reduced immune response. Disease. Reduced growth. Reduced hatchling success. Reduced reproductive output. Growth abnormalities. Behavioural disruption.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Marine mammals	Fur damage and matting, reduced mobility and buoyancy (for applicable species). Coating of feeding apparatus in some species (baleen whales).	Irritation of eyes/mouth, damage to fur and potential illness, which may cause secondary impacts such as: Mortality. Disruption to feeding / starvation. Physical restriction. Behavioural disruption.	Inhalation. Ingestion. External contact and adsorption across exposed skin and membranes.	Mortality. Cell damage, lesions. Secondary infections. Reduced metabolic capacity. Reduced immune response. Disease. Reduced growth. Reduced reproductive output. Growth abnormalities. Behavioural disruption.
Plankton	Coating of feeding apparatus. Reduced mobility and capacity for oxygen exchange.	Mortality. Behavioural disruption (for example, reduced mobility).	Inhalation. Ingestion. External contact.	Mortality. Impairment of biological activities (for example, feeding, respiration). Reduced mobility.
Water quality and sediment quality	Presence of hydrocarbon residue in the water, which may filter down to sediments or continue to biodegrade on the surface. Degree of loading in the water column is dependent upon the influence of wave energy and tidal range.	Impacts to flora and fauna, as discussed in rows above.	Adsorption via cellular membranes and soft tissue, ingestion, irritation/burning on contact and inhalation. Impacts to flora and fauna, as discussed in rows above.	Impacts to flora and fauna, as discussed in rows above.

Receptor	Physical pathway	Potential impacts	Chemical pathway	Potential impacts
Protected areas	Coating of benthic habitats, shoreline habitats and marine fauna/flora within protected areas as discussed in rows above.	Mortality, injury or behavioural disruption to marine fauna. Death or impairment of habitats within protected areas. Reduction in the quality of the marine environment within protected areas. Environmental value of protected areas is degraded.	Impacts to flora and fauna, as discussed in rows above.	Mortality, injury or behavioural disruption to marine fauna. Death or impairment of habitats within protected areas. Reduced growth of benthic habitats. Reduction in the quality of the marine environment within protected areas. Environmental value of protected areas is degraded.
Socio-economic environment (fisheries, tourism, shipping, defence, shipwrecks, Indigenous users, oil and gas)	Presence of hydrocarbon residue in the water, which may filter down to sediments or continue to biodegrade on the surface. Coating of benthic habitats, shoreline habitats and marine fauna/flora within protected areas as discussed in rows above.	Degradation of cultural or maritime heritage sites. Disruption to tourism, recreation or shipping activities. Reduction in resource available for commercial and recreational fisheries.	Impacts to flora, fauna and the physical environment as discussed in rows above. Commercial/recreational fish species – refer to 'fish' as discussed above.	Degradation of cultural or maritime heritage sites. Disruption to tourism, recreation or shipping activities. Reduction in resource available for commercial and recreational fisheries.

7.1.6.6 Summary of Potential Impacts

Table 7-11 provides a summary of the potential impacts of hydrocarbon releases to sensitive receptors and values at the moderate exposure values (see **Section 7.1.5**).

Table 7-11: Nature and Scale of Hydrocarbon Spills on Environmental and Socio-economic Receptors

Receptors	Impacts of Hydrocarbon release on sensitive receptors at the moderate exposure value
Marine fauna	
Plankton (including zooplankton; coral larvae and Benthic Invertebrates)	+ There is potential for localised mortality of plankton due to reduced water quality and toxicity. + Plankton utilising surface waters as well as pelagic invertebrates (e.g. jellyfish) could be impacted from surface, entrained or dissolved hydrocarbons. Physical contact of small hydrocarbon droplets may impair plankton mobility, feeding and/or respiration. Plankton could include the eggs and larvae of marine invertebrates (including coral) and fish. The likelihood of this would be determined by the extent and timing of the spill; for example, hard coral spawning occurs primarily in March/April, so there is a heightened potential for impacts to coral eggs and larvae to occur during this period. There is the potential for ingestion of small hydrocarbon droplets or DAHs by filter feeding organisms (e.g. jellyfish, salps, zooplankton), which could result in negative impact to some species. + Potential for impacts due to physical contact with entrained hydrocarbon is low for Reindeer condensate and MDO, given the non-persistent nature of both hydrocarbons. + Benthic invertebrates, particularly those using intertidal habitats of the Ningaloo Coast, Barrow Island and Montebello Islands could be contacted at moderate exposure values. + The abundance and diversity of epi-benthic invertebrates is likely to be highest in shallow subtidal habitats such as hard corals, seagrasses, macroalgae. Benthic invertebrates may be impacted by oiling interfering with feeding and respiratory structures. There is also the potential for hydrocarbon to be ingested by filter feeding invertebrates such as molluscs and sponges; bivalves could potentially bioaccumulate hydrocarbons. Given the non-persistent nature of both hydrocarbon, potential impacts from physical smothering are low. Recovery time of intertidal habitats may be slightly longer for a Reindeer condensate release compared to MDO, as greater proportion of the invertebrate population may be exposed to entrained hydrocarbons in the event of a Reindeer condensate (particularly subsea release) release compared to MDO.
Marine mammals	+ Marine mammals are at risk of direct contact with MDO and condensate due to chance of surfacing within the slick. Effects include irritation of eyes/mouth and potential illness. In addition, surfacing in a slick may lead to accidental ingestion

	of hydrocarbons or result in the coating of sensitive epidermal surfaces. There is an increased potential for volatile hydrocarbons to be inhaled if marine mammals were to surface within a surface slick especially if close to the release sites where the hydrocarbon would be relatively fresh (i.e. have a greater concentration of volatile monocyclic aromatic hydrocarbons such as BTEX chemicals). + Lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth and potential illness may occur should marine mammals contact dissolved and entrained hydrocarbons in the water column. Marine mammals could potentially ingest entrained hydrocarbon when feeding in open water. + 47 marine mammals were identified by the EPBC Protected Matters search for the EMBA (**Section 3.2.3**). BIAs overlapping the EMBA include: – Humpback whale - migration (north and south), resting, nursing and calving – Blue whale – foraging/migration – Pygmy blue whale – foraging, migration and distribution – Sperm whale- foraging – Australian sea lion – foraging (male and female) – Dugong - breeding, foraging (high density seagrass beds), nursing and calving – Southern Right Whale - seasonal calving habitat and calving buffer. + Of these species the humpback whale (migration and resting), pygmy blue (distribution, migration and foraging) and dugong's BIAs are closer to the OA and are therefore likely to be exposed to greater concentrations of hydrocarbons (at or above the moderate exposure values). – Surface and entrained MDO and condensate at moderate exposure concentrations could occur within the humpback whale migration BIA in the event of an unplanned release. Should a hydrocarbon spill occur within migration season (June to October) risk of impact to humpback whales is greater. A greater proportion of the migrating population may be contacted by surface or entrained hydrocarbons, and if individuals actively avoid the spill (or spill response activities) migration pathways may be disrupted. – Dugongs may be indirectly impacted via habitat loss due to reduction in seagrass due to from contact with entrained hydrocarbons. Direct impacts to dugongs could occur through foraging or ingesting seagrass coated with hydrocarbon. Additionally, where surface slicks are expected to extend into shallower coastal waters, impacts from contact with surface hydrocarbons may also occur as they surface to breathe.
Marine reptiles	+ Marine reptiles are at risk of direct contact with hydrocarbons due to chance of surfacing within slick, effects include irritation of eyes/mouth and potential illness. Entrained and dissolved hydrocarbons may lead to lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth and potential illness. + The greatest potential for impact to turtles or seasnakes is likely to be in feeding areas where surface and/or entrained hydrocarbons have contacted shallow

	water foraging habitats (e.g. seagrass, hard coral and macroalgae) or, in the case of turtles, at any turtle nesting beaches that have been contacted by stranded surface MDO or condensate. + Green, hawksbill, flatback and loggerhead turtles utilise shallow waters and nesting beaches of the Montebello Islands, Barrow Island and Lowendal Islands, which may be contacted at moderate exposure values. The risk at these nesting beaches is for hydrocarbons to contact adult females during nesting season or turtle hatchlings 6-8 weeks following nesting or to accumulate on the shorelines. Hydrocarbons may cause irritation to turtles' sensitive organs such as eyes. In terms of entrained hydrocarbons within shallow coastal waters turtles may be sensitive since they feed in shallow water coral and macroalgae habitats and may ingest entrained MDO or gas condensate as well as potentially being contacted on external surfaces. + BIAs and habitat critical for the survival of the species for the flatback turtle, green turtle, hawksbill turtle and loggerhead turtle all are within the extent of the moderate exposure value for entrained hydrocarbons from the worst-case credible spill, which is the largest area reaching moderate exposure value.
Seabirds and shorebirds	+ Lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth and potential illness may occur should seabirds and shorebirds be exposed to MDO and condensate at moderate exposure values, however it is commonly thought that MDO does not cause problems for wildlife due to the lack of visible oiling however may be toxic (WAOWRP, 2014). + Seabirds are at risk of contacting surface, entrained or dissolved MDO and condensate while diving and foraging. + Shorebirds may encounter MDO and condensate accumulating on shorelines at feeding, roosting and breeding sites. + Foraging seabirds may continue to forage within slicks as most fish survive beneath floating slicks. Smothering of oil on seabird during foraging can lead to reduced water proofing of feathers and ingestion while preening. In addition, hydrocarbons can erode feathers causing chemical damage to the feather structure that subsequently affects ability to thermoregulate and maintain buoyancy on water. + Seabirds may ingest surface and/or entrained hydrocarbon when feeding in affected offshore waters or coastal waters, however it is unlikely that significant quantities of oil would be ingested. Coating of feathers on birds diving into entrained hydrocarbon is a possibility although the concentration of hydrocarbon is unlikely to lead to significant oiling since neither MDO nor condensate are particularly sticky when compared to other hydrocarbons. The risk of impact is greater should a release within the chick rearing period, where adults forage closer to breeding colonies. EPBC listed seabird species have BIAs for resting, breeding or foraging that overlap the MEVA and are potentially impacted by a hydrocarbon release. Potential impacts to these species would be greater should a release occur within the periods of peak habitat use.

	+ The risk to shorebirds and coastal species would depend upon where hydrocarbon accumulates; accumulation near nesting colonies or areas supporting feeding aggregations (i.e. sand/mud flats) would result in greatest impacts.
Fish and sharks	+ The most likely impact of DAHs and/or entrained hydrocarbon droplets on fish is through the pathways of ingestion or the coating of gill structures. This could lead to respiratory problems or accumulation of hydrocarbons in tissues. In the worst instance this could lead to mortality, or sub-lethal stress. Although relatively low entrainment of hydrocarbons in the water column is predicted for all scenarios modelled, entrainment is expected to be greater for subsea condensate releases, resulting in a higher potential for impact to fish. + There is potential for localised mortality of fish eggs and larva 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 and therefore demersal fish communities are not expected to be impacted. + While fish and sharks do not generally break the sea surface, individuals may feed at the surface for a short period. Hydrocarbon is expected to quickly disperse and evaporate (modelling results indicate a significant proportion of the hydrocarbon mass from the water surface evaporates within 24 hours at moderate wind speeds for all hydrocarbon types), the probability of prolonged exposure to a surface slick by fish and shark species is low. + A whale shark foraging BIA is within the moderate exposure value area. Whale sharks are oceanic, but also come into shallower, coastal waters to feeds in surface waters which often coincide with specific productivity events that are a focus of feeding for the animals. It is therefore possible that surface and/or entrained hydrocarbon and/or dissolved aromatic hydrocarbon could come in contact with, or be ingested by, whale sharks migrating or aggregating in the area at the time of release.
Shoreline habitats	
Shoreline Habitats	+ There is a high probability of volumes of hydrocarbon to accumulate on shorelines. + The Montebello Islands, Barrow Island, Lowendal Islands and Muiron Islands are a regionally important nesting sites for flatback turtles. Impacts to turtles could occur from surface hydrocarbons if oil accumulated on nesting beaches. Entrained hydrocarbon could also contact sandy beaches at high tide. Such impacts would be most likely to nesting females as they move up and down beaches or to turtle hatchlings as they emerge from nests 6-8 weeks following nesting.
Intertidal/subtidal habitats	
Hard corals	+ In the worst instance direct contact to intertidal corals by surface and/or entrained hydrocarbon could lead to smothering and reduced capacity for photosynthesis by zooxanthellae; or chemical toxicity across cellular structures

	leading to coral bleaching or colony death. Direct contact by DAHs can cause lethal and sub-lethal effects in corals, depending on the time and duration of exposure of the concentrations, with sub-lethal effects including decreased growth rates and reduced reproductive success (IPIECA, 1992). In the worst-case instance, irreversible tissue necrosis and death could occur. While acute impacts to hard corals from oil spills are possible, they are most likely at high oil concentrations (as opposed to chronic impacts which can occur at relatively low concentrations over long periods) (NOAA, 2010). + Potential exists for hard coral to be contacted by entrained hydrocarbons moderate exposure values at a number of locations, notably the Ningaloo Coastline, Dampier Archipelago, Muiron island, Montebello Islands and Barrow Island. + Given that MDO and condensate have relatively low persistence and are not considered a sticky oil, hard coral exposure to a spill of the magnitude is expected to be short term. This is particularly the case in areas where wave action is conducive to dispersing oil (e.g. fringing coral reef with breaking waves or rocky shorelines/platform with hard corals). Several studies have indicated that rapid recovery rates may occur even in cases of heavy oiling (Burns et al., 1993;). Further, tidal cycles/wave action is expected to prevent long term coating of intertidal corals by surface oil. + The timing of an oil spill event in relation to other environmental stresses, such as ambient temperature, or reproductive stage could also have significance in that corals are likely to be more sensitive to oil spill events at times of physiological stress. Coral spawning at Ningaloo Coast peaks during March/April with a minor peak in October and spills during this period would likely have greatest potential for impact to hard corals and their larvae.
Macroalgae and seagrass	+ As with hard corals, intertidal and subtidal macroalgae and seagrass could be impacted by surface and/or entrained MDO and condensate. Impacts could include reduced capability for photosynthesis if the seagrass or macroalgae were smothered; or toxic effects could occur from contact with the hydrocarbon. Areas of seagrass that could be impacted based on moderate exposure values being reached include coastal waters off the Ningaloo Coast as well as outer Shark Bay. + Impacts to seagrass may present secondary impacts to species reliant on the habitat such as Dugongs.
Mangroves	+ Mangrove root systems (including pneumatophores) are sensitive to physical oiling from surface hydrocarbons. Impacts to mangroves include yellowing of leaves, defoliation, reduced reproductive output and success, mutation and increased sensitivity to other stresses (NOAA, 2010). There is the potential for stands of mangroves at a number of shorelines, notably along the Ningaloo to be contacted at moderate exposure values.
Intertidal mud/sandflats	+ Intertidal mud/sandflats contacted at moderate exposure values have the potential to interfere with infaunal organisms (crabs, molluscs) etc. either by

	modifying the habitat (blocking burrowing holes and binding sediments) or smothering feeding/respiratory/locomotory structures of these organisms. + Secondary impacts may occur to fauna such as shorebirds which utilise the mud and sandflats for feeding should they ingest contaminated invertebrates or preening of feathers in the area. + Important intertidal mud/sand flat areas along the Ningaloo Coastline are associated with mangrove areas (e.g. Mangrove Bay), which could be contacted at the moderate exposure values.
Intertidal rocky reefs	+ Contact to intertidal rocky reef areas could occur from surface entrained or dissolved hydrocarbons. These habitats often support attached invertebrates (e.g. molluscs, hard and soft corals) and support mobile invertebrates that shelter in crevices (e.g. crabs), which could potentially be exposed to lethal or sub-lethal toxicity impacts.
Socio-economic	
Fisheries	+ Several commonwealth and state fisheries are found within the MEVA and include: + 5 commonwealth fisheries (3 fisheries have management areas within the OA) + 22 state fisheries (7 fisheries intercept the OA) + Hydrocarbons in the water column can have toxic effects on fish (as outlined above) and cause 'tainting' reducing catch rates and rendering fish unsafe for consumption. + Exclusion zones surrounding a spill can directly impact fisheries by restricting access for fishermen. + Hydrocarbon releases have the potential to lead to temporary financial losses due to impact to fish. In the worst instance, a spill could lead to loss of (or loss of function of) coastal intertidal habitat (e.g. seagrass meadows, mangrove communities, intertidal mudflats), which provide nursery habitat for fishery species (e.g. fish and crustaceans). Hydrocarbon contact on fish/invertebrate gill structures, the ingestion of hydrocarbon by target species and the potential for entrained hydrocarbon to interfere with the development of fish eggs and larvae could also potentially impact fisheries for a period after the spill is contained.
Tourism	+ There is the potential for surface, entrained and/or dissolved aromatic hydrocarbon to temporarily disrupt tourism activities which rely on the presence of marine fauna and/or the use of vessels (e.g. snorkelling/scuba diving, whale/whale shark watching/swimming and recreational fishing) via displacement from an exclusion zone or a reduction in fauna abundance due to avoidance of the area. + Impacts to recreational fishing may also occur due to impacts to fish as described for Fisheries above. + Visible oiling from accumulated hydrocarbons is likely to occur on beaches on the Montebello Islands, an important tourist location, where concentrations of accumulated hydrocarbons are greatest.

Shipping	+ A number of shipping fairways intersect the EMBA and moderate exposure value area. + In the event of a hydrocarbon spill shipping activities may be impacted by exclusion zones surrounding a spill. Exclusion zones could reduce access for shipping vessels for the duration of the response undertaken for spill clean-up (if applicable) meaning vessels may have to take detours leading to potential delays and increased costs.
Defence	+ Military exercise areas are located at Exmouth and Derby associated with the Royal Australian Air Force (RAAF) Base Learmonth and Curtin respectively. These training zones overlap the EMBA and moderate exposure value area. However, they have been for aerial training are unlikely to be impacted by a hydrocarbon spill.
Shipwrecks	+ There are shipwrecks within the EMBA and moderate exposure value area. + Surface hydrocarbons will have no impact on shipwrecks. + Notable shipwrecks include three historic shipwrecks at Pt Cloates along the Ningaloo Coast (Fin, Perth and Zvir) and one historic shipwreck at North West Cape (Fairy Queen). It is unlikely that contact would have any lasting impact on these sites apart from a possible temporary reduction in aesthetic value for a period.
Indigenous	+ Marine resource use by indigenous people is generally restricted to coastal waters. Fishing, hunting and the maintenance of maritime culture and heritage through ritual, stories and traditional knowledge continue as important uses of the nearshore region and adjacent areas. + Indigenous users may be impacted by surface hydrocarbons, exclusion zones around spill sites during spill response and fishing and hunting stocks may be impacted by entrained and dissolved hydrocarbons. + The nearest sites include middens, burial, ceremonial, artefacts, rock shelters, mythological and engraving sites recorded in the Dampier Archipelago and on the Montebello and Legendre Islands.
Existing oil and gas activity	+ A number of oil and gas operators operate within the EMBA with existing projects and infrastructure in place as well as continuing drilling and exploration programs. A surface or subsea hydrocarbon spill has the potential to disrupt activity with associated economic impact. + Exclusion zones surrounding spills will reduce access, potentially resulting in delays to work schedules with possible subsequent financial implications. Facilities such as Chevron's Gorgon and WA Oil operations on Barrow Island could be impacted in the event of an unplanned spill event through exclusion or access restrictions in the event of spill response and clean-up activities (if applicable).
Protected Areas	
Protected Areas	+ The EMBA overlaps 18 KEFs (**Section 3.2.2**). The following KEFs could be contacted at the moderate exposure value:

	– Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula - the assemblages of epibenthic species of this KEF are unlikely to be impacted by a hydrocarbon release. Aggregations of pelagic species, including whale sharks, manta rays, humpback whales, sharks, large predatory fish and seabirds, may be impacted by entrained and surface hydrocarbons as described above – Ancient coastline at 125 m depth contour – this feature may support enhanced productivity and may attract opportunistic feeding by larger marine life including humpback whales, whale sharks and large pelagic fish, these species could be impacted by entrained or surface hydrocarbons – Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula – The Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula are defined as a key ecological feature as they are unique seafloor features with ecological properties of regional significance, which apply to both the benthic and pelagic habitats within the feature. – Commonwealth water adjacent to Ningaloo Reef – The Commonwealth waters adjacent to Ningaloo Reef are defined as a key ecological feature for their high productivity and aggregations of marine life, which apply to both the benthic and pelagic habitats within the feature. – Continental slope demersal fish communities – This species assemblage is recognised as a key ecological feature because of its biodiversity values, including high levels of endemism. – Exmouth Plateau – The Exmouth Plateau is defined as a key ecological feature as it is a unique seafloor feature with ecological properties of regional significance, which apply to both the benthic and pelagic habitats within the feature. Mermaid Reef and Commonwealth waters surrounding Rowley Shoals- this feature may support enhanced productivity that contributes to this species richness is thought to be facilitated by the breaking of internal waves in the waters surrounding the reefs, causing mixing and re-suspension of nutrients from water depths of 500–700 m into the photic zone – Glomar Shoals- the Glomar Shoals are regionally important for their high biological diversity and high localised productivity. – Seringapatam Reef and Commonwealth waters in the Scott Reef complex – Seringapatam Reef and Commonwealth waters in the Scott Reef complex are defined as a key ecological feature as they support diverse aggregations of marine life, have high primary productivity relative to other parts of the region, are relatively pristine and have high species richness, which apply to both the benthic and pelagic habitats within the feature. – Wallaby Saddle – Wallaby saddle is defined as a key ecological feature for its high productivity and aggregations of marine life. These values apply to both the benthic and pelagic habitats within the feature.

	– Ancient coastline between 90 and 120 m depth – The Ancient coastline between 90 and 120 m depth is defined as a key ecological feature for its potential high productivity and aggregations of marine life, biodiversity and endemism. Both benthic habitats and associated demersal communities are of conservation value. – Cape Mentelle upwelling – The Cape Mentelle upwelling is defined as a key ecological feature for its relatively high productivity and aggregations of marine life. – Commonwealth marine environment surrounding the Houtman Abrolhos Islands (and adjacent shelf break) – The Commonwealth marine environment surrounding the Houtman Abrolhos Islands (and adjacent shelf break) is defined as a key ecological feature for its high levels of biodiversity and endemism in benthic and pelagic habitats. – Commonwealth marine environment within and adjacent to the west-coast inshore lagoons – The Commonwealth marine environment within and adjacent to the west-coast inshore lagoons is defined as a key ecological feature for its high productivity and aggregations of marine life. Both benthic and pelagic habitats within the feature are of conservation value. – Naturaliste Plateau – The Naturaliste Plateau is recognised as a key ecological feature for its biodiversity values, including a unique seafloor feature with ecological properties of regional significance, which apply to its benthic and demersal habitats. – Perth Canyon and adjacent shelf break, and other west-coast canyons – The Perth Canyon forms a major biogeographical boundary and it is defined as a key ecological feature because it is an area of higher productivity that attracts feeding aggregations of deep-diving mammals and large predatory fish. It is also recognised as a unique seafloor feature with ecological properties of regional significance. – Demersal slope and associated fish communities of the Central Western Province – The Demersal slope and associated fish communities of the Central Western Province are recognised as a key ecological feature for their high levels of biodiversity and endemism. – Western rock lobster – The Western rock lobster is defined as a key ecological feature due to its presumed ecological role on the west coast continental shelf.
Commonwealth and State Marine Protected Areas	+ Protected areas within the moderate hydrocarbon exposure value for entrained hydrocarbons (which covers the largest area compared with other hydrocarbon phases) are summarised below. For full descriptions of these areas refer to **Section 3.2.2** and Santos' Values and Sensitivities of the Western Australian Marine Environment (EA-00-RI-10062), **Appendix C.** + National and World Heritage Listed Areas: – The Ningaloo Coast

	– Shark Bay, Western Australia – HMAS Sydney II – HSK Kormoran – Dampier Archipelago (including Burrup Peninsula) – Australian Marine Parks – Montebello AMP – Argo-Rowley Terrace AMP – Mermaid Reef AMP – Gascoyne AMP – Ningaloo AMP – Shark Bay AMP – Abrolhos AMP + State Marine Parks and Marine Management Areas: – Muiron Islands Marine Management Area – Marmion Marine Park – Jurien Bay Marine Park – Montebello Islands Marine Park – Shark Bay Marine Park – Ningaloo Marine Park – Barrow Island MMA and Marine Park – Rowley Shoals Marine Park + These protected areas support all the habitats and faunal groups described above. Impacts to the habitat/fauna receptors described above therefore have an impact on the values of these reserves which could have flow-on effects to tourism revenue of coastal communities that provide access to these protected areas. The areas listed above may also support nursery/feeding/aggregation areas for fisheries species and therefore may assist in maintaining healthy fish stocks and commercial/recreational fisheries.

7.2 Hydrocarbon Spill – LOWC

7.2.1 Description of Event

Event	A LOWC during drilling may occur due to a number of reasons, including: + Shallow gas; + Well kick; + Tripping/Swabbing; + Loss of primary and secondary well control; and + Failure to keep the correct mud density. In the event of a LOWC, condensate may be released to the marine environment with the most likely release points at either the MODU drill floor or seabed. Worst-case credible spill scenarios were estimated to cover the possibility of a LOWC from the well drilled under this EP. The worst-case credible spill scenarios were predicted by selecting the most likely hydrocarbon flow parameters from the well to yield the credible maximum blowout volumes and rates (i.e., environmentally credible worst-case volume and rate) from both subsurface (seabed) and surface (MODU floor) unplanned releases. Key parameters for input to this 'worst-case' blowout were taken from key Santos well design documents and Well Design Automation System (WDAS), suitable analogues, latest reservoir models, or Santos best estimates where information was unavailable. Quantitative hydrocarbon spill modelling was undertaken for the worst-case subsurface and surface spill scenarios. The LOWC worst-case discharge volumes that were used for the hydrocarbon spill modelling were based on Santos WA's Technical File Note: Use of the approved Yoorn-1 WCD TFN to define WCD parameters for other prospects in the Dampier Sub-basin (Santos, 2021) which evaluated the worst case LOWC scenarios for multiple wells in the Dampier Sub-basin. Outputs from the modelling were used to inform the environmental impact assessment and to assist with emergency planning. *Stochastic spill modelling information - Volume and Type of Release* Hydrocarbons that could be released to the environment are natural gas and hydrocarbon liquid (condensate) from a surface or subsea blowout. Quantitative hydrocarbon spill modelling was undertaken for the worst-case subsea and surface spill discharge rates and volumes from a LOWC to inform the environmental impact assessment and to assist with emergency planning. As explained in **Section 7.1.2**, Santos have identified two representative spill modelling reports for the well, based on their flow rate and location: + Yoorn-1: WA-499-P Exploration Drilling LOWC Spill Modelling (GHD, 2020). Key parameters including worst-case volumes released for each scenario modelled are given in **Table 7-3**. The environmental consequences of a LOWC are highly variable, dependant on the characteristics of the hydrocarbon released, the dynamics of the receiving environment and the proximity of the release point to sensitive environmental receptors.
Extent	The MEVA and EMBA for the worst-case hydrocarbon spill from a LOWC was defined in **Section 3.1.**

	For information on the extent of potential impact associated with a LOWC, refer to **Section 7.2.2.**
Duration	The worst-case duration of a LOWC is predicted as 11 weeks / 77 days (refer to the OPEP). This is the estimated time required to drill a relief well and gain control of the primary well. Hydrocarbons would persist within the environment for a longer period of time, although the condensate released is expected to weather quickly through evaporation and dispersion.

7.2.2 Nature and Scale of Environmental Impacts

Hydrocarbon spills will cause a decline in water quality and may cause chemical (e.g., toxic) and physical (e.g., coating of emergent habitats, oiling of wildlife at sea surface) impacts to marine species. The severity of the impact of a hydrocarbon spill depends on the magnitude of the spill (i.e., extent, duration) and sensitivity of the receptor.

The magnitude of potential environmental impact from a condensate release (which behaves in a similar manner in the marine environment to MDO) is dependent on multiple factors including hydrocarbon type, release volume and rate, and ocean and weather conditions.

An assessment of the sensitive environmental receptors at risk from a LOWC condensate release has been determined based on a literature review and trajectory and fate modelling described above. **Section 3** includes a description of biological environment present in the operational and/or spill (MEVA) trajectory area.

<u>Potential receptors:</u> Physical environment (water and sediment quality, shoals and banks, benthic habitats, offshore reefs and islands), threatened or migratory fauna (marine mammals, marine reptiles, sharks, fish, rays and birds), protected and significant areas (marine parks, heritage areas, key ecological features (KEFs)), socio-economic receptors (fisheries, tourism, recreation and other third-party operators).

A LOWC release from the Yoorn-1 well to the marine environment would result in reductions in water quality for at least one model time step (approximately an hour) at a probability greater than 10% across the 120 individual realisations over the following spatial extents (GHD, 2020):

+ For a surface release scenario at the moderate (impact) thresholds:
  - Dissolved oil (50 ppb): approximately 100 km to the south-west, approximately 80 km to the east, approximately 40 km to the north and approximately 40 km to the south from the release point.
  - Total submerged oil (100 ppb): approximately 150 km to the south-west, approximately 100 km to the east, approximately 70 km to the north and approximately 50 km to the south from the release point.
  - Surface oil (10 g/m^2): approximately 80 km to the south-west, approximately 40 km to the east, approximately 30 km to the north and approximately 30 km to the south from the release point.
+ For a seabed release scenario at the moderate (impact) thresholds:

- Dissolved oil (50 ppb): approximately 90 km to the south-west, approximately 70 km to the east, approximately 40 km to the north and approximately 40 km to the south from the release point.
- Total submerged oil (100 ppb): approximately 120 km to the south-west, approximately 90 km to the east, approximately 50 km to the north and approximately 40 km to the south from the release point.
- Surface oil (10 g/m^2): within approximately 10 km from the release point.

There is a 100% probability that condensate will contact shorelines with most shoreline loading on the Montebello Islands. The worst-case shoreline accumulations predicted at the Montebello Islands at the moderate (impact) threshold of 100 g/m^2 are 2,164 tonnes (of a total of 2,707 tonnes) and 1,037 tonnes (of a total of 1,187 tonnes) for the surface and seabed releases, respectively.

The potential impact pathways (physical and chemical) of hydrocarbon exposure to relevant habitat and marine fauna receptors are summarised in **Table 7-10**.

7.2.2.1 Hydrocarbon Weathering Behaviour

Grader C was the modelling analogue identified for the Yoorn-1 LOWC modelling.

A preliminary analysis of hydrocarbon weathering was undertaken with the SINTEF Oil Weathering Model (OWM). OWM predicts the mass balance partitioning of hydrocarbons (i.e. evaporation, surface, dispersed subsurface) under steady-state met-ocean conditions. OWM simulations were run for sustained wind speeds of 1 m/s (low winds), 5 m/s (moderate winds) and 10 m/s (high winds). The simulations are based on a test case of 100 m^3 of hydrocarbon released instantaneously onto the sea surface.

The results of the weathering analyses for the modelling analogue Grader C are presented in **Figure** 7-4.

Evaporation is the primary weathering mechanism for highly volatile condensates such as Grader C. Under low wind speeds of 1 m/s, approximately 90% of the surface slick is predicted to evaporate after 3 days (72 hours). Under moderate wind speeds of 5 m/s, approximately 82% of the surface slick is predicted to evaporate after 24 hours with the remaining approximately 18% dispersed in the water column and no surface slick under these conditions. High wind speeds of 10 m/s are predicted to rapidly (after only 6 hours) disperse (30%) and evaporate (70%) with no surface slick.

Grader C has a tendency for low levels of emulsification with up to 10% water content in the surface slick over the range of wind conditions.

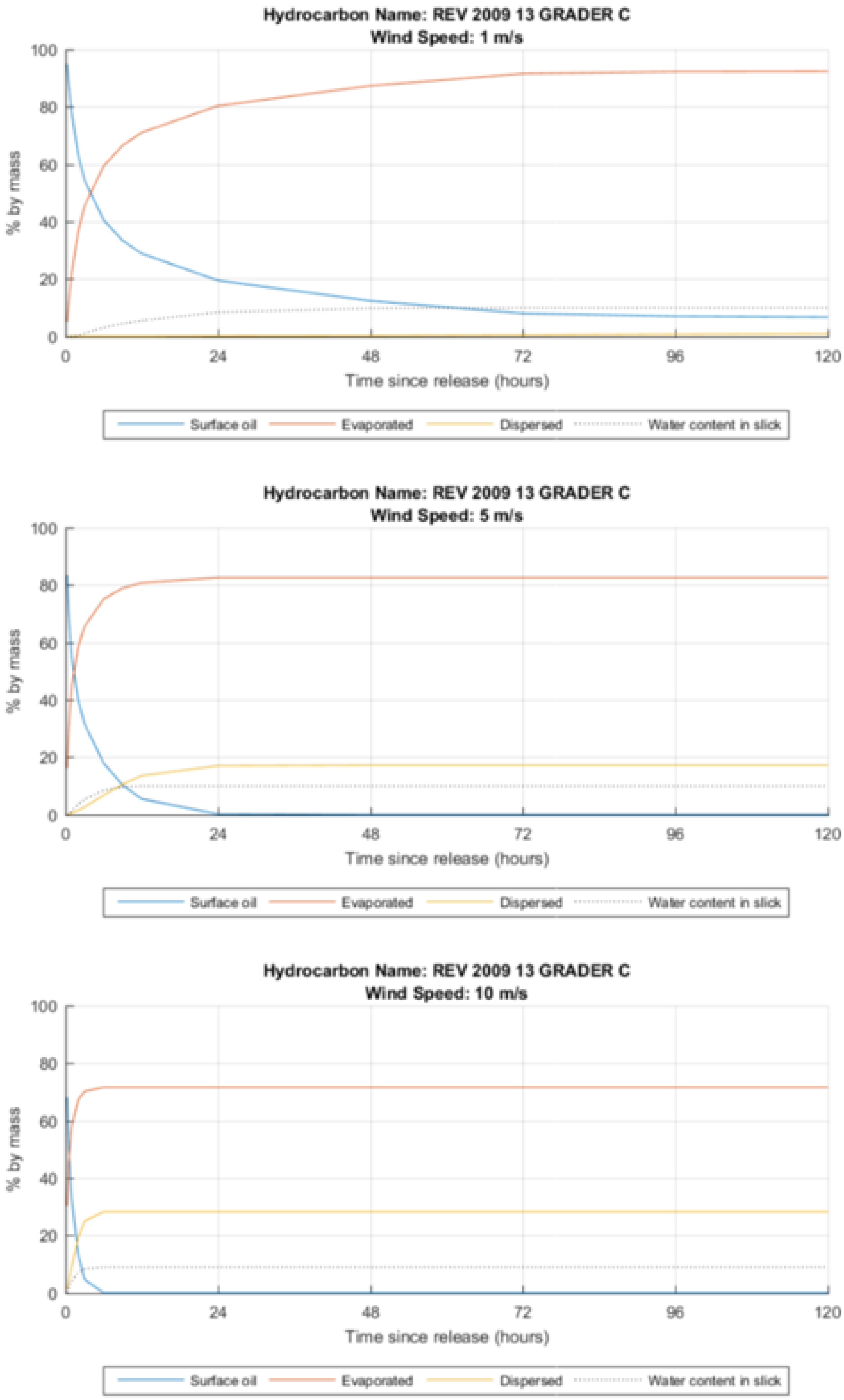

Figure 7-4: Simulated weathering of the SINTEF REV 2009 13 GRADER C hydrocarbon for constant wind speeds of 1 m/s (top), 5 m/s (middle and 10 m/s (bottom)

7.2.2.2 Spill Modelling Results

In general, for both models, the predicted environmental impacts (moderate thresholds) from surface oiling and shoreline loading were higher for the surface than seabed release scenario. Even though greater evaporative losses occurred for the surface release scenario (approximately 85% of the total release volume compared to approximately 70% for the seabed release), the proximity of shorelines when combined with appropriate metocean conditions provided conditions that transported the surface slick to proximal shorelines, which yield maximum accumulated shoreline loading approximately twice as high (approximately 2,700 tonnes versus 1,200 tonnes). Metocean conditions also led to a larger spatial extent of surface oiling above the moderate (impact) threshold for the surface versus seabed release scenario.

In contrast, the seabed release scenario defined the outer boundaries of the MEVA and EMBA. The higher proportion of total submerged oil (dissolved plus entrained hydrocarbons, though at the outer edges of both these zones submerged hydrocarbon are comprised primarily of entrained oil) at the release site resulted in lower evaporative losses (as noted previously approximately 70% for seabed release versus approximately 85% for surface release) and thereby hydrocarbons (primarily as entrained) were transported greater distances above the respective thresholds.

To determine the spatial extent of impacts from a LOWC of condensate and the dispersion characteristics over time, modelling was completed by GHD for Yoorn-1 (GHD, 2020) (as described in **Section 7.2.1**).

The modelling results are summarised in

Table 7-12 for the fate of hydrocarbon (surface, total submerged, dissolved and shoreline accumulated) at the exposure values described in **Table 7-6** to **Table 7-8** has been provided for the purposes of risk evaluation, displaying the following parameters:

+ Minimum time to contact from moderate and high exposure value
+ Maximum hydrocarbon concentration from high exposure value
+ Maximum oil loading on shoreline from moderate and high exposure value
+ Length of shoreline oiled.

The spill modelling results are provided in **Appendix E** – Spill Modelling Results.

Further parameters required to inform spill response strategies are described further in the Yoorn-1 Exploration Drilling OPEP (SO-91-BI-20003.02).

Table 7-12: Summary of LOWC Modelling Results for Yoorn-1

Exposure	Yoorn-1 Modelling
Surface Oil	
Surface release	Surface oil at concentrations above 10 g/m^2 are predicted to extend up to approximately 120 km away from the Yoorn-1 well location. The surface LOWC scenario has a larger predicted spatial footprint for surface oil than the subsea LOWC scenario due to the high degree of oil entrainment of the latter (see next bullet point).

Exposure	Yoorn-1 Modelling
	High contact probabilities were predicted for the Montebello Islands (94%), Barrow-Montebello Surrounds (97%) and Montebello AMP (100%), with maximum time-averaged surface oil concentrations of 40, 38 and 55 g/m^2, respectively, and minimum arrival times of 0.1-0.6 days. Low contact probabilities were predicted for Lowendal Islands (10%) and Barrow Island (3%), with maximum time-averaged oil concentrations of 13 g/m^2 (both receptors) and minimum arrival times of 2.1 days (Lowendal Islands) and 5.2 days (Barrow Island).
Subsea release	Surface oil at concentrations above 10 g/m^2 are predicted to occur within approximately 10 km from the Yoorn-1 well location. The high energy sub-sea release results in the formation of small entrained oil droplets with low buoyancy and thereby limits the extent of surface oiling for this scenario. The Montebello AMP is the only receptor predicted to be contacted at the moderate exposure threshold, with low contact probability (2%), a maximum time-average surface oil concentration of 11 g/m^2 and a minimum arrival time of 1.3 days.
Dissolved Oil	
Surface release	Dissolved oil above the 50 ppb (impact) threshold is predicted to extend up to approximately 160 km to the southwest and approximately 120 km to the northeast of the Yoorn-1 well location. A 100% contact probability was predicted at the Montebello Islands, Barrow-Montebello Surrounds and the Montebello AMP, with maximum time-averaged concentrations of 454, 968 and 972 ppb, respectively, and short minimum arrival times of 0.1-0.3 days. A low-moderate contact probability was predicted for Lowendal Islands (27%), with a maximum time-averaged concentration of 157 ppb and minimum arrival time of 2.0 days. Low contact probabilities (less than 11%) were predicted for Barrow Island and Offshore Ningaloo, with maximum time-averaged concentrations of 229 and 309 ppb, respectively, and minimum arrival times of 14.6 and 4.8 days, respectively.
Subsea release	Dissolved oil above the 50 ppb (impact) threshold is predicted to extend up to approximately 160 km to the southwest and approximately 110 km to the northeast from the Yoorn-1 well location. A 100% contact probability at the moderate exposure threshold (50 ppb) was predicted at the receptors of Montebello Islands, Barrow-Montebello Surrounds and the Montebello AMP, with maximum time-averaged concentrations of 817, 944 and 1,734 ppb, respectively, and short minimum arrival times of 0.1-0.5 days. A low-moderate contact probability was predicted for Lowendal Islands (28%), with a maximum time-averaged concentration of 95 ppb and minimum arrival time of 3.6 days. Low contact probabilities (less than 6%) were predicted for Barrow Island and Offshore Ningaloo, with maximum time-averaged concentrations of 99 and 627 ppb, respectively, and minimum arrival times of 3.6 and 4.9 days, respectively.
Total Submerged Oil	
Surface release	The exposure zone for the moderate (impact) threshold (100 ppb) was primarily within 300 km of the well location with some isolated exceedances (i.e. single, scattered model cells) extending a maximum of approximately 450 km from the well. High contact probabilities were predicted for the Montebello Islands (99%), Barrow-Montebello Surrounds (100%) and the Montebello AMP (100%) at the moderate exposure threshold, with maximum time-averaged total submerged oil concentrations of 618, 493 and 723 ppb, respectively, and minimum arrival times of 0.1-0.3 days.

Exposure	Yoorn-1 Modelling
	Moderate contact probabilities of 51-66% were predicted for Lowendal Islands, Barrow Island and Offshore Ningaloo, with maximum time-averaged concentrations of 267-276 ppb for the islands and 441 ppb for Offshore Ningaloo and minimum arrival times of 2.0-3.4 days. Maximum time-averaged total submerged oil concentrations at these receptors ranged between 104 and 263 ppb, with minimum arrival times of 8-39 days.
Subsea release	The exposure zone for the moderate (impact) threshold (100 ppb) was primarily within 350 km of the release location with some isolated exceedances (i.e. single, scattered model cells) extending a maximum of approximately 1,000 km from the well. High contact probabilities of 100% were predicted for the Montebello Islands, Barrow-Montebello Surrounds and the Montebello AMP at the moderate exposure threshold. Maximum time-averaged total submerged oil concentrations of 723-1,765 ppb were predicted for these receptors, with minimum arrive times of 0.1-0.5 days. Low-moderate contact probabilities of 26-53% were predicted for Barrow Island, Lowendal Islands and Offshore Ningaloo, with maximum time-averaged concentrations of 191-214 ppb for the islands and 640 ppb for Offshore Ningaloo and minimum arrival times of 3.3-4.9 days. Maximum time-averaged total submerged oil concentrations at these receptors ranged between 99 and 128 ppb, with minimum arrival times of 17-70 days.
Shoreline Accumulation	
Surface release	At the moderate (impact) threshold of 100 g/m^2, high contact probabilities were predicted for the proximal locations of Montebello Islands (100%) and Barrow Island (95%) with moderate-high contact probabilities predicted for the Lowendal Islands (69%), Southern Islands Coast (58%), Muiron Islands (60%) and Ningaloo Coast North (63%). The maximum accumulated shoreline load across all shorelines at the moderate exposure threshold is 2,707 tonnes, the majority of which occurred at Montebello Islands (2,164 tonnes) during this realisation. Moderate maximum accumulated loadings were predicted at the proximal islands of Lowendal Islands (226 tonnes) and Barrow Island (480 tonnes), with further reduced loadings at Southern Islands Coast (53 tonnes), Muiron Islands (87 tonnes) and Ningaloo Coast North (69 tonnes). Maximum accumulated shoreline loads at the other contacted receptors were less than 9 tonnes for the moderate threshold. Short minimum arrival times of 0.3-3.1 days were predicted for the proximal island groups including Montebello, Lowendal and Barrow Islands at the moderate exposure threshold. Moderate minimum arrival times of 5.9-7.4 days were predicted for Thevenard Islands, Southern Islands Coast, Muiron Islands and Ningaloo Coast North, with 9 days at Dampier Archipelago and longer arrival times of more than 41 days at all other contacted receptors. The accumulated load at the Montebello Islands for the surface LOWC scenario made up the vast majority of all oil ashore. Strong seasonality in the shoreline loading predictions is evident, with higher shoreline loads predicted to occur for simulations starting between April and August, coinciding with periods of westerly currents and south-easterly winds which transport the oil slick towards the Montebello Islands.
Subsea release	At the moderate (impact) threshold, high contact probabilities (more than 70%) were predicted for the proximal locations of Montebello Islands (100%), Lowendal Islands (73%) and Barrow

Exposure	Yoorn-1 Modelling
	Island (89%) with moderate contact probabilities predicted for the Southern Islands Coast (43%), Muiron Islands (49%) and Ningaloo Coast North (48%) The maximum accumulated shoreline load across all shorelines at the moderate exposure threshold was 1,187 tonnes, the majority of which occurred at Montebello Islands (1,037 tonnes) during this realisation. Significantly lower maximum accumulated loadings were predicted at Lowendal Islands (38 tonnes), Barrow Island (87 tonnes), Southern Islands Coast (19 tonnes), Muiron Islands (39 tonnes) and Ningaloo Coast North (23 tonnes), with less than 7 tonnes predicted at all other contacted receptors. Short minimum arrival times of less than 3 days were predicted for the proximal island groups including Montebello, Lowendal and Barrow Islands at the moderate exposure threshold. Moderate minimum arrival times of 7-9 days were predicted for Thevenard Islands, Southern Islands Coast, Muiron Islands and Ningaloo Coast North, with longer arrival times of more than 21 days at all other contacted receptors. For each realisation, the accumulated load at the Montebello Islands made up the vast majority of all oil ashore. Strong seasonality in the shoreline loading predictions is evident, with higher shoreline loads predicted to occur for simulations starting between April and August, coinciding with periods of westerly currents and south-easterly winds which transport the oil slick towards the Montebello Islands.

7.2.3 Environmental Performance Outcomes and Control Measures

The EPOs relating to this hazard include:

+ No loss of containment of hydrocarbon to the marine environment [YO-EPO-03]
+ No unplanned objects, emissions or discharges to sea or air [YO-EPO-04]
+ No injury or mortality to EPBC Act 1999 and WA Biodiversity Conservation Act 2016 listed marine fauna during operational activities [YO-EPO-05].

The extensive planning, risk assessment of the activity and the engineering and operational control measures in place are considered to result in a low risk of a hydrocarbon release due to LOWC occurring. The control measures considered for this activity are shown below with EPS' and measurement criteria for the EPOs described in **Section 8.4**.

Operational controls that would be implemented to guide and effective response after a spill has occurred are provided within relevant sections of the OPEP, together with corresponding EPS' and measurement criteria.

Table 7-13: Control Measure Evaluation for LOWC Hydrocarbon Spill

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
YO-CM-017	Drilling and Completions Management Process	Includes control measures for well integrity and well control, and MODU Safety Case that reduce the risk of unplanned discharges to the marine environment. The WOMP and Safety Case also include cyclone response plans (including monitoring for cyclones) and procedures for well suspension in the event of a cyclone	Costs associated with personnel time in writing, reviewing and implementing the WOMP and Safety Case.	**Adopted** – Benefits considered to outweigh costs. Regulatory requirement must be adopted.
YO-CM-012	MODU and support vessel spill response plans including pre-drilling source control plan	Implements response plan to deal with an unplanned hydrocarbon spills quickly and efficiently in order to reduce impacts to the marine environment.	Administrative costs of preparing documents and large costs of preparing for and implementing response strategies.	**Adopted** – Environmental benefits of ensuring response plans in place, are followed and measures implemented, and that the MODU/support vessels are compliant outweighs the costs of personnel time associated with preparation and implementation of spill response plans.
YO-CM-016	Accepted Oil Pollution Emergency Plan (OPEP)	Implements response plans to deal with an unplanned hydrocarbon release quickly and efficiently to reduce impacts to	Administrative costs of preparing documents and large costs of preparing for and implementing response strategies.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented and that the vessels are compliant outweighs

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		the marine environment.		the costs. Regulatory requirement must be adopted.
YO-CM-035	Marine Assurance Standard	Ensures vessels meet Marine assurance standards to reduce the likelihood of unplanned events as vessels and MODU fit for purpose.	Costs associated with personnel time in checking vessel.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented and that the vessels are compliant outweigh the costs.
YO-CM-038	Petroleum Safety Zone (safety) established	Reduces potential for collision or interference with other marine user activities	Negligible costs, standard industry practice	**Adopted –** Benefits considered to outweigh negligible costs to Santos
YO-CM-040	MODU Planned Maintenance System (PMS)	Requires that equipment is maintained and certified, reducing probability of loss of well control as all equipment functioning as supposed to.	Additional personnel costs of ensuring equipment is maintained and certified as appropriate and that procedures are in place and followed.	**Adopted** – Benefits of ensuring procedures are followed and equipment is compliant outweigh the minimal costs of personnel time.
YO-CM-046	Pre-campaign commencement assurance check	Ensures consideration of worst case hydrocarbon spill scenario for the proposed activity based on actual vessel, MODU and activity details. Ensures relief well MODU availability is confirmed to be able to meet the timeframes defined in Table 9-4 of the OPEP prior to spud.	Administrative costs to undertake assurance check and risk assessments for each campaign. Potential delay to drilling schedule in the event that a suitable MODU for relief well drilling is not available within required timeframes.	**Adopted** – Benefits considered to outweigh costs.

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Additional Control Measures				
N/A	Wild Well Control on standby in Perth during drilling operations in order to respond immediately to a LOWC	No environmental benefit as WWC personnel are available to provide support within 72 hours which will coincide with starting to commence sourcing of relief well MODU	Significant additional costs in having WWC personnel on standby in Perth. Locating personnel with specialised expertise in Perth may also create issues for other operators, as WWC offer this service to multiple operators. Locating them in remote locations may increase travel times to other global locations if they are required	**Rejected** – No environmental benefit in having access to personnel surplus to requirements
N/A	Contract source control personnel through an alternative provider in addition to existing arrangements	No environmental benefit if additional services are surplus to requirements	Significant additional cost in maintaining two contracts for the same service	**Rejected –** No environmental benefit in having access to personnel surplus to requirements
N/A	A dedicated second MODU on standby for the purpose of relief well drilling	Could reduce the length of time taken to drill a relief well and may reduce the timeframe for stopping a blowout by up to two weeks; although planning/approval/set-up requirements mean the reduction would likely be less.	For the dedicated second MODU to be ready for relief well drilling, it would need to be contracted, crewed and hold a valid NOPSEMA Safety Case. This could cost between $150-250KUSD per day for a minimum negotiated contract term, plus a cost associated for MODU	**Rejected** – Considered grossly disproportionate to the environmental benefit (reduction of 2 weeks of release), considering the rare likelihood of a LOWC, the existing preventative control measures in place to prevent a well blowout and the additional safety and environmental risks of having another

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
			mobilisation and demobilisation. After reviewing availability, it is anticipated a MODU would need to be brought in from overseas to guarantee availability of this rig. It is conceivable that to cover a 50 day well activity (for example) with a relief MODU on standby cost over the same duration would be in the order 15-20MMUSD, depending on where the MODU were mobilised from/to and the market at the time.	MODU and support equipment/personnel on standby. Santos don't have a MODU on standby because they ensure they know what operators are in the region of their operations and what equipment is available if they require it in an emergency. In addition, there are adequate MODUs covered under the MOU to execute a relief well, this option was rejected as the cost is grossly disproportionate to the potential reduction in environmental impact.
N/A	Having a dedicated relief well MODU on contract.	Provides for rapid mobilisation of relief well rig to location, reducing duration of spill by approximately 20-30 days.	Significant commercial effort required to align two MODUs that are not contracted. Possible that market may not be able to supply this demand.	**Rejected –** In order to perform this, the MODU will need to be contracted, crewed and hold a valid NOPSEMA Safety Case. This could cost between 150-250k USD per day for a minimum negotiated contract term, plus a cost associated for MODU mob and de-mob. It is anticipated a MODU would need to be brought in from overseas to

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
				guarantee availability of this rig in the event a relief well was required when the event occurred. It is conceivable that to cover a 50 day well activity (for example) with a relief MODU on standby cost over the same duration would be in the order of 15-20MMUSD, depending on where the MODU were mobilised from/to and the market at the time. For Yoorn-1, this would require a standby rig for a total of 100 days including contingency. Given there are adequate MODUs covered under the MOU to execute a relief well, this option was rejected as the reduction in risk is grossly disproportionate to the cost and effort required to perform it.
N/A	Use of two drilling rigs during activity drilling campaign that drill simultaneously so that one rig could act as a relief well	Could reduce the length of time taken to drill a relief well and may reduce the timeframe for stopping a blowout by 20-30 days, although planning/approval/set-up requirements mean the reduction would likely be less.	Additional costs associated with second MODU mobilisation and demobilisation of approximately $5MMUSD plus a premium of $50K/day to align the contract windows.	**Rejected** – Considered grossly disproportionate to the environmental benefit (reduction of 20-30 days of release), considering the rare likelihood of a LOWC, the existing preventative control measures in place to

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
	drilling rig for the other.	Reduction in spill duration results in less hydrocarbon exposure and reduced shoreline loading volumes.	Potential cumulative environmental impacts from drilling two wells at the same time and having multiple support vessels in the area, instead of 1 MODU and 4 vessels, there could be 2 MODUs and up to 8 vessels resulting in double the air and water emissions.	prevent a well blowout. Possible inability of the market to supply two MODUs at the same time over a two-month window. In addition, there are adequate MODUs covered under the MOU to execute a relief well, this option was rejected as the cost is grossly disproportionate to the potential reduction in environmental impact.
N/A	Time the drilling campaign to align with the other Santos drilling activities so that nearby MODU could be used for the relief well drilling.	Could reduce the length of time taken to drill a relief well and may reduce the timeframe for stopping a blowout by 20-30 days, although planning/approval/set-up requirements mean the reduction would likely be less. Reduction in spill duration by 20-30 days, results in less hydrocarbon exposure and reduced shoreline loading volumes	Delays in drilling campaign schedule to align with other activities in the area	**Rejected** – No other Santos concurrent drilling activities planned in the region until mid-2024. Drillign would have to be deferred, which would mean the exploration objectives are not achieved (i.e. to identify backfill for Devil Creek and Varanus Island facilities).
N/A	Pre-drill riserless intervals for a potential relief well, prior to drilling the main well	Reduce the time taken for the relief well to be drilled by approximately 10 days, therefore stopping the LOWC event sooner and resulting in less hydrocarbon exposure and reduced	It is not practicable with a jack-up and surface well head to pre-drill any riserless intervals for a potential relief well before drilling the main well. The activity itself would require approximately 10 days and a complete rig move to perform	**Rejected** – Detailed relief well designs will be re-evaluated and revised for an actual LOWC event. There will be several locations for the relief well identified before an incident, with the optimal location selected after a LOWC incident, based on

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		shoreline loading volumes	at a cost of approximately $6-7MM USD. Once the main well was completed, the partially completed relief well would need to be abandoned. At a further cost of approximately $6-7MM USD. A different wellhead/conductor system would need to be procured to facilitate this at estimate cost of $0.75MM USD. Additional environmental impacts from drilling wells from drill cuttings and discharges.	real-time information (i.e. prevailing weather). A pre-drilled relief well top-section might result in having to use a sub-optimal design and location. It is not industry practice, and such a pre-drilled riseless interval may adversely affect functionality and reliability of this response strategy. The additional cost associated with drilling the riserless intervals would be ~$15MM USD per well which is considered grossly disproportionate to the reduction in the duration that could potentially be achieved of a LOWC event. This option would require an additional drilling location for the well, which would require an additional two rig movements per well; and double seabed disturbance footprint, additional discharge volumes, and drilling for a longer duration.
N/A	Mange the timing to avoid drilling during cyclone season	Reduce the potential for impact to the MODU which could result in a LOWC. Potentially reduce the consequence of impact in the event of	During cyclone season the weather can provide some of the best weather windows for drilling with calm sea state. Drilling within cyclone season does not	**Rejected –** Given that drilling year-round on the NWS is well managed and understood, and there are cyclone management

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		a loss of well control due to cyclonic conditions potentially spreading an oil spill further or hindering oil spill response activities	increase the likelihood of a loss of well control as metocean conditions are monitored, and procedures are in place (as per the NOPSEMA accepted WOMP and Safety Case) to ensure that cyclone response plans are in place (including monitoring of cyclones) and barriers for cyclone suspension are implemented as required. Cyclones are a known risk on the NWS and drilling within cyclone season is well managed under current industry standards. Adjusting the timing to avoid cyclone season would preclude drilling for 6 months of the year, significantly reducing MODU availability and increasing costs.	procedures in place to manage well integrity in the event a cyclone may be encountered, the control is considered grossly disproportionate to the cost and risk of a LOWC event.

7.2.3.1 Well Control

Santos ensures control of its wells through a number of control measures incorporated into the well design, drilling procedures, mud selection, personnel training and equipment maintenance and testing. Well control requirements are detailed within the NOPSEMA accepted Well Operations Management Plan (WOMP) and Safety Case and are not restated in this EP pursuant to Regulation 31 of the OPGGS(E)R.

7.2.4 Environmental Impact Assessment

The below environmental impact assessment follows the risk assessment approach detailed in **Section 7.1.6**.

7.2.4.1 Identification of Hotspots for Consequence Analysis

Table 7-14 and Error! Reference source not found. filter the HEVs to identify the hotspots where they meet the criteria described in **Section 7.1.6** for Yoorn-1.

The values and sensitivities associated with these HEVs have been described in **Appendix C**.

Table 7-14: Identified High Environmental Value and Hotspot Receptors for Surface Release Scenario of LOWC – Yoorn-1

Receptor	HEV Value	Exposure Threshold			Hot Spot[1]
		Low	Moderate	High	
Scott Reef South	3	✓			
Mermaid Reef AMP	2	✓			
Clerke Reef MP	3	✓	✓		
Imperieuse Reef MP	3	✓	✓		
Dampier Archipelago	3	✓	✓		✓
Montebello Islands	3	✓	✓	✓	✓
Montebello AMP	4	✓	✓		
Lowendal Islands	3	✓	✓	✓	✓
Barrow Island	3	✓	✓	✓	✓
Barrow-Montebello Surrounds	3	✓	✓	✓	✓
Thevenard Island	5	✓	✓		
Muiron Islands	2	✓	✓	✓	✓
Exmouth Gulf Coast	2	✓			
Ningaloo Coast North	2	✓	✓	✓	✓
Ningaloo Coast South	3	✓	✓		
Carnarvon - Inner Shark Bay	2	✓			
Outer Shark Bay Coast	3	✓	✓		
Zuytdorp Cliffs - Kalbarri	3	✓			
Kalbarri - Geraldton	3	✓			
Outer Abrolhos Islands - Shoals	3	✓			
Abrolhos Islands Wallabi Group	2	✓			

Receptor	HEV Value	Exposure Threshold			Hot Spot[1]
		Low	Moderate	High	
Abrolhos Islands Pelsaert Group	2	✓			
Perth Coast South	3				
Perth Canyon AMP	2	✓			
Jurien Bay - Yanchep	3	✓			
Two Rocks AMP	2	✓			
Outer Ningaloo Coast North[2]	1	✓			
Jurien AMP	2	✓			
Deep Geographe – Augusta	3				
Offshore Geographe – Augusta[2]	3				
Abrolhos West	2	✓			
Outer NW Ningaloo[2]	3	✓			
Southern Islands Coast	5	✓	✓	✓	✓

[1] > 5% probability of contact at the medium/high exposure value for consideration for further Hot Spot assessment.

[2] No contact at moderate exposure threshold because total submerged oil does not have a moderate exposure value.

Table 7-15: Identified High Environmental Value and Hotspot Receptors for Subsea Release Scenario of LOWC – Yoorn-1

Receptor	HEV Value	Exposure Threshold			Hot Spot[1]
		Low	Moderate	High	
Scott Reef South	3	✓			
Mermaid Reef AMP	2				
Clerke Reef MP	3	✓			
Imperieuse Reef MP	3	✓	✓		
Dampier Archipelago	3	✓	✓		✓
Montebello Islands	3	✓	✓	✓	✓
Montebello AMP	4	✓	✓		
Lowendal Islands	3	✓	✓	✓	✓
Barrow Island	3	✓	✓	✓	✓
Barrow-Montebello Surrounds	3	✓	✓		

Receptor	HEV Value	Exposure Threshold			Hot Spot[1]
		Low	Moderate	High	
Muiron Islands	2	✓	✓	✓	✓
Thevenard Island	5	✓			
Exmouth Gulf Coast	2	✓			
Ningaloo Coast North	2	✓	✓	✓	✓
Ningaloo Coast South	3	✓	✓		
Carnarvon - Inner Shark Bay	2				
Outer Shark Bay Coast	3	✓	✓		
Zuytdorp Cliffs - Kalbarri	3	✓			
Kalbarri - Geraldton	3				
Outer Abrolhos Islands - Shoals[2]	3	✓			
Abrolhos Islands Wallabi Group	2				
Abrolhos Islands Pelsaert Group	2	✓			
Perth Coast South	3	✓			
Perth Canyon AMP	2	✓			
Jurien Bay - Yanchep	3	✓			
Two Rocks AMP	2				
Outer Ningaloo Coast North[2]	1	✓			
Jurien AMP	2	✓			
Deep Geographe – Augusta	3	✓			
Offshore Geographe – Augusta [2]	3	✓			
Abrolhos West	2	✓			
Outer NW Ningaloo[2]	3	✓		✓	
Southern Islands Coast	5	✓	✓	✓	✓

[1] > 5% probability of contact at the medium/high exposure value for consideration for further Hot Spot assessment.

[2] No contact at moderate exposure threshold because total submerged oil does not have a moderate exposure value.

This process identified the following Hotspots:

- Dampier Archipelago
- Montebello Islands
- Lowendal Islands
- Barrow Island
- Barrow-Montebello Surrounds

- Murion Islands
- Ningaloo Coast North
- Southern Islands Coast.

Table 7-16 provides a simplified summary of the consequence assessment results for each of the Hotspot areas. The consequence assessment was based on predicted contact and concentration of surface oil, accumulated oil, entrained hydrocarbon and dissolved hydrocarbons. For each Hotspot area the consequence to the key values were assessed using the methodology described in **Section 7.1.6**.

Table 7-16: Hotspot Consequence Assessment Results from a LOWC

Receptor Name	HEV Ranking	Values	Oil Spill Modelling Parameter		Yoorn-1		Consequence Category	Worst-case Consequence Ranking	Total
					Surface Release*	Subsea Release*			
Outer Ningaloo Coast North (submerged)	1	Habitats + The Ningaloo Reef itself and its juxtaposition with coastal terraces, limestone plains, reef sediments. The contact of the reef by entrained oil may reduce the aesthetic appeal and diminish these values. Marine fauna + Seasonal aggregations of whale sharks, manta rays, sea turtles and rays. + Whale sharks March-July + Logger head turtles + Green Turtles Dec-March + Low density Hawksbill turtles + Pygmy Blue Whale feeding + Socio-economic and heritage values + Very significant for recreational fishing, game fishing and charter boat tourism Protected Areas World Heritage Areas Australian Marine Park	Probability of contact by floating oil at 10 g/m²	(%)	NC	NC	+ Threatened or migratory fauna; + physical habitat; + protected areas; + socio-economic receptors	II II II II	II - Minor
			Maximum floating oil concentration >10 g/m²	(g/m²)	NC	NC			
			Maximum exposure time of floating oil at 10 g/m²	Time (d)	NC	NC			
			Maximum accumulated oil on shorelines >100 g/m²	(tonnes)	NC	NC			
			Maximum accumulated concentration >100 g/m²	(g/m²)	NC	NC			
			Maximum length of shoreline oiled (>100 g/m²)	(km)	NC	NC			
			Maximum concentration of total submerged oil >100 ppb	(ppb)	147	163			
			Maximum exposure time of total submerged oil >100 ppb	Time (d)	0.2	0.1			
			Maximum concentration of dissolved hydrocarbon >50 ppb	(ppb)	NC	NC			
			Maximum exposure time of dissolved hydrocarbon >50 ppb	Time (d)	NC	NC			
Muiron Islands	2	Turtles + Major loggerhead nesting + North and south Muiron Islands – significant green turtle nesting + Hawksbill nesting (low density) + Occasional flatback turtles Seabirds + Significant bird breeding. Whales + Humpback whale migration Protected Areas	Probability of contact by floating oil at 10 g/m²	(%)	NC	NC	+ Threatened or migratory fauna; + physical habitat; + protected areas; + socio-economic receptors	IV IV IV III	IV - Major
			Maximum floating oil concentration >10 g/m²	(g/m²)	NC	NC			
			Maximum exposure time of floating oil at 10 g/m²	Time (d)	NC	NC			
			Maximum accumulated oil on shorelines >100 g/m²	(tonnes)	87	39			
			Maximum accumulated concentration >100 g/m²	(g/m²)	6,543	2,885			
			Maximum length of shoreline oiled (>100 g/m²)	(km)	13	13			
			Maximum concentration of total submerged oil >100 ppb	(ppb)	134	128			

Receptor Name	HEV Ranking	Values	Oil Spill Modelling Parameter		Yoorn-1		Consequence Category	Worst-case Consequence Ranking	Total
					Surface Release*	Subsea Release*			
		+ The Ningaloo Coast WHA includes Muiron Island Marine Management Area (including the Muiron Islands) Socio-Economic + Exmouth gulf prawn fishery (Muiron is western boundary) + Significant for recreational fishing and charter boat tourism. Social amenities and other tourism.	Maximum exposure time of total submerged oil >100 ppb	Time (d)	0.2	0.1			
			Maximum concentration of dissolved hydrocarbon >50 ppb	(ppb)	NC	NC			
			Maximum exposure time of dissolved hydrocarbon >50 ppb	Time (d)	NC	NC			
Ningaloo Coast North	2	Habitats + Contains part of the largest fringing reef in Australia + Lagoonal, intertidal and subtidal coral communities + 9 species of seagrass + macroalgae beds + Mangrove bay – Significant for mangroves + Yardie Creek – Significant mangroves and tidal creek Marine mammals + Seasonal aggregations of whale sharks, manta rays, sea turtles and rays. + Whale sharks March-July + Loggerhead turtles + Green Turtles Dec-March + Low density Hawksbill turtles + Pygmy Blue whale feeding Seabirds + 33 species of seabirds and avifauna. Main breeding areas at Mangrove Bay, Mangrove Point, Point Maud, the Mildura Wreck Site and Fraser Island Protected Areas + Includes 13 out of the 18 sanctuary zones under the state MP. + World Heritage Areas + Exmouth Peninsula Karst System is an official value of the National Heritage Area. Socio-economic and heritage values	Probability of contact by floating oil at 10 g/m²	(%)	NC	NC	+ Threatened or migratory fauna; + physical habitat; + protected areas; + socio-economic receptors	IV	IV - Major
			Maximum floating oil concentration >10 g/m²	(g/m²)	NC	NC		IV	
			Maximum exposure time of floating oil at 10 g/m²	Time (d)	NC	NC		IV	
			Maximum accumulated oil on shorelines >100 g/m²	(tonnes)	69	23		III	
			Maximum accumulated concentration >100 g/m²	(g/m²)	1,974	638			
			Maximum length of shoreline oiled (>100 g/m²)	(km)	81	51			
			Maximum concentration of total submerged oil >100 ppb	(ppb)	176	125			
			Maximum exposure time of total submerged oil >100 ppb	Time (d)	0.7	0.1			
			Maximum concentration of dissolved hydrocarbon >50 ppb	(ppb)	NC	NC			
			Maximum exposure time of dissolved hydrocarbon >50 ppb	Time (d)	NC	NC			

Receptor Name	HEV Ranking	Values	Oil Spill Modelling Parameter		Yoorn-1 Surface Release*	Yoorn-1 Subsea Release*	Consequence Category	Worst-case Consequence Ranking	Total
		+ Tourism + Recreational Fishing + fishing and charter boat tourism							
Barrow Island	3	Habitats + Bandicoot Bay – conservation area Fisheries Act (benthic fauna/seabird protection), mudflats, rock platforms, mangroves, clay pans + Mangroves in Bandicoot Bay (considered globally unique) + Coral reefs (eastern side) – Biggada Reef (coral spawning: Mar & Oct) + Biggada Creek Turtles + Regionally and nationally significant green turtle (western side) and flatback turtle (eastern side) nesting beaches + Turtle Bay north beach + North and west coasts – John Wayne Beach also loggerhead and hawksbill turtles. + Peak turtle nesting periods – Loggerhead turtle nesting: Dec-Jan; green turtle nesting: Nov- to Apr, peak period from Jan-Feb; flatback turtle nesting: Dec-Jan; hawksbill turtle nesting: Oct-Jan Seabirds + Migratory birds (important habitat) (important bird area) 10th of top 147 bird sites. + Highest population of migratory birds in Barrow Island Nature Reserve (south-southeast island). + Double island important bird nesting (shearwaters, sea eagles). Marine mammals + Pygmy blue whale northern migration (Apr -Aug) + Cultural heritage	Probability of contact by floating oil at 10 g/m^2	(%)	2.5	NC	+ Threatened or migratory fauna + physical habitat + protected areas + socio-economic receptors	IV IV IV III	IV - Major
			Maximum floating oil concentration >10 g/m^2	(g/m^2)	13	NC			
			Maximum exposure time of floating oil at 10 g/m^2	Time (d)	0.3	NC			
			Maximum accumulated oil on shorelines >100 g/m^2	(tonnes)	497	87			
			Maximum accumulated concentration >100 g/m^2	(g/m^2)	22,374	5,133			
			Maximum length of shoreline oiled (>100 g/m^2)	(km)	59	42			
			Maximum concentration of total submerged oil >100 ppb	(ppb)	276	214			
			Maximum exposure time of total submerged oil >100 ppb	Time (d)	0.1	0.2			
			Maximum concentration of dissolved hydrocarbon >50 ppb	(ppb)	229	99			
			Maximum exposure time of dissolved hydrocarbon >50 ppb	Time (d)	0.3	0.3			

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Receptor Name	HEV Ranking	Values	Oil Spill Modelling Parameter		Yoorn-1		Consequence Category	Worst-case Consequence Ranking	Total
					Surface Release*	Subsea Release*			
		+ Important Aboriginal cultural: 13 listed sites incl. (pearling camps) Socio-economic + Significant for recreational fishing and charter boat tourism + Nominated place (national heritage)							
Barrow-Montebello Surrounds (Intertidal)	3	Habitats + Coral reefs habitat Seabirds + Migratory birds Marine mammals + Humpback/ pygmy blue whale migration Socio-economic + Significant for recreational fishing and charter boat tourism	Probability of contact by floating oil at 10 g/m²	(%)	97	NC	+ Threatened or migratory fauna + physical habitat + protected areas + socio-economic receptors	IV IV IV III	IV - Major
			Maximum floating oil concentration >10 g/m²	(g/m²)	38	NC			
			Maximum exposure time of floating oil at 10 g/m²	Time (d)	14.3	NC			
			Maximum accumulated oil on shorelines >100 g/m²	(tonnes)	NC	NC			
			Maximum accumulated concentration >100 g/m²	(g/m²)	NC	NC			
			Maximum length of shoreline oiled (>100 g/m²)	(km)	NC	NC			
			Maximum concentration of total submerged oil >100 ppb	(ppb)	493	957			
			Maximum exposure time of total submerged oil >100 ppb	Time (d)	2.4	37.1			
			Maximum concentration of dissolved hydrocarbon >50 ppb	(ppb)	968	944			
			Maximum exposure time of dissolved hydrocarbon >50 ppb	Time (d)	5.4	32.1			
Dampier Archipelago	3	Physical Habitats + Coral reefs + Seagrass + Macroalgae + Mangroves Marine Fauna + Invertebrates + Finfish and Rays	Probability of contact by floating oil at 10 g/m²	(%)	NC	NC	+ Threatened or migratory fauna + physical habitat + protected areas + socio-economic receptors	III III III II	III - Moderate

Receptor Name	HEV Ranking	Values	Oil Spill Modelling Parameter		Yoorn-1		Consequence Category	Worst-case Consequence Ranking	Total
					Surface Release*	Subsea Release*			
		+ high fish biodiversity approx. 650 species, dwarf sawfish EPBC protected Birds Marine reptiles + Flatbacks - nest on Legendre, Huay, Delambre + Green – significant rookery in NWS + Olive Ridley – known to forage + Loggerhead – nesting and foraging + Seasnakes Marine mammals + Eight species (dugong, whales, dolphins) + migratory pathway for protected humpback whale in July-Sept. Protected Area + Commonwealth Marine Reserve Socio-economic and heritage values + National Heritage Listed + Aboriginal rock art on shorelines, Burrup Peninsula	Maximum floating oil concentration >10 g/m^2	(g/m^2)	NC	NC			
			Maximum exposure time of floating oil at 10 g/m^2	Time (d)	NC	NC			
			Maximum accumulated oil on shorelines >100 g/m^2	(tonnes)	9	6			
			Maximum accumulated concentration >100 g/m^2	(g/m^2)	632	362			
			Maximum length of shoreline oiled (>100 g/m^2)	(km)	17	17			
			Maximum concentration of total submerged oil >100 ppb	(ppb)	NC	NC			
			Maximum exposure time of total submerged oil >100 ppb	Time (d)	NC	NC			
			Maximum concentration of dissolved hydrocarbon >50 ppb	(ppb)	NC	NC			
			Maximum exposure time of dissolved hydrocarbon >50 ppb	Time (d)	NC	NC			
Lowendal Islands	3	Habitats + Important shallow lagoons with seagrass for dugongs + Deep-water benthic (soft-sediment) habitats + Dugong Reef and Batman Reef (eastern side Island), + Mangroves are considered globally unique as they are offshore + Macroalgal reefs (40%) Marine reptiles + Important hawksbill (Beacon, Parakeelya, Kaia and Pipeline), loggerhead and green turtle nesting (minor) Varanus pipeline, Harriet and Andersons Beaches)	Probability of contact by floating oil at 10 g/m^2	(%)	10	NC	+ Threatened or migratory fauna + physical habitat + protected areas + socio-economic receptors	IV	IV - Major
			Maximum floating oil concentration >10 g/m^2	(g/m^2)	13	NC		IV	
			Maximum exposure time of floating oil at 10 g/m^2	Time (d)	0.4	NC		IV	
			Maximum accumulated oil on shorelines >100 g/m^2	(tonnes)	226	38		III	
			Maximum accumulated concentration >100 g/m^2	(g/m^2)	26,589	4,484			
			Maximum length of shoreline oiled (>100 g/m^2)	(km)	4	4			
			Maximum concentration of total submerged oil >100 ppb	(ppb)	267	191			
			Maximum exposure time of total submerged oil >100 ppb	Time (d)	0.6	0.8			

Receptor Name	HEV Ranking	Values	Oil Spill Modelling Parameter		Yoorn-1 Surface Release*	Yoorn-1 Subsea Release*	Consequence Category	Worst-case Consequence Ranking	Total
		+ Nesting is reported to occur throughout the year in WA, peaking between October and January + Significant flatback rookery, nesting season for flatback turtles peaks in December and January with subsequent peak hatchling emergence in February and March Seabirds + Approximately 89 species of avifauna, 12 to 14 species of migratory and threatened seabirds Marine mammals + Seagrass beds around the Lowendal Islands thought to provide valuable food source for dugongs Protected Areas + The Barrow Island Marine Management Area, most of the waters around Barrow Island, the Lowendal Islands and the Barrow Island Marine Park Socio-economic and heritage values + Social amenities and other tourism, very significant for recreational fishing and charter boat tourism	Maximum concentration of dissolved hydrocarbon >50 ppb	(ppb)	157	96			
			Maximum exposure time of dissolved hydrocarbon >50 ppb	Time (d)	0.3	0.4			
Montebello Islands	3	Habitats + Reefs – coral spawning: Mar & Oct + Algae (40%) + Mangroves (considered globally unique as they are offshore) + Fish habitat + Intertidal sand flat communities Marine reptiles + Loggerhead and green (significant rookery), hawksbill, flatback turtles – Loggerhead turtle nesting: Dec-Jan; green turtle nesting: Nov- to Apr, peak period from Jan-Feb; flatback turtle nesting: Dec-Jan; hawksbill turtle nesting: Oct-Jan	Probability of contact by floating oil at 10 g/m^2	(%)	94	NC	+ Threatened or migratory fauna + physical habitat + protected areas + socio-economic receptors	IV IV IV IV	IV - Major
			Maximum floating oil concentration >10 g/m^2	(g/m^2)	40	NC			
			Maximum exposure time of floating oil at 10 g/m^2	Time (d)	51.2	NC			
			Maximum accumulated oil on shorelines >100 g/m^2	(tonnes)	2,164	1,037			
			Maximum accumulated concentration >100 g/m^2	(g/m^2)	41,239	30,542			
			Maximum length of shoreline oiled (>100 g/m^2)	(km)	38	38			
			Maximum concentration of total submerged oil >100 ppb	(ppb)	618	723			

Receptor Name	HEV Ranking	Values	Oil Spill Modelling Parameter		Yoorn-1		Consequence Category	Worst-case Consequence Ranking	Total
					Surface Release*	Subsea Release*			
		+ Northwest and Eastern Trimouille Islands (hawksbill) + Western Reef and Southern Bay at Northwest Island (green) Seabirds + Migratory and threatened seabirds – 14 species + Significant nesting (Sept-Feb), foraging and resting areas Marine mammals + Humpback (Jun-Jul), Pygmy blue (Apr-Aug) whale migration Socio-economic + Pearling (inactive/pearling zones) + Very significant for recreational fishing and charter boat tourism + Social amenities and other tourism + Nominated place (national heritage)	Maximum exposure time of total submerged oil >100 ppb	Time (d)	3.3	12.7			
			Maximum concentration of dissolved hydrocarbon >50 ppb	(ppb)	454	817			
			Maximum exposure time of dissolved hydrocarbon >50 ppb	Time (d)	3.8	6.5			
Outer NW Ningaloo (Submerged)	3	Physical Habitats + Coral reef + Seagrasses + Macroalgal beds + Non-coral benthic habitats + high and unique sponge biodiversity Marine Fauna + Invertebrates + Cetacean migration + Finfish and rays + Whale sharks – migratory and aggregation site + Manta rays aggregation + 500 finfish species recorded Birds + 33 species seabirds and avifauna present (13 resident and 20 migratory) + 13 JAMBA/CAMBA species Marine mammals	Probability of contact by floating oil at 10 g/m²	(%)	NC	NC	+ Threatened or migratory fauna + physical habitat + protected areas + socio-economic receptors	II	II - Minor
			Maximum floating oil concentration >10 g/m²	(g/m²)	NC	NC		II	
			Maximum exposure time of floating oil at 10 g/m²	Time (d)	NC	NC		II	
			Maximum accumulated oil on shorelines >100 g/m²	(tonnes)	NC	NC		II	
			Maximum accumulated concentration >100 g/m²	(g/m²)	NC	NC			
			Maximum length of shoreline oiled (>100 g/m²)	(km)	NC	NC			
			Maximum concentration of total submerged oil >100 ppb	(ppb)	263	126			
			Maximum exposure time of total submerged oil >100 ppb	Time (d)	0.1	0.1			
			Maximum concentration of dissolved hydrocarbon >50 ppb	(ppb)	NC	NC			

Receptor Name	HEV Ranking	Values	Oil Spill Modelling Parameter		Yoorn-1		Consequence Category	Worst-case Consequence Ranking	Total
					Surface Release*	Subsea Release*			
		+ 13 species of toothed whale and dolphin and 7 species of baleen whale Protected Area + Key Ecological Feature (Commonwealth waters adjacent to Ningaloo Reef) and Continental Slope Demersal Fish Communities + Socio-economic and heritage values + sanctuary zones under state MP + National Heritage Place + shipwrecks important as diving sites	Maximum exposure time of dissolved hydrocarbon >50 ppb	Time (d)	NC	NC			
Southern Islands Coast	5	Overlaps BIAs for + Humpback whales + Green turtle and hawksbill critical habitat (nesting) + Wedge tailed shearwater + Lesser crested tern + Fairy tern + Roseate tern Seagrass meadows Flatback turtle nesting Adjacent to Exmouth Gulf Coast and Ningaloo hotspot (refer above) Onslow port within area	Probability of contact by floating oil at 10 g/m^2	(%)	NC	NC	+ Threatened or migratory fauna + physical habitat + protected areas + socio-economic receptors	II II II I	II - Minor
			Maximum floating oil concentration >10 g/m^2	(g/m^2)	NC	NC			
			Maximum exposure time of floating oil at 10 g/m^2	Time (d)	NC	NC			
			Maximum accumulated oil on shorelines >100 g/m^2	(tonnes)	52.5	18.7			
			Maximum accumulated concentration >100 g/m^2	(g/m^2)	4,003.3	1,763.7			
			Maximum length of shoreline oiled (>100 g/m^2)	(km)	12.7	12.7			
			Maximum concentration of total submerged oil >100 ppb	(ppb)	134.2	114.8			
			Maximum exposure time of total submerged oil >100 ppb	Time (d)	19.1	17.3			
			Maximum concentration of dissolved hydrocarbon >50 ppb	(ppb)	NC	NC			
			Maximum exposure time of dissolved hydrocarbon >50 ppb	Time (d)	NC	NC			

Note: NC = No contact at the defined criteria or less than 5% probability. HEV = high environmental value.

7.2.4.2 Subsea and Surface LOWC

Receptors	+ Physical environment (water and sediment quality, benthic habitats, offshore reefs and islands) + Threatened or migratory fauna (marine mammals, marine reptiles, sharks, rays, fish, and birds) + Protected and significant areas (marine parks and KEFs) + Socio-economic receptors (fisheries, tourism and recreation)
Consequence	IV - Major

The detailed consequence assessment for each hotspot is provided in **Table 7-16**. A summary of the consequence assessment for each receptor category is presented below.

Physical environment or habitat

In the highly unlikely event of a LOWC at the Yoorn-1 well, hydrocarbons will likely reach both subsea and shoreline habitats (highest probabilities at Montebello Islands, Barrow Island, Muiron Islands, Lowendal Islands, Dampier Archipelago, Ningaloo Southern Islands Coast and Montebello AMP). Hydrocarbons that reach nearshore environments also have the potential to impact benthic coral reefs and mangrove areas, which may result in a long-term decrease in ecological values given toxicity impacts associated with hydrocarbon exposure.

Threatened or migratory fauna

In the highly unlikely event of a LOWC, the volume of condensate released would result in a localised reduction in water quality with the potential to impact marine fauna. Marine fauna present in the area may be potentially impacted by a spill through exposure to floating oil, entrained oil, or DAH's. A description of impacts to marine fauna from exposure to condensate is provided in **Table 7-11.**

Impacts from a LOWC release would be greatest within several kilometres from the spill when the toxic aromatic components of the fuel will be at their highest concentration and when the hydrocarbon is at its thickest on the surface of the receiving waters. Upon release to the marine environment, the condensate will rapidly lose toxicity with time and will spread thinner at the surface as evaporation continues or will become entrained within the water column. The potential sensitive receptors in the surrounding areas of the spill will include fish, marine mammals, marine reptiles and seabirds at the sea surface, as discussed in **Table 7-11.**

Habitat modification, degradation, disruption or loss, deteriorating water quality and marine pollution are identified as potential threats to a number of marine fauna species in relevant recovery plans and conservation advices (**Table 3-9**). With controls in place that align with relevant actions described in various recovery plans, the activity will be conducted in a manner that reduces potential impacts to ALARP and an acceptable level.

Protected areas

The MEVA intersects several protected areas and AMPs and marine management areas (**Section 3.2.2**). Combined, these areas support all the habitats and faunal groups described above. Impacts to the habitat or fauna receptors described above therefore have an impact on the values of these reserves, which could have flow-on effects to tourism revenue of coastal communities that provide access to these marine reserves. Many of these receptors are values of protected areas, and there could be moderate-term effects to them.

Socio-economic receptors

There is the potential for entrained oil to temporarily disrupt fishing activities if the surface or entrained oil moves through fishing areas (**Table 7-11**).

Entrained oil at more than 100 ppb could reach pearl farming activities at the Montebello Islands. Pearl oysters are filter feeders; therefore, entrained oil droplets could create negative impacts through ingestion

and accumulation of hydrocarbon compounds in oyster tissues or interference with respiratory structures. Ecotox (2009) reported that no observable effect concentration levels from weathered condensates for a comparable oyster species ranged from approximately 9,000 to 28,000 ppm. Significant impacts on aquaculture would therefore be unlikely, as predictive modelling reported that the maximum time-averaged submerged total concentration for the worst realisation at the Montebello Islands was 723 ppb. Additionally, pearling leases identified in the region are currently inactive; and no stakeholder concerns have been raised. However, if these leases were to become active within the life of this EP, then some loss of value to the local industry could occur in the event of a LOWC that results in a condensate spill at the Yoorn-1 well. In addition, recreational fishing hotspots including the Montebello Islands, Barrow Island, Lowendal Islands, Muiron Islands and Ningaloo are of high value to recreational fishers. Tourism could be affected by spilled condensate, either from reduced water quality or shoreline oiling preventing recreational activities, reducing aesthetic appeal or from impacts to habitats and marine fauna as described in **Table 7-11**. Indigenous users may be impacted in the event that a land-based response is required. However, consultation will help manage activities such that potential impacts are reduced to acceptable levels. A number of oil and gas operators operate within the MEVA with existing projects and infrastructure in place, as well as continuing drilling and exploration programs. A LOWC has the potential to disrupt these activities, with associated economic impact, albeit on a temporary basis. On the basis of the above assessment, a LOWC has the potential to impact an array of receptors. Given the extent, the worst-case consequence is considered to be Major (IV).	
Likelihood	b - Unlikely
The likelihood of a LOWC event occurring during the activity is extremely low when considering industry statistics, Santos statistics and the standard preventive control measures in place. Wells are designed with essential engineering and safety control measures to prevent a loss of containment occurring. Blowout and well release frequencies for exploration drilling has been reported at 1.5 x 10^{-4} per drilled well (IOGP, 2019; wildcat exploration drilling operations on deep, normal wells of North Sea standard). This frequency is based on two blowout incidents occurring in the UK between 1980 and 2014 during wildcat exploration drilling (IOGP, 2019) and supports the likelihood of 'has occurred elsewhere OR could occur within decades'. Management controls in place to control the flow of hydrocarbons include construction design, safety shutdown systems, regular inspection and maintenance, and competent personnel. Additional industry-standard and activity-specific control measures to reduce the chance of a loss of containment event have also been implemented including (but not limited to) procedures such as the WOMP, safety case, crew training and awareness, and a spill response plan (OPEP). These control measures are considered to reduce the risk of a loss of containment (and minimise impacts) occurring to a level that is acceptable. The likelihood of a LOWC resulting in a Major (IV) consequence is considered to be unlikely (b).	
Residual Risk	The residual risk associated with this event is **Low**.

7.2.5 Demonstration of ALARP

The use of industry standard safe drilling methodologies, including the inherently safe well design and its operations with primary (i.e., maintaining the appropriate hydrostatic pressure) and secondary well control features (i.e., blowout preventers), reduces the probability of a loss of containment occurring to a very low level. All safety options have been considered in well design and equipment choice for the activity, with no additional safety options possible, it is considered that the risk of a loss of containment occurring has been reduced to ALARP.

The combination of the standard prevention control measures (which reduce the likelihood of the event happening), and the spill response strategies (which may reduce the consequence) together reduce the hydrocarbon spill risk.

Based on the stochastic spill modelling, Santos has determined applicable source control response measures to limit the spill volume from a LOWC event to ALARP.

7.2.5.1 Source Control

A number of source control options have been evaluated for the activity (refer to OPEP). Of these source control options; the drilling of a relief well is considered the primary means of controlling the source in the event of an unplanned well release. Spill response and impact assessment for this activity has been based on the relief well taking 77 days (11 weeks) to execute. A breakdown of the key tasks and their timeframe to drill a relief well in 11 weeks have been included in Section 9.3.1.3 of the OPEP.

Supporting controls to allow the relief well schedule to be met include:

+ "Assurance Review 4: Readiness to Spud" is conducted under the Drilling & Completions Management Process (DCMP).
+ Rig capability register is maintained.
+ A well-specific Source Control Plan (SCP) is prepared in accordance with the Santos Source Control Planning and Response Guidelines. The SCP contains information and considerations for relief well operations including but not limited to:
  - Relief well surface locations (primary and secondary)
  - Relief well trajectory and interception target point
  - Dynamic well kill modelling calculations for controlling a worst-case discharge (e.g. kill mud weight, kill pump rate/pressure and kill mud volume required)
  - Status of relief well tangible equipment
  - Assumptions for relief well MODU availability and verification that a suitable MODU to execute a relief well is either in Australian Waters or there is a suitably robust mobilization plan for one outside of Australia. The activity will not proceed if there is not at least one relief well MODU option that could execute a relief well within the timeframes committed to in this EP.
  - In addition, during the activity, if the preferred relief well MODU/s becomes unavailable, the SCP will be updated and a suitable replacement identified.
+ Australian Petroleum Production and Exploration Association (APPEA) Memorandum of Understanding (MoU) provides for access to other Operator rigs.
+ Contracts and MoUs for third-party independent well control specialist personnel are in place.

An ALARP assessment of the various source control strategies is included in Appendix A of the OPEP.

The implementation timeframe of this control is key to its effectiveness. A second MODU positioned on standby in the vicinity of the activity during the drilling activity was considered as an additional control that could reduce the length of time taken to drill a relief well. This would involve hiring an additional rig for the duration of the activity every time a well is drilled under this EP. If adopted, this may reduce the timeframe for stopping a blowout by up to two weeks, although planning/approval/set-up requirements mean the reduction would likely be less. The cost of having a MODU and personnel/equipment on standby (at a rate of ca. $250,000/day) would double the cost of the activity and introduce additional safety and environmental risks due to presence of an additional MODU and support vessels/equipment being on standby. This is considered grossly disproportionate to the environmental benefit (a potential reduction of two weeks to stop the LOWC, particularly considering the likelihood of a LOWC and the existing preventative control measures in place to prevent a well blowout. Having a dedicated second MODU on standby for the purpose of relief well drilling was therefore rejected as a control measure.

In order to minimise lead times a rig with a NOPSEMA approved Safety Case will be preferred. These rigs are tracked on the Rig Capability Register and access is covered under the APPEA MoU. Given the shallow water depths, a jack-up MODU would be the preferred rig type for a relief well. A semi-submersible could possibly be used to drill the relief well, but most floating units would not be suitable given the shallow water depth as it presents significant challenges with mooring (including feasible distance from the relief well target), limited space between the BOP & MODU and wellhead loading/fatigue concerns. The Well Specific Source Control plan written prior to the activity commencing will specifically look at what MODUs are available when the activity commences and ensures that there will be at least one technically suitable unit available to drill a relief well. Should a semi-submersible rig be the only option for a relief well, detailed engineering would be performed, and long lead items would be organised to ensure there is a feasible MODU available to execute a relief well. Again, this would be documented in the Well Specific Source Control Plan.

Direct surface intervention (i.e. deployment onto the jack-up rig) using specialised well control personnel is a strategy that could be adopted and supported through contractual arrangements with well control vendors. This strategy is contingent on technical aspects of the LOWC event and safety considerations which could only be assessed at the time of a spill event. For this reason, the current preparedness measures for well intervention experts is considered ALARP.

Installation of a capping stack is not compatible with jack-up drilling (required in the shallow water depth of the OA), and is not applicable.

Santos has access to a subsea first response toolkit (SFRT) and deployment personnel through contract to AMOSC and Oceaneering respectively. The SFRT may provide value in allowing a subsea survey in the instance of conductor damage but given that capping stack deployment is not a feasible strategy, the use of SFRT for the application of dispersants is not considered required from a source control perspective. However, the application of dispersants via SFRT may provide an environmental benefit in reducing the volume of hydrocarbons reaching shorelines. Notwithstanding the above, the use of SFRT is considered unlikely due to safety and technical constraints (i.e., shallow water depths and high predicted gas release rates).

In the unlikely event SFRT was required, SFRT equipment can be mobilised to Dampier from the Jandakot storage yard in two days, under existing arrangements. Locating this equipment in Dampier could potentially reduce deployment time by two days providing a suitable vessel was on standby for immediate mobilisation. However, the equipment is a shared resource across AMOSC SFRT subscription members so relocating for a drilling campaign is not considered viable. Providing a vessel on standby for SFRT deployment could reduce deployment time; but given SFRT deployment may not be suitable or feasible a potential reduction in deployment time due to a vessel being on standby is not seen to offer sufficient environmental benefit given crewed vessel standby costs would be tens of thousands of dollars each day over the drilling period.

7.2.5.2 Spill Mitigation Controls

Santos considers that through the selection of appropriate spill response strategies, development of spill response controls and maintenance of preparedness arrangements and resources to implement these controls, spill risk is mitigated to ALARP. Preparedness spill response controls are outlined in **Table 7-13** while those that would be implemented in the event of a spill are outlined within the OPEP.

7.2.6 Acceptability Evaluation

Is the risk ranked between Low and Medium?	Yes - maximum credible hydrocarbon spill volume (condensate from a LOWC) residual risk is ranked as Low.
Is further information required in the consequence assessment?	No – hydrocarbon spill modelling results were used to determine consequence and risk; no further information is required.
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian Marine Park zoning objectives)?	Yes – management consistent with OPGGS(E)R 2009 Regulations, including safety case and WOMP. The following material published in relation to threatened and migratory species within the EMBA identifies habitat degradation / modification, pollution or oil spills as a threat (**Table 3-9**): **Conservation Advice:** + Approved Conservation Advice on *Pristis clavate* (Dwarf Sawfish) (2009) + Approved Conservation Advice on *Pristis zijsron* (green sawfish) (2008) + Approved Conservation Advice for *Milyeringa veritas* (Blind Gudgeon) (2008) + Approved Conservation Advice for *Ophisternon candidum* (Blind Cave Eel) (2008) + Approved Conservation Advice for *Pristis pristis* (Largetooth sawfish) (2014) + Approved Conservation Advice for *Glyphis garricki* (northern river shark) 2014 + Approved Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015a)

	+ Approved Conservation Advice for *Aipysurus apraefrontalis* (Short-nosed Sea Snake) (2011) + Approved Conservation Advice for *Aipysurus foliosquama* (Leaf-scaled Seasnake) (2011) + Commonwealth Conservation Advice on Dermochelys coriacea (2008) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015c) + Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (2015d) + Approved Conservation Advice on *Neophoca cinerea* Australian Sea Lion (2020) + and relevant recovery plans and conservation advices for birds. **Recovery Plans:** + Sawfish and River Sharks Multispecies Recovery Plan (2015a) + Recovery Plan for the White Shark (*Carcharodon carcharias*) (2013a) + Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (2014) + Wildlife Conservation Plan for Migratory Shorebirds (Commonwealth of Australia 2015) + Draft Wildlife Conservation Plan for Seabirds (Commonwealth of Australia 2019) + National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011) + Recovery Plan for Marine Turtles in Australia (DoEE, 2017) + Blue Whale Conservation Management Plan 2015 - 2025 (DoE, 2015b) + Conservation Management Plan for the Southern Right Whale 2011 – 2021 (2012) + Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (2013) Recovery Plans / Conservation Advice for other species that may occur in the EMBA do not identify pollution or habitat degradation / modification as a key threat or have explicit relevant objectives or management actions. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) + South-west Marine Parks Network Management Plan (2018) + Conservation values of the identified protection priorities (**Section 3.2.2**) have been considered, including the Montebello AMP, the Barrow Island Marine Park and Management Area, Montebello Islands Marine Park (State Marine Park), Muiron Island Marine Management Area, and Ningaloo Marine Park.

	+ Management is also consistent with the zoning of the Australian marine parks, in that risks have been reduced to ALARP, e.g., implementation of spill response activities will limit impacts, thereby conserving the marine park values (described in **Section 3.2.2** and **Table 3-4)**. The objectives of these publications were considered during the assessment of impacts and risks. The activity is not inconsistent with these objectives. The controls outlined in **Table 7-13** are consistent with the objectives of the material listed above and in **Table 3-4** and **Table 3-9**. Santos considers the impacts of LOWC to not be inconsistent with these objectives.
Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – DBCA raised concern of the potential impacts to Montebello Islands Conservation Park and Marine Park, Lowendal Islands Nature Reserve, and Barrow Island Nature Reserve, Marine Park and Marine Management Area in the event of a spill. The values of these reserves are described in the EP. Concerns raised around baseline monitoring were addressed by Santos during consultation (refer **Table 4-2**); and scientific monitoring and response strategies are described further within the OPEP. DMIRS requested that the EP includes information about the reporting of environmental incidents that could potentially impact on any land or water in State jurisdiction. Santos considers these concerns to have been addressed or will be addressed as per the Activity Notification and Reporting Requirements (**Table 8-4**).
Are performance standards such that the impact or risk is considered to be ALARP?	Yes (see ALARP above)

The likelihood of a LOWC event during the activity is unlikely when considering industry statistics, Santos statistics and the preventative controls in place. Wells are designed with essential engineering and safety control measures to prevent a LOWC incident occurring. Additional industry-standard and activity-specific control measures to reduce the chance of the event occurring (and minimise impacts) have also been implemented, including (but not limited to) procedures such as the NOSPEMA accepted safety case and WOMP, personnel training and awareness, and a spill response plan (OPEP). In accordance with Santos' risk assessment process, the residual risk is considered to be ALARP. The proposed control measures will reduce the risk of impacts from a LOWC to a level that is considered acceptable.

7.3 Hydrocarbon Spill – Marine Diesel Oil

Surface release of marine diesel oil (MDO) from a ruptured vessel fuel tank as a result of a collision or a MODU refuelling incident.

7.3.1 Description of Event

Event	Diesel spills have the potential to impact on the marine environment through reductions in water quality and exposure to fauna and habitats. *Worst-Credible MDO Spill* It is considered credible that a release of MDO to the marine environment could occur between the support vessels, between a support vessel and the MODU, or between a passing 3rd party vessel and the MODU or a support vessel. The worst-case environmental incident resulting from a vessel collision is the rupturing of a vessel fuel tank resulting in the release of MDO to the environment. Vessel collision could occur due to factors such as human error, poor navigation, vessel equipment failure or poor weather. A maximum credible spill volume has been determined based on technical guidance provided by AMSA (AMSA, 2015). This guidance states that for a vessel other than an oil tanker, the maximum credible spill from a collision can be determined from the volume of the largest single fuel tank. In reviewing the general arrangements and fuel tank capacities of typical vessels likely to be utilised for the drilling activities, the largest single fuel tank capacity identified was no greater than approximately 329 m^3 of MDO for support vessels. This scenario would result in a spill of MDO at the sea surface. As explained in **Section 7.1.2**, an MDO release was modelled from Yoorn-1 (WA-499-P Geophysical and Geotechnical Surveys Diesel Spill Modelling Report; GHD, 2019). *Refuelling Incident* There may be helicopter refuelling on the MODU and vessel refuelling within the OA during the activity. The second most significant MDO spill scenario identified is a MODU refuelling incident (fuel hose failure or rupture, coupling failure or tank overfilling) where fuel would need to be stopped manually. Fuel released prior to the cessation of pumping as well as fuel remaining in the transfer line may escape to the environment. The AMSA (2015) *Technical Guidelines for Preparing Contingency Plans for Marine and Coastal Facilities* provides guidance for calculating a maximum credible spill volume for a refuelling spill. The guidance provided by AMSA (2015) for a refuelling spill under continuous supervision is considered appropriate given refuelling will be constantly supervised. The maximum credible spill volume during refuelling is calculated as: transfer rate (150 m^3/ hr) x 15 minutes of flow giving a volume of 37.5 m^3. The detection time of 15 minutes is seen as conservative but applicable following failure of multiple barriers followed by manual detection and isolation of the fuel supply.
Extent	A release of 329 m^3 of MDO as a result of a vessel collision is the maximum credible diesel spill scenario, and was modelled by GHD for a release at Yoorn-1 (GHD, 2019): + Hotspot analysis for Yoorn-1 release identified the Montebello Islands and Barrow-Montebello Surrounds. + Shoreline loading at moderate exposure (100 g/m^2) was confined to the proximal locations of the Montebello Islands, Lowendal Islands and Barrow Island for Yoorn-1. + Maximum spatial extent of surface oil above the moderate exposure value of 10 g/m^2, was predicted to occur up to approximately 200 km from the spill location. + Exceedances of total submerged oil in the water column at the high exposure value (100 ppb) were predicted up to a maximum of approximately 200 km to the east of the spill location and approximately 100 km to the north and east from the release location.

	+ Dissolved oil in the water column above the exposure value of 50 ppb was predicted up to approximately 200 km from the release location. Refer to MDO Spill Modelling Results summary below in **Section 7.3.2** for further information.
Duration	Modelling undertaken for 0.5 hours - loss is instantaneous through the rupture. MDO fuel at the sea surface will spread rapidly in the direction of the prevailing wind and surface currents. Evaporation contributes to a substantial proportion of removal of the spilled MDO on the sea surface during calm conditions, while entrainment of droplets within the water column will increasingly contribute to removal of surface oil as wind speed increases. There is a very low chance for emulsion formation. It is estimated through modelling under realistic weather conditions that surface hydrocarbons would decrease to below 1% of the total mass within three days (in moderate wind conditions, 5 metres per second (m/s)) through dispersion and evaporation. In conditions of sustained energetic winds (10 m/s), the surface oil is expected to be entirely evaporated and dispersed after 12 hours. Refer to MDO Spill Modelling Results summary below in **Section 7.3.2** for further information.

7.3.2 Nature and Scale of Environmental Impacts

Hydrocarbon spills will cause a decline in water quality and can cause chemical (e.g. toxic) and physical (e.g. coating of emergent habitats, oiling of wildlife at sea surface) impacts to marine species. The severity of the impact of a hydrocarbon spill depends on the magnitude of the hydrocarbon spill (i.e. extent, duration) and sensitivity of the receptor.

Potential Receptors: Physical environment (water and sediment quality), threatened or migratory fauna (marine mammals, marine reptiles, sharks, fish, rays and birds), protected and significant areas (marine parks and KEFs), socio-economic receptors (fisheries, tourism and recreation).

As a light hydrocarbon, MDO undergoes rapid spreading and evaporative loss in warm waters, indicating that a surface slick will be temporary, with approximately 40% of the released volume evaporating within 40 hours. The high rate of evaporation means that little MDO will become entrained and few aromatic hydrocarbons are predicted to become dissolved.

Potential impact pathways (physical and chemical) of hydrocarbon exposure for receptors are summarised in **Table 7-10** and potential impacts to receptors found within the EMBA are further described in **Table 7-11**.

7.3.2.1 Hydrocarbon Weathering Behaviour

ITOPF (2011) and the AMOSC (2011) categorise MDO as a light ‘group II’ hydrocarbon. In the marine environment, MDO is expected to behave as follows:

+ MDO will spread rapidly in the direction of the prevailing wind and waves
+ Evaporation will be the dominant process contributing to the fate of spilled diesel from the sea surface and will account for 60 to 80% reduction of the net hydrocarbon balance
+ The evaporation rate of diesel will increase in warmer air and sea temperatures
+ MDO 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.

Under low winds (1 m/s), 60% of the surface slick is predicted to remain after 120 hours (five days). Under moderate winds (5 m/s), 40% of the initial surface slick is predicted to remain after 24 hours decreasing further to approximately 10% after 48 hours and 1% after 72 hours. With high winds (10 m/s), the surface slick is predicted to be almost entirely evaporated and dispersed after 12 hours (GHD, 2019) (**Figure 7-5**).

Marine Diesel (IKU) has been used as an analogue for MDO in the modelling study (GHD, 2019). Marine Diesel (IKU) has a very low tendency for emulsion formation, with only 1% water content entrained into the surface slick after 120 hours for all wind conditions assessed (GHD, 2019) (**Figure 7-5**).

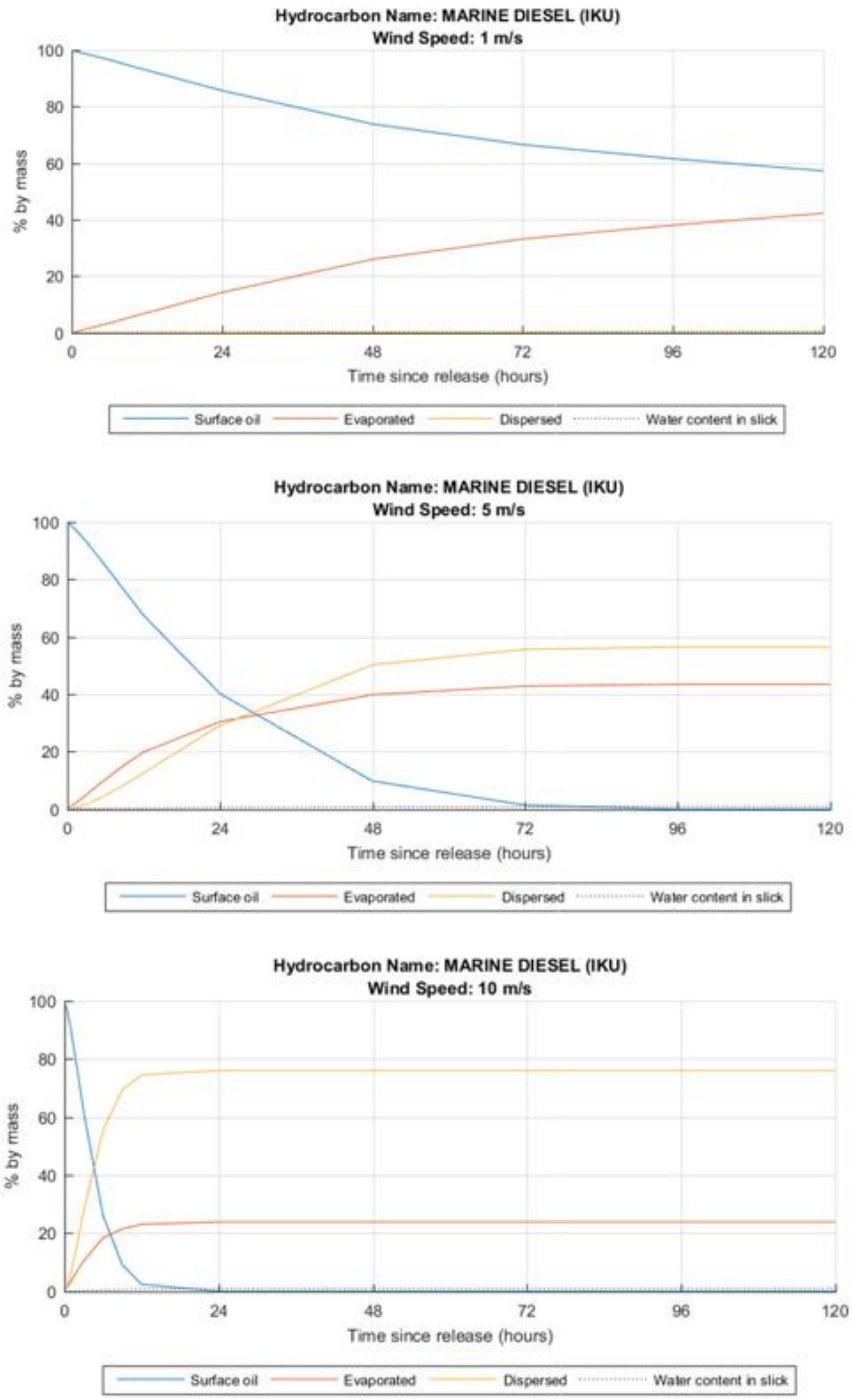

Figure 7-5: Simulated Weathering of the Foundation for Specific and Industrial Research at the Norwegian Institute of Technology (SINTEF) Marine Diesel (IKU) Hydrocarbon for Constant Wind Speeds of 1 m/s (top), 5 m/s (middle) and 10 m/s (bottom)

7.3.2.2 Spill Modelling Results

To determine the spatial extent of impacts from a potential surface release of MDO, and the dispersion characteristics over time, modelling was completed by GHD (GHD, 2019). A volume of 329 m^3 released over 0.5 hours was modelled.

Modelling results have been provided for each of the four hydrocarbon fates: shoreline accumulation; surface; dissolved and entrained.

The modelling results are provided in **Table 7-17** for the fate of hydrocarbon at the exposure values defined in **Section 7.1.3** has been provided for the purposes of risk evaluation, displaying the following parameters:

+ Minimum time to contact from moderate and high exposure value
+ Maximum hydrocarbon concentration from high exposure value
+ Maximum oil accumulation on shoreline from moderate and high exposure value
+ Length of shoreline oiled.

The spill modelling results are provided in **Appendix E** – Spill Modelling Results.

Further parameters required to inform spill response strategies are described further in the Yoorn-1 Exploration Drilling OPEP.

Table 7-17: Summary of MDO Release Modelling Results for Yoorn-1

Exposure	Yoorn-1 Modelling
Surface Oil	Surface oil above 10 g/m^2 were predicted to extend approximately 200 km to the southwest and approximately 130 km to the northeast of the spill location. A high exposure probability (99.2%) was predicted at the Montebello AMP, with a maximum time-averaged oil concentration at this receptor of 283.8 g/m^2, and a minimum predicted arrival time of 0.1 days. Low-moderate exposure probabilities were predicted at Barrow-Montebello Surrounds (20.8%) and the Montebello Islands (14.2%). Maximum predicted time-averaged oil concentrations were 264.9 g/m^2 and 259.6 g/m^2, respectively. Minimum arrival times were 0.3 days for both receptors. Low exposure probabilities were predicted for Offshore Ningaloo (6.7%), Barrow Island (3.3%) and the Lowendal Islands (2.5%). Maximum predicted time-averaged oil concentrations were Offshore Ningaloo (60 g/m^2), Barrow Island (77.5 g/m^2) and Lowendal Islands (153.8 g/m^2). Minimum arrival times were 1.8 days for Offshore Ningaloo, 2.4 days at Barrow Island and 1.3 days at the Lowendal Islands. No contact at concentrations above 10 g/m^2 was predicted at Dampier AMP or Outer NW Ningaloo.
Dissolved Oil	Time-averaged dissolved oil above the 50 ppb threshold was predicted to occur up to approximately 150 km to the southwest and approximately 110 km to the northeast from the spill location. The key receptor predicted to be contacted by dissolved oil above the moderate exposure value (50 ppb) is the Montebello AMP, with 97.5% contact probability, maximum time-averaged concentration of 544.7 ppb and short minimum arrival time of 0.1 days. Further, low-moderate exposure probabilities were predicted at Barrow-Montebello Surrounds (21.7% probability, 354.4 ppb maximum time-averaged concentration, 0.3 days minimum arrival time) and Montebello Islands (15.8%, 290.3 ppb, 0.3 days). Low exposure probabilities were predicted at Offshore Ningaloo (4.2%), Barrow Island (2.5%) and Lowendal Islands (2.5%). Maximum time-averaged concentrations were 79.8 ppb, 96.7 ppb and 257.9 ppb, respectively. Minimum arrival times for surface concentrations above 50 ppb were 1.8 days for Offshore Ningaloo, 2.4 days for Barrow Island and 1.3 days for Lowendal Islands.
Total Submerged Oil	Entrainment of the surface slicks resulted in predicted total submerged oil concentrations above the 100 ppb threshold to occur up to approximately 160 km to the southwest of the spill location and approximately 140 km to the northeast. A high exposure probability (95%) was predicted at the Montebello AMP, with a maximum time-averaged concentration at this receptor of 1,153.9 ppb, and a minimum predicted arrival time of 0.1 days. Low-moderate exposure probabilities were predicted at Barrow-Montebello Surrounds (20.0%) and Montebello Islands (15.8%). Maximum time-averaged concentrations were 864.3 ppb and 344.2 ppb, respectively, and minimum arrival times of 0.3 days for both receptors. Low contact probabilities were predicted at Offshore Ningaloo (5.0%), Barrow Island (2.5%) and Lowendal Islands (2.5%). Maximum time-averaged concentrations were 212.2 ppb, 340.7 ppb and 293.2 ppb, respectively. Minimum arrival times for surface

Exposure	Yoorn-1 Modelling
	concentrations above 100 ppb were 1.8 days for Offshore Ningaloo, 2.4 days for Barrow Island and 1.3 days for Lowendal Islands. No contact at concentrations above 100 ppb was predicted at Glomar Shoals, Dampier AMP or Outer NW Ningaloo.
Shoreline Accumulation	Shoreline oiling above the 100 g/m^2 threshold was confined to the proximal locations of Montebello Islands, Lowendal Islands and Barrow Island. Predicted contact probabilities across all shorelines was 15%, with the Montebello Islands predicted to have the highest contact probability of 13%. Lowendal Islands and Barrow Island also had predicted contact probabilities of 1-4%. The maximum predicted accumulated oil ashore across all shorelines was approximately 222 tonnes, which occurred entirely at Montebello Islands. Of the other contacted receptors, a maximum accumulated shoreline loading of approximately 130 tonnes was predicted for Barrow Island, approximately 11 tonnes for Lowendal Islands and no contact at Dampier Archipelago, Muiron Islands and Ningaloo Coast North. Short arrival times of less than 1 week were predicted for all contacted receptors with the fastest arrival time of 0.5 days at the Montebello Islands to the longest of 2.4 days at Barrow Island. The highest predicted oiled shoreline length across all shorelines was approximately 18 km. For individual shorelines, Montebello Islands, Barrow Island and Lowendal Islands had predicted oiled shoreline lengths of 14 km, 11 km and 3 km, respectively.

7.3.3 Environmental Performance Outcomes and Control Measures

The EPOs relating to this event include:

+ No loss of containment of hydrocarbon to the marine environment [YO-EPO-03]
+ No unplanned objects, emissions or discharges to sea or air [YO-EPO-04]
+ No injury or mortality to EPBC Act 1999 and WA Biodiversity Conservation Act 2016 listed marine fauna during operational activities. [YO-EPO-05].

The control measures considered for this activity are shown below with EPS' and measurement criteria for the EPOs described in **Section 8.4**.

Table 7-18: Control Measure Evaluation for the Surface Release of MDO

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
YO-CM-003	MODU move procedure	MODU move procedure contains a passage plan to	Personnel costs associated with ensuring procedure is in place and	**Adopted** – Benefits of ensuring procedure is

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		reduce risk of collision.	implemented during inspections.	followed and measures to reduce collision risk are implemented outweigh the costs of personnel time.
YO-CM-012	MODU and support vessel spill response plans including pre-drilling source control plan	Implements response plans on board vessels to deal with unplanned hydrocarbon releases and spills quickly and efficiently to reduce impacts to the marine environment.	Administrative costs of preparing documents. Generally undertaken by vessel contractor so time for Santos personnel to confirm and check SOPEP/ Shipboard Marine Pollution Emergency Plan (SMPEP) in place.	**Adopted** – Benefits of ensuring response plans in place, are followed and measures implemented and that the MODU/support vessels are compliant outweigh costs.
YO-CM-014	Maritime notices	Ensure other marine users are aware of the presence of the MODU/support vessels and the relatively slow speed and restricted manoeuvrability	Limited additional costs to Santos. Stakeholders time required to review consultation material and communicate with Santos.	**Adopted** – Benefits are considered to outweigh negligible costs to Santos.
YO-CM-015	Support vessel(s)	Monitor the MODU 500 m Petroleum Safety Zone (PSZ) and be equipped with an AIS to aid in its detection at sea, and radar to aid in the detection of approaching third party vessels. Reduces risk of vessel collision and subsequent unplanned release of hydrocarbons causing potential harm to the marine environment.	High cost associated with contracting vessel. Negligible costs of operating navigational equipment.	**Adopted** – The safety and environmental benefits from reducing risk of vessel collisions outweigh costs to Santo WA.

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
YO-CM-016	Accepted Oil pollution emergency plan (OPEP)	Optimises efficiencies and preparedness of incident response.	No additional cost given is a regulatory requirement.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented and that the vessels are compliant outweigh the costs.
YO-CM-020	Fuel oil quality	Use of diesel reduces the potential impacts to marine environment in the event of unplanned hydrocarbon spills or leaks during bunkering.	Additional personnel costs of ensuring vessels are using the required fuel.	**Adopted –** Benefits of ensuring procedures are followed outweighs the minimal costs of personnel time.
YO-CM-024	MODU identification system	MODU has an Automatic Identification System (AIS) to aid in its detection at sea that is only active while under tow. Reduces risk of environmental impact from vessel collisions through ensuring safety requirements are fulfilled.	Negligible costs of operating navigational equipment.	**Adopted** – The safety and environmental benefits outweigh the cost to Santos.
YO-CM-034	Seafarer Certification	Requires appropriately trained and competent personnel to navigate MODU and vessels to reduce interaction with other marine users.	Costs associated with personnel time in obtaining qualifications.	**Adopted –** Benefits considered to outweigh costs and is a legislated requirement.
YO-CM-035	Marine Assurance Standard	Ensures vessels meet Marine assurance standards to reduce	Costs associated with personnel time in checking vessel.	**Adopted –** Benefits of ensuring

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		the likelihood of unplanned discharge.		procedures are followed and measures implemented and that the vessels are compliant outweigh the costs. Regulatory requirement must be adopted.
YO-CM-037	Refuelling and chemical transfer procedure	Minimises risk of pollution to ALARP during hydrocarbon transfers between MODU and vessels.	Personnel costs associated with ensuring procedures are in place and implemented during refuelling and chemical transfers.	**Adopted –** Benefits of ensuring procedures are followed and measures implemented outweigh the costs.
YO-CM-038	Petroleum Safety Zone (safety) established	Reduces potential for collision or interference with other marine user activities	Negligible costs, standard industry practice	**Adopted –** Benefits considered to outweigh negligible costs to Santos
Additional Control Measures				
N/A	Zero fuel bunkering via hose	Removes spill risk from hose operations.	Cost associated with transfer of MDO via drums or containers. Not possible to modify MODU to allow additional fuel storage. Cost associated with vessel transits and risk transfer to Health and Safety issues with additional trips to port instead. Would significantly increase the schedule to include multiple trips.	**Rejected** – Storage of fuel on MODU would result in unacceptable transfer of environmental risks to OHS/operational risks and would not eliminate risk of MDO spills to sea. Costs associated with implementing control is deemed grossly

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
				disproportionate to environmental benefit and low risk activity with standard controls in place.
N/A	Dedicated resources (e.g. dedicated spill response facilities on location) in the event of loss of hydrocarbons to allow rapid response	May allow for quicker response to a spill as resources will be within close proximity, however, shoreline contact is predicted to take 50 hours meaning benefits are negligible	Large costs associated with a dedicated resource on location. Modelling shows shoreline contact albeit with low maximum volumes, with the exception of the Montebello Islands (moderate shoreline loading).	**Rejected** – Large cost associated with dedicated resources on location deemed grossly disproportionate compared to low risk of large MDO spill and subsequent rapid dispersion and evaporation.
N/A	Require all support vessels involved in the activity to be double hulled.	Reduces the likelihood of a loss of hydrocarbon inventory minimising potential environmental impact.	Vessels are subject to availability and are required to meet Santos' standards during activities; requirement of a double hull on vessels would limit the number available to Santos; also, requiring vessels to be refitted to ensure double hulls would be of high cost.	**Rejected** – Large costs associated with vessel selection and by having an activity schedule determined by vessel availability considered to be grossly disproportionate compared to low risk of a vessel collision and low risk of a large diesel spill.

7.3.4 Environmental Impact Assessment

The below environmental impact assessment follows the risk assessment approach detailed in **Section 7.1.6**.

7.3.4.1 Identification of Hotspots for Consequence Analysis

As described in **Section 7.1.6**, all HEVs within the EMBA (low exposure value) are listed in **Table 7-19** for Yoorn-1. The values and sensitivities associated with these HEVs have been described in **Appendix C**. Further to this, **Table 7-19** filters the HEV to identify the hotspots where they meet the criteria described in **Section 7.1.6**.

Table 7-19: Identified High Exposure Value and Hotspot Receptors – Yoorn-1

Receptor	HEV Value	Exposure Value			Hotspot
		Low	Moderate	High	
Dampier Archipelago	3	✓			
Northern Islands Coast	5				
Montebello Islands	3	✓	✓	✓	✓
Barrow Island	3	✓	✓	✓	
Southern Islands Coast	5				
Glomar Shoals	5				
Rankin Bank	5				
Barrow-Montebello Surrounds	3	✓	✓	✓	✓
Montebello AMP	4				
Offshore Ningaloo	4				
Lowendal Islands	3	✓	✓	✓	
Muiron Islands	2	✓			
Ningaloo Coast North	2	✓			
Outer NW Ningaloo	3	✓			

This process identified the following Hotspots:

- Montebello Islands
- Barrow-Montebello Surrounds

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Table 7-20 provides a simplified summary of the consequence assessment results for each of the Hotspot areas for the two sets of model outputs. The consequence assessment was based on predicted contact and concentration of surface oil, accumulated oil, entrained hydrocarbon and dissolved hydrocarbons. For each Hotspot area the consequence to the key values were assessed using the methodology described in **Section 7.1.6**.

Table 7-20: Hotspot Consequence Assessment Results from Surface Release of MDO

Receptor Name	HEV Ranking	Values	Oil Spill Modelling Parameter		Yoorn-1	Consequence Category	Worst-case Consequence Ranking	Total
Montebello Islands	3	Habitats + Reefs – coral spawning Mar & Oct + Algae (40%) + Mangroves (considered globally unique as they are offshore) + Fish habitat + Intertidal sand flat communities Turtles + Loggerhead and green (significant rookery), hawksbill, flatback turtles – Loggerhead turtle nesting: Dec-Jan; green turtle nesting: Nov- to Apr, peak period from Jan-Feb; flatback turtle nesting: Dec-Jan; hawksbill turtle nesting: Oct-Jan + Northwest and Eastern Trimouille Islands (hawksbill) + Western Reef and Southern Bay at Northwest Island (green) Seabirds + Migratory and threatened seabirds + Significant nesting (Sept-Feb), foraging and resting areas Whales + Humpback (Jun-Jul), Pygmy blue (Apr-Aug) whale migration Socio-economic + Pearling (inactive/pearling zones) + Very significant for recreational fishing and charter boat tourism + Social amenities and other tourism + Nominated place (national heritage)	Probability of contact by surface oil at 10 g/m^2	(%)	14.2	+ Threatened or migratory fauna; + physical habitat; + protected areas; + socio- economic receptors	III III III III	III - Moderate
			Minimum time to contact by surface oil 10 g/m^2	Time (d)	0.3			
			Maximum oil loading on shorelines >100g/m^2	(tonnes)	221.5			
			Maximum accumulated concentration >100g/m^2	(g/m^2)	18,935.2			
			Maximum length of shoreline oiled (>100 g/m^2)	(km)	14.1			
			Maximum concentration of entrained hydrocarbon >100 ppb	(ppb)	344.2			
			Maximum concentration of dissolved aromatic hydrocarbon >10 ppb	(ppb)	260.2			
Barrow-Montebello Surrounds	3	Habitats	Probability of contact by surface oil at 10 g/m^2	(%)	20.8	+ Threatened or migratory fauna;	III	III - Moderate

Receptor Name	HEV Ranking	Values	Oil Spill Modelling Parameter		Yoorn-1	Consequence Category	Worst-case Consequence Ranking	Total
		+ Coral Reef habitats Marine Fauna + Migratory seabirds + Humpback / pygmy blue whale migration Socio-economic and heritage values + Tourism + Significant for recreational fishing and charter boat tourism	Minimum time to contact by surface oil 10 g/m^2	Time (d)	0.3	+ physical habitat; + protected areas; + socio- economic receptors	III III III	
			Maximum oil loading on shorelines >100g/m^2	(tonnes)	NC			
			Maximum accumulated concentration >100g/m^2	(g/m^2)	NC			
			Maximum length of shoreline oiled (>100 g/m^2)	(km)	NC			
			Maximum concentration of entrained hydrocarbon >100 ppb	(ppb)	864.3			
			Maximum concentration of dissolved aromatic hydrocarbon >10 ppb	(ppb)	354.4			

7.3.4.2 Surface Release of MDO from a vessel as a result of an external impact (vessel collision) or a MODU refuelling incident

Receptors	+ Marine fauna – plankton, fish and sharks, marine mammals, marine reptiles, seabirds/shorebirds + Physical Environment / Habitats + Protected areas + Socio-economic and heritage receptors
Consequence	III- Moderate

In the event of a vessel collision, the volume of hydrocarbons released would be a finite amount limited to the maximum credible spill of a full tank inventory release (329 m^3). Given the properties of MDO, dilution and dispersion from natural weathering processes, such as evaporation and ocean currents, indicate that the extent of exposure will be limited in extent and duration.

Habitat modification, degradation, disruption or loss, deteriorating water quality and marine pollution are identified as potential threats to a number of marine fauna species in relevant recovery plans and conservation advices (**Table 3-9**). In addition, the Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves states that Department of Parks and Wildlife (DPaW) should '*Ensure that important seabird and shorebird breeding and feeding areas are not significantly affected by human activities*'.

The susceptibility of marine fauna to hydrocarbons depends on hydrocarbon type and exposure duration. The high volatility of marine diesel will result in the rapid evaporation and loss of the more toxic aromatic components, resulting in a reducing toxicity threat to marine fauna with time; as such, exposure to marine fauna from this hazard is not expected to result in a fauna fatality. Potential impacts to marine fauna from a hydrocarbon exposure are described in detail in **Table 7-10**.

In the unlikely event of a vessel collision/refuelling spill of MDO, the potential impacts to the environment would be greatest within several kilometres from the spill when the toxic aromatic components of the fuel will be at their highest concentration and when the hydrocarbon is at its thickest on the surface of the receiving waters. Diesel will rapidly lose toxicity with time and spread thinner as evaporation continues. The potential sensitive receptors in the surrounding areas of the spill will include those in the water column, such as fish, marine mammals, marine reptiles and seabirds at the sea surface, as discussed in **Table 7-11**. Given that exposures would be limited in extent and duration, exposure to marine fauna from this hazard is it expected to be limited to a small number of individuals, with no impacts to regional populations.

Marine habitats may also be impacted as discussed in **Table 7-11**. As per **Appendix E** – Spill Modelling Results, a maximum of 222 tonnes of MDO may accumulate on the shoreline of Montebello Islands. Lower maximum shoreline loadings were predicted for other shorelines including Barrow Island and Lowendal Islands may receive approximately 130 and 11 tonnes, respectively, noting the lower (4.2% and 1.7%) contact probability. Indigenous users may be impacted in the event that a land-based response is required, however consultation will ensure potential impacts are reduced to acceptable levels.

There is the potential for surface diesel to disrupt fishing activities if the diesel moves through fishing areas (**Table 3-10**).

Tourism could be affected by surface diesel, either from reduced water quality preventing recreational activities or reducing aesthetic appeal or from impacts to marine fauna as described in **Table 7-11**. Potential impacts to these receptors from a larger condensate release are described in detail in **Section 7.2**.

Potential impacts to protected areas identified as areas of HEV within the Moderate exposure value area (MEVA), including socio-economic and heritage values, are assessed in detail in **Section 7.2.**

An overall consequence ranking of III- Moderate was assigned to this scenario based on the potential impacts to Priorities for Protection as described in **Section 7.1.6**. This is due to the potential for: + Shoreline impact and loading to Montebello Islands (emergent); and Montebello Islands Marine Park and Barrow Island Marine Park and Management Area (emergent) + Entrained oil impacts at Glomar Shoal and on the AMP values (foraging and habitats) within the Montebello AMP (submerged). + Hydrocarbon impact on the migratory shorebirds at Barrow Island.	
Likelihood	b – Unlikely
A worst-case diesel release resulting from a vessel collision is unlikely to have widespread ecological effects given the nature of the hydrocarbons on board, the finite volumes that could be released, the water depth and the transient nature of marine fauna in this area. Long-term impacts resulting in complete habitat loss or degradation are not considered likely given the control measures proposed to prevent releases; therefore, the activity will be conducted in a manner that is considered acceptable. The likelihood of a diesel release occurring due to refuelling is limited given the set of mitigation and management controls in place. Consequently, the likelihood of a vessel collision releasing hydrocarbons to the environment, is considered to be b- Unlikely.	
Residual Risk	The residual risk associated with this hazard is **Low**

7.3.5 Demonstration of ALARP

The use of vessels is integral to activity and therefore vessels and associated risks of unplanned hydrocarbon releases, cannot be completely eliminated.

Offshore refuelling is standard industry practice and oil pollution legislation (*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and MARPOL Annex I) has been developed to safeguard against the risk of a hydrocarbon spill occurring during refuelling. Other hydrocarbon types such as HFO, IFO have specifically not been selected for this Activity (only diesel will be used in the operational areas) to ensure potential environmental impacts are reduced to ALARP.

The combination of the standard prevention CMs (which reduce the likelihood of the event happening), and the spill response strategies (which may reduce the consequence) together reduce the overall hydrocarbon spill risk.

No additional controls have been identified and given the controls in place detailed above, the assessed residual risk for this impact is Low and cannot be reduced further. It is considered therefore that the impact of the activities conducted is reduced to ALARP.

In terms of spill response activities, Santos will implement oil spill response as specified within the OPEP. A detailed ALARP assessment on the adequacy of arrangements available to support spill response strategies and CMs is presented in the OPEP.

The North-west Marine Parks Network Management Plan states that 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 of the marine parks identified with the EMBA (DNP, 2018a) without an authorisation issued by the Director, provided that the actions are taken in accordance with an EP that has been accepted by NOPSEMA, and the Director is notified in the event of oil pollution within a marine park, or where an oil spill response action must be taken within a marine park, so far as reasonably practicable, prior to response action being taken.

7.3.6 Acceptability Evaluation

Is the risk ranked between Low to Medium?	Yes – maximum credible spill volume from vessel collision (329 m^3) residual risk is ranked as low.
Is further information required in the consequence assessment?	Yes – Hydrocarbon spill modelling results used to determine consequence and risk.
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian Marine Park zoning objectives)?	Yes – management consistent with OPGGS (E) R 2009 including safety case and WOMP. The following material published in relation to threatened and migratory species within the EMBA identifies habitat degradation / modification, pollution or oil spills as a threat (**Table 3-9**): **Conservation Advice:** + Approved Conservation Advice on *Pristis clavate* (Dwarf Sawfish) (2009) + Approved Conservation Advice on *Pristis zijsron* (green sawfish) (2008) + Approved Conservation Advice for *Milyeringa veritas* (Blind Gudgeon) (2008) + Approved Conservation Advice for *Ophisternon candidum* (Blind Cave Eel) (2008) + Approved Conservation Advice for *Pristis pristis* (Largetooth sawfish) (2014) + Approved Conservation Advice for *Glyphis garricki* (northern river shark) 2014 + Approved Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015a) + Approved Conservation Advice for *Aipysurus apraefrontalis* (Short-nosed Sea Snake) (2011) + Approved Conservation Advice for *Aipysurus foliosquama* (Leaf-scaled Seasnake) (2011) + Commonwealth Conservation Advice on Dermochelys coriacea (2008) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015b) + Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (2015d)

	+ Approved Conservation Advice on *Neophoca cinerea* Australian Sea Lion (2020) + and relevant recovery plans and conservation advices for birds. **Recovery Plans:** + Sawfish and River Sharks Multispecies Recovery Plan (2015a) + Recovery Plan for the White Shark (*Carcharodon carcharias*) (2013a) + Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (2014) + Wildlife Conservation Plan for Migratory Shorebirds (Commonwealth of Australia 2015) + Draft Wildlife Conservation Plan for Seabirds (Commonwealth of Australia 2019) + National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011) + Recovery Plan for Marine Turtles in Australia (DoEE, 2017) + Blue Whale Conservation Management Plan 2015 - 2025 (DoE, 2015b) + Conservation Management Plan for the Southern Right Whale 2011 – 2021 (2012) + Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (2013) Recovery Plans / Conservation Advice for other species that may occur in the EMBA do not identify pollution or habitat degradation / modification as a key threat or have explicit relevant objectives or management actions. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) + South-west Marine Parks Network Management Plan (2018) + Conservation values of the identified protection priorities (**Section 3.2.2**) have been considered, including the Montebello AMP, the Barrow Island Marine Park and Management Area, Montebello Islands Marine Park (State Marine Park), Muiron Island Marine Management Area, and Ningaloo Marine Park. + Management is also consistent with the zoning of the Australian Marine Parks, in that risks have been reduced to ALARP, e.g., implementation of spill response activities will limit impacts, thereby conserving the marine park values (described in **Section 3.2.2** and **Table 3-4)**. The objectives of these publications were considered during the assessment of impacts and risks. The activity is not inconsistent

	with these objectives. The controls outlined in **Table 7-18** are consistent with the objectives of the material listed above and in **Table 3-4** and **Table 3-9**. Santos considers the impacts of hydrocarbon spill - MDO to not be inconsistent with these objectives.
Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised. AMSA requested that vessels comply with the International Rules for Preventing Collisions at Sea (COLREGs), in particular, the use of appropriate lights and shapes to reflect the nature of operations; and that navigation status is set correctly in the ship's ASI unit. AMSA also requested that appropriate notifications of activity are made to AMSA's JRCC and the Australian Hydrographic Office (for Notice to Mariners); and that timely and relevant Maritime Safety Information (MSI) is promulgated for the area and nature of operations. DMIRS requested that the EP includes information about the reporting of environmental incidents that could potentially impact on any land or water in State jurisdiction. Santos considers these concerns to have been addressed or will be addressed as per the Activity Notification and Reporting Requirements (**Table 8-4**).
Are performance standards such that the impact or risk is considered to be ALARP?	Yes (see ALARP above).

The potential impacts and risks from diesel spills are well understood, and the activities will be managed in accordance with relevant legislation and standards. With the implementation of industry-standard and activity-specific control measures to reduce the likelihood of a diesel spill event (and minimise impacts), the residual risk is assessed to be low and ALARP. No stakeholder concerns have been raised regarding this hazard. Therefore, it is considered that the proposed control measures will reduce the risk of impact from a diesel spill to a level that is acceptable.

7.4 Minor Hydrocarbon Release (Surface and Subsea)

7.4.1 Description of Event

Event	Sources of risk from a minor hydrocarbon release may occur as a result of: + MODU Operations + Vessel Operations + ROV Operations

	Causes for accident hydrocarbon releases (other than diesel release from a vessel collision or refuelling, and LOWC) include: + ROV failure (including oil seal, hydraulic system hose and quick disconnect system failures) + Loss of primary containment (drums, tanks, intermediate bulk containers (IBC), etc.) due to handling, storage and dropped objects (e.g. swinging load during lifting activities) + Vessel or MODU pipework failure or rupture, hydraulic hose failure, inadequate bunding + Lifting – dropped objects damaging diesel infrastructure (hoses, pipes, tanks, etc.). The MODU and support vessels main engines and equipment such as pumps, cranes, winches, power packs and generators require MDO for fuel and a variety of hydraulic fluids and lubricating oils for efficient operation and maintenance of moving parts. These products are present within the equipment and also held in storage containers and tanks on the support vessels. Small hydrocarbon leaks could occur from loss of primary containment due to handling, storage and dropped objects (during lifting activities). Volumes are likely to be small and limited to the volume of individual containers (e.g., IBC, 44-gallon drums, etc.) stored on the deck of vessels or the MODU. The credible spill for this scenario is considered to be the loss of an IBC (1 m^3) during transfer from a support vessel to the MODU. Equipment deployed overboard during drilling (e.g., ROV operations) can result in unplanned discharges (of hydraulic fluids) directly to the marine environment due to equipment failure, equipment interactions with the vessel thrusters and/or accidental contact with subsea infrastructure. The largest credible hydrocarbon spill from ROV operations would be an accidental release of approximately 0.05 m^3 (50 L) of hydraulic fluid from the deployed ROV. Minor accidental loss of other hydrocarbon-based liquids (e.g., used lubricating oils, cooking oil, and hydraulic oil) to the marine environment could also occur via tank pipework failure or rupture, hydraulic hose failure, inadequate bunding and/ or storage, insufficient fastening or inadequate handling which could result in impacts to water quality and hence sensitive environmental receptors. For environmental impacts of planned discharges, please refer to previous **Section 6.6** and **Section 6.7**.
Extent	Any hydrocarbon-based liquid accidentally discharged within the OA will either sink within the surrounding area or disperse rapidly within the OA (in the case of small leaks/spills).
Duration	An instantaneous release occurring during the activity not extending beyond the OA.

7.4.2 Nature and Scale of Environmental Impacts

Potential Receptors: Physical environment (water and sediment quality, shoals and banks, benthic habitats, offshore reefs and islands), threatened, migratory or local fauna (marine mammals, marine reptiles, sharks and rays, fish and birds), protected and significant areas (marine parks) and socio-economic receptors (tourism and recreation).

Hydrocarbons released into the marine environment through onboard spills and leaks directed through deck drainage or from a release of hydraulic oil from an ROV umbilical would disperse quickly in waters within the vicinity of the OA.

7.4.2.1 Physical environment

Lubricating and hydraulic oils will behave similarly to MGO if spilt to the marine environment, although lubricating oils are more viscous and so the spreading rate of a slick of these oils would be slightly slower. Hydraulic oils are medium oils of light to moderate viscosity and have a relatively rapid spreading rate and dissipate quickly in higher sea states.

7.4.2.2 Threatened/migratory fauna

A release could potentially impact plankton, fish and sharks, marine mammals and marine reptiles although given the highly dispersive waters within the OA, the extent of the water column and the relatively small potential volumes associated with such a release, rapid dilution is expected, and concentrations are unlikely to persist for periods of time where impacts would likely be felt. The greatest potential for impact would likely be for passive or low mobility fauna such as plankton, including both invertebrates and fish larvae which may be exposed for the greatest periods of time and likely have a permanent presence within the OA. 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.

Large, more mobile fauna (including protected species such as cetaceans, marine turtles, seabirds and whale sharks) are likely to be transient within the OA and toxic impacts are unlikely to occur to these species in the event of a small liquid hazardous hydrocarbon release (although refer **Sections 7.2** to **7.3** for potential impacts of larger unplanned hydrocarbon releases).

With respect to demersal fishes, it is possible that some impact may occur through the release of hydraulic oil from an ROV near the seabed. However, given the small volume of any credible ROV release (approximately 50 L) and the lack of any natural seabed features that would indicate a high abundance or diversity of demersal fishes, it is considered that such a release would have a negligible impact on the demersal fish populations.

7.4.2.3 Protected and significant areas and Socio-economic receptors

The OA intersects the Montebello Marine Park (Multiple Use Zone – IUCN Category VI). The conservation values of the marine park (as outlined in **Section 3.2.2**) have the potential to be impacted by hazardous liquid releases through impacts to the physical environment and marine fauna. Impacts to the physical environment and marine fauna are discussed in the sections above.

Other marine users within the Montebello Marine Park include tourists and recreational visitors, which are important to the socio-economic values for the marine park. Given the localised and temporary impacts of an unplanned hydrocarbon spill, any impact to tourism and recreation activities, such as snorkelling, diving, surfing and recreational fishing that predominantly occur within the Montebello Islands is considered unlikely.

7.4.3 Environmental Performance Outcomes and Control Measures

The EPOs relating to this event include:

- No loss of containment of hydrocarbon to the marine environment (YO-EPO-03)
- No unplanned objects, emissions or discharges to sea or air (YO-EPO-04)
- No injury or mortality to EPBC Act 1999 and WA Biodiversity Conservation Act 2016 listed marine fauna during operational activities. (YO-EPO-05).

The control measures considered for this event are shown in **Table 7-21**, and EPSs and measurement criteria for the EPOs are described in **Section 8.4**.

Table 7-21: Control Measure Evaluation for Minor Hydrocarbon Release (Surface and Subsea)

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
YO-CM-002	Dropped object prevention procedures	Impacts to environment are reduced by preventing dropped objects and by retrieving dropped objects where possible. Minimises drop risk during MODU lifting operations. Ensures lifting equipment certified and inspected.	Personnel costs involved in implementing procedures and in incident reporting.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweigh costs.
YO-CM-005	Hazardous chemical management procedures	Reduces the risk of spills and leaks (discharges) to sea by controlling the storage, handling and clean-up.	Personnel cost associated with implementation of procedures and permanent or temporary storage areas.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweigh costs.
YO-CM-008	General chemical management procedures	Potential impacts to the environment are reduced through following correct procedures for the safe handling and storage of chemicals.	Personnel costs associated with ensuring procedures are in place and implemented during inspections.	**Adopted –** Benefits of ensuring procedures are followed and measures implemented outweigh the costs of personnel time.
YO-CM-009	Maritime Dangerous Goods Code	Dangerous goods managed in accordance with International Maritime Dangerous Goods Code (IMDG Code) to reduce the risk of an environmental incident, such as an accidental release	Cost associated with implementation of code/procedure.	**Adopted –** Benefits of ensuring procedures are followed and measures implemented outweigh costs.

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		to sea or unintended chemical reaction.		
YO-CM-012	MODU and support vessel spill response plans including pre-drilling source control plan	Potential impacts to the environment are reduced through effective management of an accidental spill (discharge to sea).	Personnel cost associated with ongoing management (spill response exercises) and implementation of plans.	**Adopted** – Benefits of ensuring response plans in place, are followed, measures implemented, and that the MODU / vessels are compliant outweighs costs.
YO-CM-013	ROV inspection and maintenance procedures	Maintenance and pre-deployment inspection on ROV completed as scheduled to reduce the risk of hydraulic fluid releases to the marine environment.	Additional personnel costs of ensuring procedures in place and followed.	**Adopted** – Benefits of ensuring procedures are followed outweigh costs.
YO-CM-010	Bulk liquid transfer procedure	Bulk liquid (hydrocarbon) transferred in accordance with bulk transfer procedure to reduce the risk of an unintentional release to the marine environment.	Personnel costs associated with ensuring procedure is in place and implemented during inspections. Cost of purchasing and maintaining equipment (e.g. bulk hoses and connections).	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweighs costs.
YO-CM-16	Accepted Oil pollution emergency plan (OPEP)	Implements response plan to deal with an unplanned hydrocarbon spills quickly and efficiently in order to reduce impacts	Personnel and administrative costs associated with preparing documents, ongoing management (spill response exercises) and	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweighs costs.

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		to the marine environment.	implementation of OPEP.	
Additional Control Measures				
No additional control measures are considered as the risk is considered ALARP				

7.4.4 Environmental Impact Assessment

Table 7-22: Impact, Likelihood and Consequence Ranking – Minor Hydrocarbon Release (Surface and Subsea)

Receptors	+ Physical environment (water and sediment quality, shoals and banks, benthic habitats, offshore reefs and islands) + Threatened, migratory or local fauna (marine mammals, marine reptiles, sharks, fish, rays and birds) + Protected and significant areas and Socio-economic receptors (marine parks, tourism and recreation)
Consequence	II - Minor
In the event of a minor hydrocarbon spill, the quantities would be limited to approximately 1 m^3 for the loss of the contents of an IBC, or 50 L for ROV hydraulic fluid. The small volumes, dilution and dispersion from natural weathering processes such as ocean currents are such that spills will be limited in area and duration. The number of receptors present at the activity location are expected to be limited to a small number of transient individuals. The susceptibility of marine fauna to hydrocarbons is dependent on hydrocarbon type and exposure duration; however, given that exposures would be limited in extent and duration, exposure to marine fauna from this hazard is considered to be low. The small volumes of worst-case discharges are such that, the impacts to receptors will decline rapidly with time and distance at the sea surface. Rapid dilution at depth would also result in the impacts to receptors declining rapidly with time and distance. Deteriorating water quality and marine pollution are identified as potential threats to a number of marine fauna species in relevant Recovery Plans and Conservation Advice (**Table 3-9**) and to MNES (DoE, 2013). With control measures in place, the activity will be conducted in a manner that reduces potential impacts to ALARP and an acceptable level. Toxic impacts are not expected to the benthic community due to the water depths. 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. In offshore waters near to the release point, pelagic fish are at risk of exposure to the more toxic aromatic components of the hydrocarbons. 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. The potential minor hydrocarbon releases are not expected to significantly impact the receiving	

environment with control measures proposed to prevent releases and therefore the activity will be conducted in a manner that is considered acceptable. Given that a small hydrocarbon spill would not result in a decreased population size at a local or regional scale, it is expected that a spill of this nature would result in a Minor (II) consequence.	
Likelihood	b – Unlikely
A small hydrocarbon liquid release is unlikely to have widespread ecological effects given: + The nature of the hydrocarbons (hydraulic fluids, lubricant oils and waste oils) stored on-board + The small volumes that could be released + The water depth + The transient nature of marine fauna in this area + The control measures in place to prevent spills + The procedures in place to clean up a spill. Consequently, the likelihood of releasing minor volumes of hydrocarbons to the environment, which results in a minor consequence, is considered Unlikely (b).	
Residual Risk	The residual risk associated with this event is **Very Low**.

7.4.5 Demonstration of ALARP

Storage and use of hydraulic and lubricating oils/ fluids for equipment and machinery, including for ROV operations, are required to undertake the activity, so their removal from the activity is not viable. A thorough set of control measures have been proposed to ensure the risks of minor hydrocarbons spills and leaks occurring and subsequent impacts are minimised. The resulting impacts to marine fauna that could potentially result from a spill of this size would be negligible, with impacts restricted to a small number of individuals within a localised area. The assessed residual risk for this impact is low and cannot be reduced further. Therefore, it is considered that the impact of the activities conducted is ALARP.

7.4.6 Acceptability Evaluation

Is the risk ranked between Low and Medium?	Yes - maximum minor hydrocarbon spill residual risk is ranked as Low.
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans,	Yes – management consistent with International Convention of the Safety of Life at Sea (SOLAS) 1974 and Navigation Act 2012, Marine Order 91 (Marine pollution prevention – oil). The following material published in relation to threatened and migratory species within the OA identifies habitat degradation / modification as a threat (**Table 3-9**): **Conservation Advice:**

conservation advice and Australian Marine Park zoning objectives)?	+ Approved Conservation Advice on *Pristis clavate* (Dwarf Sawfish) (2009) + Approved Conservation Advice on *Pristis zijsron* (green sawfish) (2008) + Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015) + Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (2015) + Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (2015) + Approved Conservation Advice for *Calidris canutus* (Red knot) (2016) + Commonwealth Conservation Advice on *Dermochelys coriacea* (2008) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015) **Recovery Plans:** + Sawfish and River Sharks Multispecies Recovery Plan (2015) + Recovery plan for the White Shark (*Carcharodon carcharias*) (2013) + Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (2014) + Wildlife Conservation Plan for Migratory Shorebirds (CoA,2015) + Draft Wildlife Conservation Plan for Seabirds (CoA, 2019) + Recovery plan for marine turtles in Australia 2017 – 2027 (CoA, 2017a) + Blue Whale Conservation Management Plan 2015 – 2025 (2015) + For all the recovery plans identified above, the objectives are achieved through the adoption of YO-EPO-03, YO-EPO-4, YO-EPO-05 and the control measures outlined in **Table 7-21**; and Santos considers the impacts of a minor hydrocarbon release to not be inconsistent with these recovery plans. Recovery Plans / Conservation Advice for other species that may occur in the project area do not identify habitat degradation / modification as a key threat or have explicit relevant objectives or management actions related to habitat degradation / modification.

	Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) identifies habitat modification as a pressure that may impact marine park values. It seeks to minimise the impact of pressures on the marine park values as far as reasonably practicable. The implementation of YO-EPO-03, YO-EPO-4, YO-EPO-05 and the control measures outlined in **Table 7-21** will ensure the risk associated with an unplanned minor release of hydrocarbons will not compromise this outcome. + The OA intersects the Montebello Marine Park which is categorised as Multiple Use Zone (IUCN Category VI) (**Table** 3-4). The objective of the Multiple Use Zone (VI) is to provide ecologically sustainable use and the conservation of ecosystems, habitats and native species. The management of the activity in relation to minor hydrocarbon release is aligned with this objective through the adoption of YO-EPO-03, YO-EPO-4, YO-EPO-05 and the control measures outlined in **Table 7-21**. The objectives and actions of these publications were considered during the assessment of impacts and risks. The controls outlined in **Table 7-21** are consistent with the objectives of the material listed above and Santos considers the impacts of minor hydrocarbon release to not be inconsistent with these objectives.
Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

With the control measures in place to prevent the accidental release of minor volumes of hydrocarbons, and potential social and environmental impacts and risk well understood and considered low, the environmental risk associated with a minor hydrocarbon release is considered acceptable.

7.5 Non-hydrocarbon and Chemicals Release (Surface) – Liquids

7.5.1 Description of Event

Event	Sources of risk from an accidental release of non-hydrocarbon and chemical release (liquids) may occur as a result of: + Vessel Operations

	+ MODU Operations Non-hydrocarbon liquids including miscellaneous chemicals and waste streams (brine, mixed cement, cleaning and cooling agents, stored or spent chemicals and leftover paint materials) are used or stored on-board the MODU/ vessels during the activity. The presence of non-hydrocarbons liquids and chemicals represents a potential spill risk during chemical storage and handling e.g., due to tank damage, or human error. Another credible spill is due to a hose that parts when loading/offloading brine. Rupture of the pumping hose used to transfer these chemicals may occur due to dropped object, vessel motion, or hose failure. An accidental release of chemicals and other non-hydrocarbon liquids into the marine environment has the potential to occur from the following activities: + MODU and support vessel operations + Transferring, storing or using bulk products (e.g., mixed cement) + Mechanical failure of equipment + Handling and storage spills and leaks + Hose or hose connection failure or leak + Lifting – dropped objects damaging liquid vessels (containers). Accidental loss of non-hydrocarbon liquids or chemicals to the marine environment could occur via tank pipework failure or rupture, inadequate bunding and/ or storage, insufficient fastening or inadequate handling may result in impacts to water quality and hence sensitive environmental receptors.
Extent	The maximum volume of non-hydrocarbon liquids or chemicals that could be released during routine operations is likely to be small and realistically limited to the volume of individual containers (e.g., drums etc.) stored on deck of vessels or the MODU. The worst-case credible scenario, however, would be a malfunction with the machinery and cause an aborted cement job of the largest worst-case spill volumes of 30 m^3 at the sea surface and 100 m^3 at the seabed. For the purpose of this scenario, a conservative 100 m^3 discharge volume will be used as a worst-case scenario. The environment that may be affected for non-hydrocarbon liquids or chemical release resulting in a decrease in water quality is likely to be restricted to around the MODU and vessels but contained within the OA.
Duration	Instantaneous release during the activity.

7.5.2 Nature and Scale of Environmental Impacts

<u>Potential Receptors: Physical environment (water and sediment quality, shoals and banks, benthic habitats, offshore reefs and islands), threatened, migratory or local fauna (marine mammals, marine reptiles, sharks and rays, fish and birds), protected and significant areas (marine parks) and socio-economic receptors (tourism and recreation).</u>

7.5.2.1 Physical environment

Non-hydrocarbon liquids or chemicals released to the marine environment may lead to contamination of the water column in the vicinity of the MODU and vessels. The potential impacts would most likely be highly localised and restricted to the immediate area surrounding the spill, with rapid dispersal to concentrations below impact thresholds likely to occur in the open ocean (high energy environment that facilitates rapid dispersion and dilution to non-toxic concentrations) (French McCay et al. 2004).

The changes to water quality that may result could potentially lead to short-term impacts (few hours) on marine fauna (e.g. plankton, pelagic/benthic fish, epifauna, cetaceans, marine reptiles and seabirds), with chronic impacts not expected owing to the short exposure times and is unlikely to lead to widespread ecological effects.

7.5.2.2 Threatened/migratory fauna

Changes to water quality could potentially lead to short-term impacts on marine fauna (e.g., pelagic fish and sharks, marine mammals, marine reptiles and seabirds). As summarised in **Table 3-8**, the OA overlaps several BIAs, including the green, flatback and hawksbill turtles (internesting buffer, including critical habitat); humpback whale (migration); and pygmy blue whale (distribution).

Recovery plans and conservation advices for numerous bird species identify marine pollution and contamination impacts as a threat to the species. This includes the following marine species identified as potentially occurring within the OA: red knot, southern giant petrel and eastern curlew. In addition, the Recovery Plan for the Grey Nurse Shark (Carcharias taurus) (DoE, 2014) identifies pollution as a threat to the species; and the Recovery Plan for Marine Turtles in Australia 2017 – 2027 (DoEE, 2017) identifies deteriorating water quality as a threat to all species of marine turtles in Australia. Given the distance from the OA to the nearest island (Trimouille Island, approximately 20 km), these species are expected to be transient within the OA.

Chemical spills are unlikely to have widespread ecological effects on threatened or migratory fauna, given the nature of the chemicals on board, the small volumes that could be released, and the open-ocean environment of the location. Physical coating of marine fauna, in particular those present at the sea surface (e.g., seabirds), by entrained or surface hazardous liquids and sublethal or lethal effects from toxic chemicals are considered unlikely given the expected low concentrations and short exposure times.

Plankton, Fish (pelagic) & Sharks

A release of hazardous chemicals could potentially impact plankton, pelagic invertebrates and pelagic fish in the immediate vicinity of the release, however given the highly dispersive waters within the OA, the extent of the water column (water depth approximately 45 m) and the relatively small potential volumes associated with such releases, rapid dilution is expected, and concentrations are unlikely to persist for periods of time where impacts would likely be felt. The greatest potential for impact would likely be for passive or low mobility fauna such as plankton, pelagic invertebrates and pelagic fish which may be exposed for the greatest periods of time and likely have a permanent presence within the OA.

Marine Mammals

A release of hazardous chemicals could potentially impact marine mammals in the immediate vicinity of the release, however given the highly dispersive waters within the OA, the extent of the water column (water depth approximately 45 m) and the relatively small potential volumes associated with such releases, rapid dilution is expected, and concentrations are unlikely to persist for periods of time where impacts would likely be felt. The OA overlaps a migration BIA for humpback whales and a distribution BIA for pygmy blue whales, however no habitat critical to the survival of species or breeding BIAs overlap the OA. Marine mammals are large and more mobile fauna are likely to be transient within the OA and toxic impacts are unlikely to occur to these species in the event of a small liquid hazardous hydrocarbon release.

The Conservation Management Plan for Blue Whales (DoE, 2015a) has identified acute and chronic chemical discharge as a threat to pygmy blue whales. However, the impacts are concentrated within the OA and the potential release of hazardous / non-hazardous liquids is not expected to significantly impact the receiving environment.

The Conservation Advice for humpback whales (TSSC, 2015d) and have not identified the potential release of hazardous / non-hazardous liquids into the marine environment to be a threat to the species.

Marine Turtles

The OA is within an internesting habitat critical to the survival of flatback turtles, Hawksbill turtles and Green turtles, which is also designated a BIA.. However, the presence of internesting flatback turtles is unlikely, given the undesirable conditions of deep-water depths compared to a study by Whittock et al 2016 that showed a suitable internesting habitat was in waters 0-16 m deep and within 5-10 km of the coastline, while unsuitable internesting flatback turtle habitats was defined as water >25 m and 27 km from the coastline.

The Recovery Plan for Marine Turtles in Australia 2017 – 2027 (Commonwealth of Australia, 2017a) identifies deteriorating water quality as a threat to all species of marine turtles in Australia. Given the distance from the OA to the nearest island (Trimouille Island, approximately 20 km), these species are expected to be transient within the OA.

Seabirds

The wedge-tailed shearwater and roseate tern have a breeding/foraging BIA that overlaps the OA. However, given the highly dispersive waters within the OA, the extent of the water column (water depth approximately 45 m) and the relatively small potential volumes associated with such releases, rapid dilution is expected, and concentrations are unlikely to persist for periods of time where impacts would likely be felt.

There are no Recovery Plan or Conservation Advice for the wedge-tailed shearwater or roseate tern.

7.5.2.3 Protected and significant areas and Socio-economic receptors

The OA intersects the Montebello Marine Park (Multiple Use Zone – IUCN Category VI). The conservation values of the marine park (as outlined in **Section 3.2.2**) have the potential to be impacted by hazardous liquid releases through impacts to the physical environment and marine fauna. Impacts to the physical environment and marine fauna are discussed in the sections above.

Other marine users within the Montebello Marine Park include tourists and recreational visitors, which are important to the socio-economic values for the marine park. Given the localised and temporary impacts of an unplanned hazardous liquid spill, any impact to tourism and recreation activities, such as snorkelling, diving, surfing and recreational fishing that predominantly occur within the Montebello Islands is considered unlikely.

7.5.3 Environmental Performance Outcomes and Control Measures

The EPOs relating to this event include:

- No unplanned objects, emissions or discharges to sea or air (YO-EPO-04)
- No injury or mortality to EPBC Act and WA Biodiversity Conservation Act 2016 listed marine fauna during operational activities. [YO-EPO-05].

The control measures for this event are shown in **Table 7-23**, and the EPS' and measurement criteria for the EPOs are described in **Section 8.4**.

Table 7-23: Control Measure Evaluation for Non-hydrocarbon and Chemicals Release (Surface) – Liquids

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
YO-CM-002	Dropped object prevention procedure	Minimises dropped object risk during MODU/ vessel lifting operations that may cause secondary spill resulting in reduction in water quality. Ensures lifting equipment certified and inspected.	Cost to maintain lifting equipment and implement procedure.	**Adopted –** Benefits of ensuring procedures are followed and measures implemented outweighs costs.
YO-CM-005	Hazardous chemical management procedures	Reduces the risk of spills and leaks (discharges) to the sea by controlling the storage, handling and clean-up of hazardous chemicals.	Personnel cost associated with implementation of procedures and permanent or temporary storage areas.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweigh the costs of personnel time.
YO-CM-006	Deck cleaning product selection	Improves water quality discharge (reduced toxicity) to the marine environment. Those deck cleaning products planned to be released to sea meet the criteria for not being harmful to the marine environment according to MARPOL Annex V	Personnel costs of implementing, potential additional cost and delays of chemical substitution.	**Adopted –** Benefits of ensuring MODU/vessels are compliant and those deck cleaning products planned to be released to sea meet Australian Marine Orders criteria.
YO-CM-007	Chemical selection procedure	Improves water quality discharge (reduced toxicity) to the marine environment in the event of an unplanned release.	Cost associated with implementation of procedure. Range of chemicals reduced but potentially higher costs. Potential additional	**Adopted –** Benefits of ensuring procedures are followed and measures implemented

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
			cost and delays of chemical substitution	outweigh the costs of personnel time.
YO-CM-008	General chemical management procedures	Potential impacts to the environment are reduced through following correct procedures for the safe handling and storage of chemicals.	Personnel costs associated with ensuring procedures are in place and implemented during inspections.	**Adopted –** Benefits of ensuring procedures are followed and measures implemented outweigh the costs of personnel time.
YO-CM-009	Maritime Dangerous Goods Code	Dangerous goods managed in accordance with International Maritime Dangerous Goods Code (IMDG Code) to reduce the risk of an environmental incident, such as an accidental release to sea or unintended chemical reaction.	Cost associated with implementation of code/procedure.	**Adopted –** Benefits of ensuring procedures are followed and measures implemented outweighs costs.
YO-CM-010	Bulk liquid transfer procedure	Bulk liquid transferred in accordance with bulk transfer procedures to reduce the risk of an unintentional release to the sea.	Cost to implement ongoing procedure. Cost of purchasing and maintaining equipment (e.g. bulk hoses and connections).	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweighs costs.
YO-CM-013	ROV inspection and maintenance procedures	Maintenance and pre-deployment inspection on ROV completed as scheduled to reduce the risk of hydraulic fluid releases to the marine environment.	Additional personnel costs of ensuring procedures in place and followed.	**Adopted –** Benefits of ensuring procedures are followed outweigh costs.
YO-CM-040	MODU Planned Maintenance System (PMS)	Reduces discharges from the MODU because equipment is	Operational costs and labour or access requirements of	**Adopted** – Benefits of ensuring procedures are followed and

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
		operating within its parameters	undertaking maintenance	measures implemented outweighs costs.
YO-CM-041	Vessel PMS to maintain vessel DP, engines and machinery	Reduces discharges from the vessel because equipment is operating within its parameters	Operational costs and labour or access requirements of undertaking maintenance	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweighs costs.
Additional Control Measures				
No additional control measures are considered as the risk is considered ALARP				

7.5.4 Environmental Impact Assessment

Table 7-24: Impact, Likelihood and Consequence Ranking – Non-hydrocarbon and Chemicals Release (Surface) – Liquids

Receptors	+ Physical environment (water and sediment quality, shoals and banks, benthic habitats, offshore reefs and islands) + Marine fauna – Plankton, fish, sharks, marine mammals, marine reptiles, seabirds + Protected and significant areas and Socio-economic receptors - marine parks, tourism and recreation
Consequence	I – Negligible
In the event of a non-hydrocarbon liquid or chemical spill, the quantities of a worst-case liquid release is unlikely to be greater than 1 m^3, but for the conservative approach it could possibly be up to 100 m^3. The small volumes, dilution and dispersion from natural weathering processes such as ocean currents indicate that the extent of exposure will be limited in area and duration. The susceptibility of marine fauna to non-hydrocarbon liquids and chemicals is dependent on the type and exposure duration however given that exposures would be limited in extent and duration, exposure to marine fauna from this hazard is not expected to result in a fauna fatality. Impacts from discharges to the marine environment to water quality would be short-term and localised, due to the nature and behaviour of the chemicals identified as being at risk of spilling; only pelagic fauna present in the immediate vicinity of the spill would likely be at risk of impact. Habitat degradation, deteriorating water quality and marine pollution are identified as potential threats to a number of marine fauna species (that may be present in the OA) in relevant Recovery Plans and Conservation Advice (**Table 3-9**) and to MNES (DoE, 2013). However, the potential non-hydrocarbon releases of liquids or chemicals are not expected to significantly impact the receiving environment with control measures proposed to prevent releases.	

Given that a non-hydrocarbon or chemical spill would not result in a decreased population size at a local or regional scale and will have an insignificant impact to the protected area values of the Montebello AMP, it is expected that a spill of this nature would result in a I (Negligible) consequence.	
Likelihood	C – Possible
A small non-hydrocarbon liquid release is unlikely to have widespread ecological effects, given the nature of the chemicals on board, the small volume that could be released, the depth and transient nature of marine fauna in this area, and the prevention and management procedures in place to clean up a spill. Santos' reviewed non-hydrocarbon liquid spills and leaks from equipment and machinery in recent history (due to split hoses, small leaks, or handling errors). Most of the spills and leaks reported occurred within bunded areas, were less than 100 L, did not reach the marine environment and were cleaned up immediately. The likelihood of a small hazardous liquids release occurring is limited given the set of mitigation and management controls in place for this program. Consequently, the likelihood of releasing hazardous liquids to the environment, which results in a minor consequence, is considered to be Possible (c).	
Residual Risk	The residual risk associated with this event is **Very Low**.

7.5.5 Demonstration of ALARP

Non-hydrocarbon liquids and chemicals will be required to undertake the activity, so their removal from the operation is not viable. Dangerous chemicals used during the activity will be managed where applicable, in compliance with the Maritime Dangerous Goods Code. Procedures are in place for the transfer of bulk liquids, reducing the risk of unplanned releases to sea due to equipment failure, operational error, or overflows and leaks. Objects will need to be moved around the decks of the MODU and vessels and transferred between the MODU and the support vessels. Control measures in place will ensure correct lifting, storage and handling procedures are followed as well as ensuring the maintenance of equipment is undertaken according to preventative management systems. No beneficial additional control measures were identified to further reduce the risk of this hazard. The control measures proposed align with applicable actions described in relevant recovery plans and conservation advices to reduce risk of habitat degradation and deteriorating water quality (e.g., from pollution) to a level considered ALARP by Santos. The assessed residual risk for this impact is low and cannot be reduced further. It is considered therefore that the risk of the activities is ALARP.

7.5.6 Acceptability Evaluation

Is the risk ranked between Very Low to Medium?	Yes – maximum hazardous liquid release (surface) residual risk is ranked Very Low.
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.

Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian Marine Park zoning objectives)?	Yes – management consistent with Marine Order 94 (Marine pollution prevention – packaged harmful substances). The following material published in relation to threatened and migratory species within the OA identifies habitat degradation / modification as a threat (**Table 3-9**): **Conservation Advice:** + Approved Conservation Advice on *Pristis clavate* (Dwarf Sawfish) (2009) + Approved Conservation Advice on *Pristis zijsron* (green sawfish) (2008) + Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015) + Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (2015) + Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (2015) + Approved Conservation Advice for *Calidris canutus* (Red knot) (2016) + Commonwealth Conservation Advice on *Dermochelys coriacea* (2008) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015) **Recovery Plans:** + Sawfish and River Sharks Multispecies Recovery Plan (2015) + Recovery plan for the White Shark (*Carcharodon carcharias*) (2013) + Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (2014) + Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015) + Draft Wildlife Conservation Plan for Seabirds (CoA, 2019) + Recovery plan for marine turtles in Australia 2017 – 2027 (CoA 2017a) + Blue Whale Conservation Management Plan 2015 – 2025 (2015) + For all the recovery plans identified above, the objectives are achieved through the adoption of YO-EPO-4, YO-EPO-05 and the control measures outlined in **Table 7-23**; and Santos considers the impacts of a non-hydrocarbon chemicals release to not be inconsistent with these recovery plans.

	Recovery Plans / Conservation Advice for other species that may occur in the project area do not identify habitat degradation / modification as a key threat or have explicit relevant objectives or management actions related to habitat degradation / modification. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) identifies habitat modification as a pressure that may impact marine park values. It seeks to minimise the impact of pressures on the marine park values as far as reasonably practicable. The implementation of YO-EPO-4, YO-EPO-05 and the control measures outlined in **Table 7-23** will ensure the risk associated with unplanned release of non-hydrocarbons and chemicals will not compromise this outcome. + The OA intersects the Montebello Marine Park which is categorised as Multiple Use Zone (IUCN Category VI) (**Table** 3-4). The objective of the Multiple Use Zone (VI) is to provide ecologically sustainable use and the conservation of ecosystems, habitats and native species. The management of the activity in relation to non-hydrocarbon and chemicals release is aligned with this objective through the adoption of YO-EPO-4, YO-EPO-05 and the control measures outlined in **Table 7-23**. The objectives and actions of these publications were considered during the assessment of impacts and risks. The controls outlined in **Table 7-23** are consistent with the objectives of the material listed above and Santos considers the impacts of non-hydrocarbon and chemicals release to not be inconsistent with these objectives.
Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

With the controls in place to prevent an accidental release of small volumes of non-hydrocarbon liquids and chemicals and the negligible impacts predicted from an unplanned release of such material, the risk to the marine environment is considered low. Potential risks are unlikely to be greater than those caused by other commercial marine vessels or offshore petroleum activities in deep water.

The materials will be managed in accordance with relevant legislation and standards and Santos procedures. The small volumes negate the need for any further contingencies to be in place that are included for some of the larger spill scenarios associated with the activity.

With the controls in place to prevent accidental spills and the I (Negligible) impacts predicted from a spill of this size, the environmental risk of using and handling the required chemicals is considered ALARP and environmentally acceptable.

7.6 Release of Solid Objects

7.6.1 Description of Event

Event	Sources of risks from an accidental release of solid waste (non-hydrocarbon) may occur as a result of: + MODU Operations + Vessel Operations Solid objects, such as those listed below, can be accidentally released to the marine environment, and potentially impact on sensitive receptors: + Non-hazardous solid wastes, such as paper and packaging + Hazardous solid wastes, such as batteries, fluorescent tubes, and aerosol cans + Equipment and materials, such as hard hats, tools, or infrastructure parts. Release of these waste streams may occur as a result of overfull and/ or uncovered bins, incorrectly disposed items or spills during transfers of waste, or dropped objects/ lost equipment. In addition, accidental discharge of non-hydrocarbon solid materials has the potential to occur during product transfers or storage of dry bulk product (e.g., cement) and solid additives (e.g., barite and bentonite).
Extent	Localised, as all non-buoyant waste material or dropped objects are expected to remain within the OA. Buoyant waste material or dropped objects could potentially move beyond the OA under wave action.
Duration	Temporary (duration of the Activity) or until the solid waste degrades or is retrieved.

7.6.2 Nature and Scale of Environmental Impacts

<u>Potential Receptors: Physical environment (shoals and banks, benthic habitats, offshore reefs and islands), threatened or migratory fauna (marine mammals, marine reptiles, sharks and rays, fish and birds), protected and significant areas (marine parks) and socio-economic receptors (tourism and recreation).</u>

7.6.2.1 Physical environment

The seabed within the OA is primarily soft sediments with little epifauna; this habitat type is widely distributed and well represented in the North West Shelf region. While soft sediment benthic habits will not be destroyed, disturbance of the communities on and within them (i.e., the epifauna) will occur in the event of a dropped object; and depressions may remain on the seabed for some time after removal of the dropped object as they gradually infill over time.

Impacts to benthic communities from dropped object disturbance are expected to be short term in duration due to the ability for such communities to recover. Recovery is expected within 6 to 12 months, based on previous surveys from drilling impacts (URS, 2001).

Buoyant dropped objects have the potential to be transported by marine currents and may impact on reefs, islands, shoals and banks within the region. Accidentally dropped objects such as plastics have the potential to smother benthic environments, and the release of hazardous solids (e.g., wastes such as batteries) could also impact water quality through pollution of the immediate receiving environment. Impacts from accidentally released liquids are discussed in **Section 7.5**.

7.6.2.2 Threatened/migratory fauna

The Recovery Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018a) have specified a number of recovery actions to help combat this threat. Of relevance to this activity is the legislation for the prevention of garbage disposal from vessels, which Santos implements through the accordance with Marine Order 95 (Marine pollution prevention – garbage) requirements.

The humpback whale and pygmy blue whale may be present within the OA, but they will most likely be transient and/or migrating through the area, where they can divert and move away from objects.

Floating non-biodegradable marine debris has been highlighted as a threat to humpback whales (TSSC, 2015d) and pygmy blue whales (DoE, 2015a). The Recovery Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018a) have specified a number of recovery actions to help combat this threat. Of relevance to this activity is the legislation for the prevention of garbage disposal from vessels, which Santos implements through accordance with Marine Order 95 (Marine pollution prevention – garbage) requirements. Both species that may be present within the OA are large marine fauna that are mobile species and are able to move away from areas.

Marine reptiles are particularly at risk from entanglement. Marine turtles may mistake buoyant waste for food; once ingested, plastics can damage internal tissues and inhibit physiological processes (Nelms et al 2015), which can both potentially result in fauna fatality. The OA is within an internesting habitat critical to the survival of flatback turtles, which is also a designated BIA. The OA is also within an internesting habitat critical to the survival of Green and Hawksbill turtles. However, internesting flatback turtles are unlikely to be present within the OA because of the water depth and distances from nesting beaches being in waters 0-16 m deep and within 5-10 km of the coastline, while unsuitable internesting flatback turtle habitats was defined as water >25 m and 27 km from the coastline (Whittock et al. 2016).

Floating non-biodegradable marine debris has been highlighted as a threat to marine turtles within the Marine Turtle Recovery Plan (Commonwealth of Australia, 2017a). The Recovery Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018a) have specified a number of recovery actions to help combat this threat. Of relevance to this activity is the legislation for the prevention of garbage disposal from vessels, which Santos implements through the accordance with Marine Order 95 (Marine pollution prevention – garbage) requirements.

Seabirds are particularly at risk from entanglement. The OA is within a breeding/foraging BIA for the Roseate tern and wedge-tailed shearwater. However, the OA is 68.12 km from the mainland, therefore, there are no close roosting sites located nearby. The vertebrate wildlife of Australia's coasts and oceans (DoEE, 2018a) have specified a number of recovery actions to help combat this threat. Of relevance to this activity is the legislation for the prevention of garbage disposal from vessels, which Santos implements through the accordance with Marine Order 95 (Marine pollution prevention – garbage) requirements.

7.6.2.3 Protected and significant areas and socio-economic receptors

The OA intersects the Montebello Marine Park (Multiple Use Zone – IUCN Category VI). Conservation values of the marine park (as outlined in **Section 3.2.2**) have the potential to be impacted by a release of solid objects through impacts to marine fauna, which are discussed in the section above.

Other marine users within the Montebello Marine Park include tourists and recreational visitors, which are important to the socio-economic values for the marine park. Tourism activities, such as snorkelling, diving, surfing and recreational fishing, may occur around the Montebello Islands but are not expected to occur in the OA, given the water depth (approximately 45 m), lack of seafloor features and distance from shore. Potential impacts to tourists and recreational visitors within the Montebello Marine Park include the aesthetic impacts of buoyant waste floating into the park and potentially washing up on the shores of the Montebello Islands, as well as the aesthetic impacts of any damage to reefs, shoals and banks.

Impacts to socioeconomic receptors may occur if hazardous / non-hazardous solids cause a safety hazard to other marine users or potentially damage their equipment (e.g. fishing nets).

The area of potential disturbance due to a non-buoyant dropped object would be restricted to the OA. In the unlikely event of damage to or loss of equipment, potential environmental effects could be limited to physical impacts on benthic communities arising from associated equipment sinking to the seabed.

With appropriate management measures in place, solid non-hydrocarbon releases are not expected to occur frequently or to a scale that may cause significant pollution that would impact the conservation or socio-economic values of the Montebello Marine Park.

7.6.3 Environmental Performance Outcomes and Control Measures

The EPOs relating to this event include:

+ No unplanned objects, emissions or discharges to sea or air (YO-EPO-04); and
+ No injury or mortality to EPBC Act 1999 and WA Biodiversity Conservation Act 2016 listed marine fauna during operational activities. [YO-EPO-05].

The control measures for this event are shown in **Table 7-25**, and the EPS' and measurement criteria for the EPOs are described in **Section 8.4**.

Table 7-25: Control Measure Evaluation for the Release of Solid Objects

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
YO-CM-002	Dropped object prevention procedures	Impacts to environment are reduced by preventing dropped objects and by retrieving dropped objects unless the environmental consequences are negligible or there are risks to safety. Minimises drop risk during MODU lifting operations. Ensures lifting equipment certified and inspected.	Personnel costs involved in implementing procedures and in incident reporting.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweigh cost to Santos.
YO-CM-004	Waste (Garbage) Management Procedure	Reduces probability of waste being discharged to sea, reducing potential impacts to marine fauna. Ensures food waste is discharged in manner that does not pose risk to the environment. Ensures compliance with Marine Orders (94 and 95) and MARPOL (Annex III and V) requirements as appropriate for vessel class.	Personnel cost of vessel audits and inspections, and in recording and reporting waste management.	**Adopted –** Benefits of ensuring MODU/vessels are compliant outweighs the minimal costs of personnel time and it is a legislated requirement.
YO-CM-005	Hazardous chemical management procedures	Reduces the risk of spills and leaks (discharges) to sea by controlling the storage, handling and clean-up.	Personnel cost associated with implementation of procedures and permanent or temporary storage areas.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweigh costs.
YO-CM-008	General chemical	Potential impacts to the environment are	Personnel costs associated with	**Adopted** – Benefits of ensuring

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
	management procedures	reduced through following correct procedures for the safe handling and storage of chemicals.	ensuring procedures are in place and implemented during inspections.	procedures are followed and measures implemented outweigh costs.
YO-CM-009	Maritime Dangerous Goods Code	Dangerous goods managed in accordance with International Maritime Dangerous Goods Code (IMDG Code) to reduce the risk of an environmental incident, such as an accidental release to sea or unintended chemical reaction.	Cost associated with implementation of code/ procedure.	**Adopted** – Benefits of ensuring procedures are followed and measures implemented outweigh costs.
YO-CM-011	Bulk transfer procedure	Bulk solids transferred in accordance with bulk transfer procedure to reduce the risk of an unintentional release to sea.	Personnel cost of implementing procedure. Cost of purchasing and maintaining equipment (e.g. bulk hoses and connections).	**Adopted –** Benefits of ensuring procedures followed and measures implemented outweigh costs.
YO-CM-007	Chemical selection procedure	Reduced toxicity to marine environment through ensuring only environmentally acceptable chemicals discharged to sea.	Potential additional cost and delays of chemical substitution.	**Adopted** – Environmental benefit of using lower toxicity chemicals outweigh procedural implementation costs.
Additional Control Measures				
N/A	Eliminate lifting in field.	Reduces the risk release of non-hydrocarbon solid to the marine environment due to dropped object.	Eliminating lifting would require MODU/ vessels storing more equipment and supplies on-board, and/ or additional trips to shore. MODU/ vessels will	**Rejected** – Not feasible to eliminate lifting in the field.

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
			not have enough deck space to store all required equipment, materials, supplies needed for the duration of the activity.	

7.6.4 Environmental Impact Assessment

Table 7-26: Impact, Likelihood and Consequence Ranking – Release of Solid Objects

Receptors	+ Physical environment (shoals and banks, benthic habitats, offshore reefs and islands) + Threatened, migratory or local fauna (marine mammals, marine reptiles, sharks and rays, fish and birds) + Protected and significant areas and socio-economic receptors (marine parks, tourism and recreation)
Consequence	I - Negligible
Physical Environment – benthic habitats In the event of lost equipment / dropped object, it is expected that it may result in localised damage to the seabed. The extent of the impact is limited to the size of the dropped object and given the size of standard materials transferred, any impact is expected to be very small. Surveys of previous seabed disturbances following rotary borehole sampling drilling activities indicate that recovery of benthic fauna in soft sediment substrates occurs between 6-12 months after the Activity ceases (URS, 2001), suggesting any impacts are short term in duration, and result in a negligible reduction in habitat area/function.	
Marine fauna – fish, sharks, marine mammals, marine reptiles, seabirds. In the event of a hazardous / non-hazardous solid release, the quantities would be limited. This unplanned release could cause localised impacts to water quality and the benthic environment if the solid can degrade, which may lead to impacts on marine flora and fauna species. Solid wastes have the potential to result in fauna mortality or injury through ingestion or entanglement. Any impacts would be restricted to a small number of individuals in close proximity to the unplanned release. Small volumes of the solid waste stream would be generated during the activity and with the management measures in place, any accidental loss to the environment would be small in size. Marine debris is identified as a potential threat to a number of marine fauna species in relevant Recovery Plans and Conservation Advice (**Table 3-9**). The controls implemented demonstrate that the activity will be conducted in a manner that reduces marine debris and therefore potential impacts are reduced to ALARP and of an acceptable level.	

The limited quantities of accidental hazardous/ non-hazardous solid release associated with this event indicate that, in a worst-case release, fatalities would be limited to individuals and is not expected to result in a decrease of the local population size and the consequence level is therefore, negligible.	
Protected and significant areas and Socio-economic receptors (marine parks, tourism and recreation, commercial fishing). In the event of a release of a buoyant object that cannot be recovered, it could present an obstacle to other marine users. Eventually the buoyant object may become non-buoyant and sink to the seabed where it may degrade over time. The time taken for this is dependent on the material released and any impacts to marine fauna and the seabed are described above. This may present a risk to commercial trawling activities and damage their equipment, so fishers may be required to avoid a highly localised area to avoid interaction. Given the likely size of buoyant equipment (i.e. storage drum), it will drift with the currents. It is considered unlikely to present a significant hazard to other marine users and the consequence level is therefore negligible. Impacts to the Montebello AMP have the potential to occur through buoyant objects floating into the park, adversely impacting conservation values and creating poor aesthetics. Given the limited quantities associated with this unplanned event, even a worst-case release of solid waste is unlikely to have flow-on effects significant enough to impact the tourism and recreation industries. However, there will be a detectable impact, so the consequence level is therefore assessed as I (Negligible).	
Likelihood	C – Possible
Control measures proposed ensure that the risk of dropped objects, lost equipment or release of non-hydrocarbon solid waste to the environment has been minimised. Given the controls in place, the likelihood of releasing non-hydrocarbon solids to the environment resulting in a minor consequence is considered Possible (c).	
Residual Risk	The residual risk associated with this event is **Very Low**.

7.6.5 Demonstration of ALARP

Solid waste will be generated during the activity and lifting operations and MODU / vessel operations are required as part of the activity. Equipment loss and dropped objects, which might occur during MODU / vessel transfers in the field will be managed through lifting and transfer procedures and equipment management. The control measures proposed reduce the risk of non-hydrocarbon solid releases to a residual risk level that is Very Low and cannot be reduced further. There are no reasonably practicable additional control measures identified that would reduce the chance of a loss of non-hydrocarbon solid release.

Therefore, it is considered that the impact of the activities conducted is ALARP.

7.6.6 Acceptability Evaluation

Is the risk ranked between Very Low to Medium?	Yes – release of solid objects risk is ranked Very Low.
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.

Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian Marine Park zoning objectives)?	Yes – management consistent with Marine Order 95. Controls implemented will minimise the potential impacts from the activity to species identified in recovery plans and approved conservation advices as having the potential to be impacted by solid objects. The following material published in relation to threatened and migratory species within the OA identifies marine debris as a threat (**Table 3-9**): **Conservation Advice:** + Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015) + Commonwealth Conservation Advice on *Dermochelys coriacea* (2008) **Recovery Plans:** + Threat Abatement Plan for Impacts of Marine Debris on Vertebrate wildlife of Australia's coasts and oceans (2018). Specific actions that contribute to the long-term prevention of marine debris (Objective 1 of the plan) have been adopted. + Draft Wildlife Conservation Plan for Seabirds (Commonwealth of Australia 2019) + Recovery plan for marine turtles in Australia 2017 – 2027 (CoA, 2017a) + Blue Whale Conservation Management Plan 2015 - 2025 (CoA, 2015) identifies marine debris as a threat to blue whales. + For all the recovery plans identified above, the objectives are achieved through the adoption of YO-EPO-04, YO-EPO-05 and control measures outlined in **Table 7-25**; and Santos considers the impacts of operational discharges to not be inconsistent with these recovery plans. Recovery Plans / Conservation Advice for other species that may occur in the OA do not identify marine debris as a key threat or have explicit relevant objectives or management actions related to marine debris. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) identifies marine debris pollution as a pressure that may impact marine park values. It seeks to minimise the impact of pressures on the marine park values as far as reasonably practicable. The implementation of YO-EPO-4, YO-EPO-05 and the control

	measures outlined in **Table 7-25** will ensure the release of solid objects will not compromise this outcome. + The OA intersects the Montebello Marine Park which is categorised as Multiple Use Zone (IUCN Category VI) (**Table 3-4**). The objective of the Multiple Use Zone (VI) is to provide ecologically sustainable use and the conservation of ecosystems, habitats and native species. The management of the activity in relation to release of solid objects is aligned with this objective through the adoption of YO-EPO-4, YO-EPO-05 and the control measures outlined in **Table 7-25**. The objectives and actions of these publications were considered during the assessment of impacts and risks. The controls outlined in **Table 7-25** are consistent with the objectives of the material listed above and Santos considers the impacts of unplanned release of solid objects to not be inconsistent with these objectives.
Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

The handling and use of non-hydrocarbon solid materials is standard industry practice and the potential impacts well understood. This aspect will be managed consistent with relevant legislation, regulations and guidelines and the residual risks are low and ALARP.

The control measures proposed are consistent with applicable actions described in the relevant Recovery Plans and Approved Conservation Advice and no stakeholder concerns have been raised regarding this event.

With the control measures in place to prevent accidental releases and the negligible impacts predicted from these types of solids, the low risk of a non-hydrocarbon solid release to the environment is considered environmentally acceptable.

7.7 Introduction of Invasive Marine Species

7.7.1 Description of Event

Event	Introduction of invasive marine species (IMS) may occur due to: + Biofouling on MODU or support vessels and external/internal (e.g., sea chests, seawater systems) niches + Biofouling on equipment that is routinely submerged in water (e.g., ROVs)

	+ Discharge of high-risk ballast water + Cross contamination between vessels and the MODU. Once established, IMS have the potential to out-compete indigenous species and affect overall native ecosystem function.
Extent	Localised (seabed within the OA) to widespread if successfully translocated to new areas via ocean currents or project equipment transit.
Duration	Temporary to long-term (in the event of successful translocation and establishment).

7.7.2 Nature and Scale of Environmental Impacts

Potential receptors: Physical environment (shoals and banks, benthic habitats, offshore reefs and islands), threatened/migratory fauna (marine mammals, marine reptiles, sharks, fish and rays), protected and significant areas (marine parks), socio-economic receptors (fisheries, tourism and recreation).

IMS are marine plants, animals and algae that have been introduced into a region that is beyond their natural range but that have the ability to survive and possibly thrive (DAWE, 2019). The majority of climatically compatible IMS to the North West Shelf are found in southeast Asian countries. Some IMS pose a significant risk to environmental values, biodiversity, ecosystem health, human health, fisheries, aquaculture, shipping, ports and tourism (DAWE, 2019; Wells et al., 2009). IMS can cause a variety of adverse effects in a receiving environment, including:

+ Over predation of native flora and fauna
+ Displacement of native marine species
+ Outcompeting of native flora and fauna for food
+ Depletion of viable fishing areas and aquaculture stock
+ Reduction of coastal aesthetics.

The above impacts can result in flow-on detrimental effects to marine parks, tourism and recreation.

IMS of concern are those that are not native to the region, are likely to survive and establish in the region, and are able to spread by human mediated or natural means. Species of concern vary from one region to another depending on various environmental factors, such as water temperature, salinity, nutrient levels and habitat type. These factors dictate their survival and invasive capabilities.

It is recognised that artificial, disturbed and/or polluted habitats in tropical regions are susceptible to invasive marine species introductions, which is why ports are often areas of higher IMS risk (Neil et al., 2005). However, in Australia there are limited records of detrimental impact from IMS compared to other tropical regions (such as the Caribbean).

Following their establishment, eradication of IMS populations is difficult, limiting management options to ongoing control or impact minimisation. Case studies in Australia indicate that, from detection to eradication, this can take approximately four weeks (Bax et al., 2003). However, this depends on the environmental conditions and species. For this reason, increased management requirements have been implemented in recent years by Commonwealth and State regulatory agencies.

Ballast water is responsible for 20 to 30% of all marine pest 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 (DAFF, 2011). The potential biofouling risk presented by vessels will relate to:

+ The length of time that these vessels have already been operating in Australian waters or, if they have been operating outside Australian waters
+ The locations of the operations they have been undertaking
+ The length of time spent at these locations
+ Whether the vessels have undergone hull inspections, cleaning and application of new anti-foulant coating prior to returning to operate in Australia.

Support vessels based in local ports, such as Dampier or Onslow, do not carry the same quarantine risks as international vessels (e.g., offtake tankers) or out of State vessels, as they supply the same waters as those the OA resides in.

7.7.3 Environmental Performance Outcomes and Control Measures

The EPO relating to this event is:

+ No introduction of invasive marine species [YO-EPO-02]

The control measures for this event are shown in **Table 7-27**, and the EPSs and measurement criteria for this EPO are described in **Section 8.4**.

Table 7-27: Control Measure Evaluation for the Introduction of Invasive Marine Species

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
YO-CM-023	Compliance with the Biosecurity Act 2015	Reduces the risk of introducing IMS through implementation of the vessel assessments and requirement for immersible equipment to be cleaned.	Personnel costs involved in demonstrating MODU and vessel(s) are of 'low risk' of introducing IMS through completion of risk assessments as well as the requirement for equipment to be cleaned could lead to potential delays in activity schedule should remediation activities (e.g. additional cleaning and inspections) be required, potentially affecting vessel contracting process.	**Adopt** – Benefits considered to outweigh costs. Regulatory requirement must be adopted.
YO-CM-026	Anti-foulant System	The risk of introducing IMS is reduced due to anti-foulant systems.	Could lead to potential delays and therefore costs, in vessel contracting process due to availability of vessels with appropriate anti foulant systems.	**Adopted –** minimal potential delays or costs to project are considered outweighed by the benefits of reducing the risk of IMS.
Additional Control Measures				
N/A	Heat or chemical treatment of ballast water to eliminate IMS.	Would reduce potential for IMS to establish by eliminating individuals present in ballast water.	High cost compared to existing risk; introduction of chemicals or water at much higher temperature than surrounding marine environment would likely be toxic or result in death of native marine species.	**Rejected** – Based on increased risk to marine environment and high cost considered disproportionate compared to base case risk (after application of standard controls (see above)).
N/A	Contract MODU/vessels only operating in local, State or Commonwealth	Reduce potential for IMS to be transported into area since vessels would not have originated elsewhere.	MODU/vessels and equipment suitable for the activity may not be available in State/Commonwealth waters. Potential significant costs and delay in activity	**Rejected** – Not feasible.

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
	waters to reduce potential for IMS.		schedule by only contracting MODU/ vessels working in State/ National waters.	
N/A	Mandatory dry docking of vessels prior to entering field to clean vessel and/or equipment and remove biofouling.	Ensure that no IMS are present on vessel or associated equipment.	Significant cost (grossly disproportionate to the risk) would lead to scheduling delays.	**Rejected –** Costs disproportionately high compared to environmental benefit given other controls in place already reduce the risk.
N/A	Utilise an alternative ballast system to avoid uptake and discharge of water in vessels.	Eliminate need for ballast water exchange, therefore decreasing risk of introducing IMS through ballast water.	MODU/vessels suitable for the activity may not have options for alternative ballast, therefore would require modification at significant cost.	**Rejected** – Cost disproportionately high compared to environment benefit.
N/A	Zero discharge of ballast water.	Would reduce the potential for IMS by implementation of no ballast water exchange policy on MODU and vessels.	Ballast water exchange required on the MODU and vessels for stability.	**Rejected** – On the basis that ballast water exchange is a safety-critical activity for marine operations.

7.7.4 Environmental Impact Assessment

Table 7-28: Impact, Likelihood and Consequence Ranking – Introduction of Invasive Marine Species

Receptors	+ Physical environment (shoals and banks, benthic habitats, offshore reefs and islands) + Threatened, migratory and local fauna (marine mammals, marine reptiles, sharks, fish and rays) + Protected and significant areas + Socio-economic receptors (marine parks, fisheries, tourism and recreation)
Consequence	III – Moderate
IMS, if they successfully establish, can outcompete native species for food or space, prey on native species or change the nature of the environment and can subsequently impact on fisheries or aquaculture. This is primarily through altering benthic habitats, which in turn may result in changes to faunal assemblages and a reduction in diversity. Any such reduction in diversity or health of the ecosystem may result in economic	

losses with long-term effects on industry. Given the soft sediment and low biodiversity expected in the OA, the overall consequence level was assessed as Moderate (III).	
Likelihood	B – Unlikely
The pathways for IMS introduction are well known; consequently, standard preventive measures are proposed. The ability for invasive marine species to colonise a habitat is dependent on a number of environmental conditions. It has been found that highly disturbed environments (such as marinas) are more susceptible to colonisation than open water environments where the number of dilutions and the degree of dispersal are high (Paulay et al., 2002). The risk of an IMS being able to successfully establish itself will depend on depth, distance from the coast, water movement and latitude. The depth of the OA (approximately 45 m) creates an unfavourable habitat for colonisation (i.e., light limiting and low habitat biodiversity with sparse epibiota). The OA is approximately 20 km from the nearest shallow coastal habitats (Montebello Islands). The time a vessel spends in a location (residence time) has an influence on the likelihood of species attachment or uptake at a source. The longer a vessel sits in any one location, the more likely it is to be colonised by biofouling species and can also impact on the performance of some types of antifouling coatings (MIAL 2020). The MODU and support vessels will be at the OA for a up to 100 days, including contingency. The MODU expected to be used for the activity will have been in Australian waters, prior to mobilising to the OA to start work under this EP (i.e. they will not be mobilised from international waters). Therefore, the risk of translocation of IMS from international waters is very low. The support vessels are local and based out of domestic ports. There is a low likelihood that IMS would be able to survive translocation and subsequently establish and colonise. Given the dispersive open-ocean environment of the OA, the successful translocation to surrounding shallower habitats of an IMS introduced to the are unlikely. With controls in place to reduce the risk of IMS introduction, the likelihood is considered Unlikely (b).	
Residual Risk	The residual risk associated with this event is **Low**.

7.7.5 Demonstration of ALARP

There are no alternatives to the use of a MODU and support vessels in order to undertake the activity. The risks from IMS are well understood and, with the proposed control measures, the activity will comply with relevant regulations and guidelines. The proposed management controls are considered appropriate to manage the risk of introduction of IMS to ALARP.

Ballast water exchange will be managed through a Ballast Water Management Plan, and a vessel biosecurity risk assessment in accordance with the Invasive Marine Species Management Plan (EA-00-RI-10172) will be undertaken to demonstrate that the MODU/vessels are low risk so that IMS are not introduced.

Santos has adopted a risk-based approach to managing biofouling given it is not practicable or reasonable to inspect and/or clean every vessel before each voyage. Such an approach is consistent with other petroleum operators on the North West Shelf and is beyond that enforced on the majority of commercial and recreation vessels that regularly transit the same bioregion. International vessels are given the highest priority to prevent the introduction of IMS into Australian waters. However, domestic vessels (interstate and locally sourced) are also risk-assessed to reduce the likelihood of spreading marine pest species already established in Australian waters. The biofouling risk assessment approach adopted by Santos will ensure that the Aquatic Resources Management Act 2016 and associated regulations prohibiting the introduction of non-endemic fish species will be met.

With adherence to the proposed management controls, the risk to the environment from IMS has been reduced to ALARP.

7.7.6 Acceptability Evaluation

Is the risk ranked between Very Low to Medium?	Yes – introduction of IMS residual risk ranking is Low
Is further information required in the consequence assessment?	No – potential impacts and risks well understood through the information available
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian Marine Park zoning objectives)?	Yes – management consistent with Biosecurity Act 2015, National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee, 2018) and the *Aquatic Resources Management Act 2016*. The following material published in relation to threatened and migratory species within the OA identifies invasive species or disease as a threat (**Table 3-9**): **Recovery Plans:** + Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (2014) identifies disease as a threat to grey nurse sharks. Action 7.1 of the plan highlights the necessity to review and assess the potential threat of introduced species, pathogens and pollutants. + Draft Wildlife Conservation Plan for Seabirds (CoA, 2019) identifies invasive species as a threat to seabirds. + National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011) identifies parasites and disease as a threat to albatross and giant petrels. + Recovery plan for marine turtles in Australia 2017 – 2027 (CoA, 2017a) identifies disease and pathogens as a threat to marine turtles. + For all the recovery plans identified above, the objectives are achieved through the adoption of YO-EPO-02, YOI-CM-023 and YO-CM-026; and Santos considers the impacts of invasive marine species to not be inconsistent with these recovery plans. Recovery Plans / Conservation Advice for other species that may occur in the operational area do not identify invasive species or

	disease as a key threat or have explicit relevant objectives or management actions related to invasive species or disease. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) identifies invasive species as a pressure that may impact marine park values. It seeks to minimise the impact of pressures on the marine park values as far as reasonably practicable. The implementation of EPO-02, FRI-CM-023 and FRI-CM-026 will ensure the risk of invasive species will not compromise this outcome. + The OA intersects the Montebello Marine Park which is categorised as Multiple Use Zone (IUCN Category VI) (**Table 3-4**). The objective of the Multiple Use Zone (VI) is to provide ecologically sustainable use and the conservation of ecosystems, habitats and native species. The management of the activity in relation to invasive marine species is aligned with this objective through the adoption of EPO-02, FRI-CM-023 and FRI-CM-026. The objectives and actions of these publications were considered during the assessment of impacts and risks. The controls outlined in **Table 7-27** are consistent with the objectives of the material listed above and Santos considers the impacts of unplanned release of solid objects to not be inconsistent with these objectives.
Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

The mobilisation of MODU/vessels and equipment to undertake offshore petroleum activities is industry standard practice, and the IMS risks are well understood and subject to regulation. The vessels and equipment that are internationally mobilised will meet Australian biosecurity requirements, and proposed management is consistent with National Biofouling Management Guidance for the petroleum Production and Exploration Industry (Marine Pest Sectoral Committee, 2018).

Application of the proposed control measures and adherence to legislation and regulations reduce the likelihood of introducing IMS into the OA, and the dispersive offshore location in the OA reduces the probability of successful establishment in the unlikely event of introduction.

No stakeholder concerns have been raised regarding this aspect, and the proposed controls will reduce the residual level of risk to Low and ALARP. Therefore, the residual risk associated with IMS is considered by Santos to be environmentally acceptable.

7.8 Marine Fauna Interaction

7.8.1 Description of Event

Event	Marine fauna interactions may occur as a result of: + MODU operations + Vessel operations + Helicopter operations The MODU will be towed into position at the well location by one or two support vessels. The MODU will be supported by approximately two vessels, with a maximum of 4 accounted for in this EP. The vessels will be either stationary or operating at slow speeds while undertaking activities within the OA including: + Towing the MODU + Holding MODU position temporarily over the drilling location while pinning rig + Standing-by at close proximity to the MODU during critical operations + Standing-by outside the 500m PSZ from the MODU + Delivering food, potable water, drill water, fuel, dry bulk, drilling fluids, chemicals, equipment and other supplies from shore + Back loading dry bulk, chemicals, equipment and waste to shore for delivery. Helicopters will also be required for crew changes for the duration of the activity with a minimum of helicopter flights per week. There is the potential for MODU, vessels or equipment from the vessels involved in operational activities, as well as helicopters to interact with marine fauna, including potential strike or collision, potentially resulting in severe injury or mortality.
Extent	Within the OA, in the immediate vicinity of the MODU and vessels.
Duration	For the duration of the Activity, as described in **Section 2.2**

7.8.2 Nature and Scale of Environmental Impacts

<u>Potential receptors: Fish and Sharks, Birds, Marine Mammals and Marine Turtles; protected and significant areas (marine parks) and socio-economic receptors (tourism and recreation).</u>

Movement of the MODU, vessels and helicopter in the OA introduces the potential for interaction with marine fauna present at the same location during the activity. Marine fauna in surface waters that would be most at risk from vessel collision include marine mammals, marine turtles and whale sharks. The use of helicopters also creates a risk of bird strike as birds move through the OA.As summarised in **Table 3-8**, the OA overlaps several BIAs, including the flatback turtle, green turtle, and hawksbill turtle (internesting buffer, including habitat critical), humpback whale (migration), pygmy blue whale (distribution), whale shark (foraging), wedge-tailed shearwater (breeding/foraging) and roseate tern (breeding/foraging).

Vessel / helicopter strike,vessel disturbance and anthropogenic disturbance are identified as potential threats to a number of marine fauna species in relevant recovery plans and conservation advices (**Table 3-9**). Incidents with marine fauna are recorded and reported by Santos as described in **Section 8.8**.

7.8.2.1 Threatened/Migratory fauna

Marine Mammals and Fish and Sharks

The Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (TSSC, 2015d) indicates that humpback whales are one of the most frequently reported whale species involved in vessel strikes worldwide (Laist et al., 2001; Jensen & Silber, 2003). This observation is supported by Australian studies referenced in The National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (DoEE, 2017). The increase in vessel numbers (Silber & Bettridge, 2012) is not only a threat to humpback whales in relation to vessel strikes but also in relation to disturbance and displacement from key habitats. Similarly, vessel strike is also recognised by the Approved Conservation Advice for *Rhincodon typus* (whale shark) (TSSC, 2015a) as one of the threats to the recovery of whale sharks.

The most commonly sighted whale in continental shelf waters of the region is the humpback whale. As described in the EE (**Appendix D**), the humpback whale migrates between calving grounds in the Kimberley region of Western Australia to feeding grounds in Antarctica, with the northbound migration from early June to early August (BHPB, 2005) and the peak of the northbound migration between Exmouth Gulf and the Dampier Archipelago occurring around July, concentrated inshore of the 200-m depth contour (Jenner et al., 2001). The southern migration peaks around early September, with pods travelling in shallower waters, typically at 30 m to 100 m and passing west of Barrow Island and north of the Montebello Islands. Higher numbers may be encountered in the OA during the humpback whale southern migration, given the water depths in the OA of approximately 45 m.

The worst potential impact from vessel collision would be mortality or serious injury of an individual. Collisions between vessels and cetaceans are most frequent on continental shelf areas where high vessel traffic and cetacean habitat occur simultaneously (WDCS, 2006). Instances of cetacean deaths as a result of vessel collisions in Australian waters have been recorded (e.g., a Bryde's whale in Bass Strait in 1992) (WDCS, 2006), although the data indicates this is likely to be associated with container ships and fast ferries. The Whale and Dolphin Conservation Society also indicates that some cetacean species, such as humpback whales, can detect and change course to avoid a vessel (WDCS, 2006). The reaction of whales to the approach of a ship is quite variable. Some species remain motionless when in the vicinity of a ship while others are known to be curious and often approach ships that have stopped or are slow-moving, although they generally do not approach and sometimes avoid faster-moving ships (Richardson et al., 1995).

Whale sharks are at risk from vessel strikes when feeding at the surface or in shallow waters (where options to dive are limited). The OA overlaps a whale shark foraging BIA (**Figure 3-18**), therefore, individuals may be encountered during operational activities. However, their presence would be transitory and of a short duration. No constraints within the OA (e.g., shallow water or shorelines) would prevent whale sharks from moving away from vessels. Vessel speed has been demonstrated to be a key factor in relation to collision with marine fauna, particularly cetaceans, with faster-moving vessels posing a greater collision risk than slower vessels (Laist et.al., 2001; Jensen & Silber, 2003; Hazel, 2009). Laist et al., (2001) suggest that the most severe and lethal injuries to cetaceans are caused by vessels travelling at 14 knots or faster.

Marine Turtles

Marine turtle and vessel interactions arising from increased vessel traffic is recognised as one of a number of key threats to marine turtles in the Recovery Plan for Marine Turtles (DoEE, 2017). It is likely that flatback turtles may be transient within the OA due to the presence of internesting buffer BIAs (including habitat critical).

Marine turtle mortality due to vessel strike has been identified as an issue in Queensland waters in the Recovery Plan for Marine Turtles in Australia (DoEE, 2017). However, turtles appear to be more vulnerable to vessel strike in areas of high urban population where incidents of pleasure crafts are higher. WA turtle populations have not been highlighted as those most affected by vessel strike, possibly due to the relatively low human population density of the North West Shelf coastline.

Turtles will typically avoid vessels by rapidly diving; however, their ability to respond varies greatly depending on the speed of the vessel. Hazel (2009) reported that the number of turtles that fled vessels decreased significantly as vessel speed increased. Turtles are also adapted to detect sound in water (Popper et al., 2014) and will generally move from anthropogenic noise-generating sources, including vessels, within their detection range.

Birds

Seabirds and migratory seabirds may opportunistically rest on the MODU and are expected to pass through the OA during the activity increasing the risk of bird strike with helicopter operations. The Draft Wildlife Conservation Plan for Seabirds recognises that seabirds are known to aggregate around oil and gas platforms in above average numbers due to night lighting, flaring, food concentrations and other visual cues (Wiese et al. 2001). Although seabirds may be attracted to the MODU due to increased feeding opportunities on pelagic fish, these behavioural changes are unlikely to alter population dynamics or significantly change the habitat use of birds due to the short duration of the activity (up to 100 days including contingency).

The risk of bird collision with helicopter operations is an ongoing concern for the safety of flights to and from infrastructure. The consequence of a helicopter bird strike is related to seasonal distribution, body mass, flocking behaviour, and flight behaviour, while the probability of a strike is related to the abundances of different bird species on or near the infrastructure.

Collision risk from the presence of infrastructure is well documented and collision with man-made structures is ranked as one of the highest instances of bird mortality. Birds are often attracted to illuminated offshore structures (for further information on the impact of light emissions see Birds – **Section 6.3**), particularly nocturnally migrating species. Poor light conditions particularly during adverse weather conditions can also increase the risk of collision.

The OA overlaps with the breeding / foraging BIAs for the wedge-tailed shearwater and roseate tern (**Figure 3-19** and **Figure 3-28**). Although bird strike and anthropogenic disturbance has been identified as a threat in several conservation plans for birds (**Table 3-9**), it is not a recognised threat for these two species.

7.8.2.2 Protected and significant areas and Socio-economic receptors

The OA intersects the Montebello Marine Park (Multiple Use Zone – IUCN Category VI). The conservation values of the marine park (as outlined in **Section 3.2.2**) have the potential to be impacted by interaction with marine fauna – in particular where those fauna are identified as natural values of the AMP. BIAs within the Marine Park include breeding habitat for seabirds, internesting, foraging, mating, and nesting habitat for marine turtles, a migratory pathway for humpback whales and foraging habitat for whale sharks (DNP, 2018).

Other marine users within the Montebello Marine Park include tourists and recreational visitors, which are important to the socio-economic values for the marine park. Given the localised and temporary impacts of interaction with marine fauna, any impact to tourism and recreation activities, such as snorkelling, diving, surfing and recreational fishing that predominantly occur within the Montebello Islands is considered unlikely.

7.8.3 Environmental Performance Outcomes and Control Measures

The EPO relating to this event is:

+ No injury or mortality to EPBC Act 1999 and WA Biodiversity Conservation Act 2016 listed marine fauna during operational activities. [YO-EPO-05].

The control measures for this event are shown in **Table 7-29**, and the EPSs and measurement criteria for this EPO are described in **Section 8.4**.

Table 7-29: Control Measure Evaluation for Marine Fauna Interaction

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
Standard Controls				
YO-CM-001	Procedure for interacting with marine fauna	Reduces risk of physical and behavioural impacts to marine fauna from vessels and helicopters. If marine fauna are sighted, then vessels can slow down or move away, and helicopters can increase distances from sighted fauna if required.	Operational costs to adhere to marine fauna interaction restrictions, such as vessel and helicopter speed and direction, are based on legislated requirements and must be accepted.	**Adopted** – Benefits in reducing impacts to marine fauna outweigh the costs incurred by Santos. Control measure ensures compliance with Part 8 of the EPBC Regulations.
YO-CM-15	Support Vessel	Constant bridge watch on vessels. Monitoring of surrounding marine environment to identify potential collision risks (and reducing harm) to cetaceans and other marine fauna.	High cost associated with contracting vessel. No additional cost for constant bridge watch as it is industry practice and regulated by AMSA.	**Adopted –** Industry practice, benefits outweigh cost.
Additional Control Measures				

Control Measure Reference No.	Control Measure	Environmental Benefit	Potential Cost/Issues	Evaluation
N/A	Restrict the timing of activities to operate outside of sensitive periods only	Reduce risk of collisions (causing harm) during environmentally sensitive periods for listed marine fauna.	High cost in moving or delaying schedule while the risk to all listed marine fauna cannot be reduced due to variability in timing of migration periods and unpredictable presence of some species.	**Rejected** – Grossly disproportionate to low incremental environmental benefit given existing low level of risk.
N/A	Dedicated Marine Fauna Observer	Improves ability to spot and identify marine fauna at risk of collision (that may cause harm).	Additional cost of contracting several specialist Marine Fauna Observers.	**Rejected –** Cost disproportionate to increase in environmental benefit and would severely limit operations, which are required to occur 24 hours a day, 7 days a week.
N/A	Activities will only occur during daylight hours	Reduced potential for a vessel-fauna collision occurring as activities only undertaken during daylight hours when visibility highest.	Lengthens duration of the activity as operations only continue for approximately 10 hours per day. Increased cost due to increased activity time (more than double the cost). Lengthened schedule results in increased impacts and risks (e.g. planned emissions and discharges, interference with other marine users, etc.).	**Rejected** –Substantial additional cost due to doubling of activity duration. No overall environmental benefit as results in increased impacts and risks.

7.8.4 Environmental Impact Assessment

Table 7-30: Impact, Likelihood and Consequence Ranking – Marine Fauna Interaction

Receptors	+ Threatened or migratory fauna (marine mammals, marine turtles, sharks and rays, fish and birds)
Consequence	II – Minor
In the event of a collision with marine fauna, there is the potential for injury or death to an individual. The number of receptors present in the OA during the short duration of the activity is expected to be limited to a small number of transient individuals. Although the OA is located within the flatback turtle internesting BIA and habitat critical to the survival of species, given the distance from the nearest nesting areas, significant numbers are not expected. This is also expected for Green and Hawksbill turtles with internesting BIA and habitat critical to the survival of species within the OA. Boat / helicopter strike and vessel disturbance are identified as potential threats to a number of marine fauna species in relevant Recovery Plan and Conservation Advice (**Table 3-9**). The above information demonstrates that with control measures in place the activity will be conducted in a manner that reduces potential impacts to ALARP and of acceptable level. There is the potential for death or injury of EPBC Act listed individual species. However, as they would represent a small proportion of the local population it is not expected that it would result in a decreased population size over what would usually occur due to natural variation, at a local or regional scale, it is expected that the loss of an individual would be a minor consequence.	
Likelihood	B – Unlikely
Given the presence of a number of BIAs for turtles, marine mammals and birds, receptors are expected to be present in the OA at various times of the year. The OA overlaps the humpback whale northern and southern migration pathway, and as such migrating individuals may traverse the OA. No known aggregation areas (breeding, resting or calving) occur within the OA and therefore concentrations of milling individuals are unlikely. Support vessels will be moving very slowly whilst inside the OA, posing a low risk of collision with marine fauna. In addition, the noise generated from vessel operations will deter marine fauna from coming in close proximity to vessels. Helicopters will also be moving through the OA for periodic crew changes throughout the activity, posing a low risk of collision with birds. The primary hazard recorded on local Santos platforms is birds taking flight as helicopters approach. This causes pilot distraction and introduces the potential for bird strike, which could lead to helicopter damage / crash, potentially escalating to a multiple fatality event. On average, there are approximately 100 Air Transport Movements (ATMs) per year at nearby Santos platforms, from which there has been 12 recorded bird strikes. As this activity is undertaken using a MODU nd support vessels, rather than permanent infrastructure, and is of short duration (up to 100 days including contingency), the occurrence of birds around the helicopter pad are expected to be unlikely. With the control measures in place, incidence is reduced to very low. With controls in place ensuring the vessels are compliant with EPBC Regulations, the likelihood of a collision with marine fauna resulting in a very low/negligible consequence is considered to be b-Unlikely.	
Residual Risk	The residual risk associated with this event is **Very Low**

7.8.5 Demonstration of ALARP

There are no alternatives to the use of the MODU and support vessels to undertake the activity. The inherent likelihood of encountering fauna in the OA is limited by the short duration of the activity and the separation from areas of high surface fauna density. With relatively low vessel speeds and compliance with fauna interaction procedures, including Regulation 8 of the EPBC Regulations 2000, a fauna collision is considered very unlikely.

With the control measures adopted, the assessed residual risk for this impact is Very Low and cannot be reduced further. Additional control measures were considered but rejected since the associated cost or effort was grossly disproportionate to any benefit, as detailed in **Section 0**. Therefore, it is considered that the impact of the activities conducted is ALARP.

7.8.6 Acceptability Evaluation

Is the risk ranked between Very Low to Medium?	Yes – marine fauna interaction residual risk ranking is Very Low.
Is further information required in the consequence assessment?	No – potential impacts and risks are well understood through the information available.
Are risks and impacts consistent with the principles of ecological sustainable development (ESD)?	Yes – activity evaluated in accordance with Santos' Environmental Hazard Identification and Assessment Procedure, which considers principles of ecologically sustainable development.
Are risks and impacts consistent with relevant legislation, international agreements and conventions, guidelines and codes of practice (including species recovery plans, threat abatement plans, conservation advice and Australian Marine Park zoning objectives)?	The following material published in relation to threatened and migratory species within the OA identifies vessel/bird strike or anthropogenic disturbance as a threat (**Table 3-9**): **Conservation Advice:** + Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015) + Conservation Advice *Calidris canutus* red knot (2016) + Commonwealth Conservation Advice on *Dermochelys coriacea* (2008) + Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015) **Management Plans:** + Wildlife Conservation Plan for Migratory Shorebirds (2015) identifies anthropogenic disturbance as a threat to migratory shorebirds. + Draft Wildlife Conservation Plan for Seabirds (2019) identifies anthropogenic disturbance as a threat to seabirds. Action 2E: manage the effects of anthropogenic disturbance to seabird breeding and roosting areas is managed through YO-EPO-05 and YO-CM-001.

	+ Recovery plan for marine turtles in Australia 2017 – 2027 (CoA, 2017a) + Blue Whale Conservation Management Plan 2015 – 2025 (2015) identifies vessel collisions as a threat to Blue Whales. Action A4: minimising vessel collisions by ensuring the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required appropriate mitigation measures are implemented; and ensure all vessel strike incidents are reported in the National Ship Strike Database. The adoption of YO-EPO-05, YO-CM-001 and YO-CM-015 ensures the activity is not inconsistent with the objectives of the management plan. + For all the recovery plans identified above, the objectives are achieved through the adoption of YO-EPO-05, YO-CM-001 and YO-CM-015; and Santos considers the impacts of marine fauna interaction to not be inconsistent with these recovery plans. Recovery Plans / Conservation Advice for other species that may occur in the project area do not identify vessel/bird strike or anthropogenic disturbance as a key threat or have explicit relevant objectives or management actions related to vessel/bird strike or anthropogenic disturbance. Australian Marine Park zoning principles and objectives were also considered: + North-west Marine Parks Network Management Plan (2018) identifies human presence as a pressure that may impact marine park values through collision. It seeks to minimise the impact of pressures on the marine park values as far as reasonably practicable. The implementation of YO-EPO-05, YO-CM-001 and YO-CM-015 will ensure the release of solid objects will not compromise this outcome. + The OA intersects the Montebello Marine Park which is categorised as Multiple Use Zone (IUCN Category VI) (Table 3 4). The objective of the Multiple Use Zone (VI) is to provide ecologically sustainable use and the conservation of ecosystems, habitats and native species. The management of marine fauna interactions during the activity are aligned with these objectives through the adoption of YO-EPO-05, YO-CM-001 and YO-CM-015. The objectives and actions of these publications were considered during the assessment of impacts and risks. The controls outlined in **Table 7-29** are consistent with the objectives of the material listed above and Santos considers the risk of marine fauna interactions to not be inconsistent with these objectives.

Are risks and impacts consistent with Santos' Environmental, Health and Safety Policy?	Yes – aligns with Santos' Environmental, Health and Safety Policy.
Are risks and impacts consistent with stakeholder expectations?	Yes – no concerns raised.
Are performance standards such that the impact or risk is considered to be ALARP?	Yes – see ALARP above.

Movement of the MODU and support vessels are unavoidable to undertake the activity. The possibility of vessel strike is a well understood risk for maritime operations, including for commercial shipping and fishing.

Vessel movements will comply with all relevant maritime standards and regulations, including EPBC regulations to minimise risks to marine fauna. Application of the proposed management controls and adherence to Commonwealth regulations reduces the likelihood of vessel interactions with marine fauna. While the potential exists for a collision to occur, it is considered an unlikely (b) scenario. As part of Santos' reporting requirements for the activity, in the unlikely event that an impact did occur in the OA, it will be reported in the National Ship Strike Database (refer to **Table 8-4**).

Therefore, the impact is considered to be ALARP and environmentally acceptable.

With application of the proposed control measures, the potential impacts and risks to threatened fauna will be managed consistent with relevant Recovery Plans and Approved Conservation Advice. No stakeholder concerns have been raised regarding this event. Therefore, the impact is considered to be ALARP and environmentally acceptable.

8 Implementation Strategy

OPGGS(E)R 2009 Requirements
Regulation 14(1)
The environment plan must contain an implementation strategy for the activity in accordance with this regulation.
Regulation 14(10)
The implementation strategy must comply with the Act, the regulations and any other environmental legislation applying to the activity.

The specific measures and arrangements that will be implemented in the event of an oil pollution emergency are detailed within the OPEP.

Stakeholder engagement is assessed separately for the requirements of the activities. Ongoing stakeholder management strategies are discussed in **Section 4**.

8.1 Environmental Management System

OPGGS(E)R 2009 Requirements
Regulation 14(3)
The implementation strategy must contain a description of the environmental management system for the activity, including specific measures to be used to ensure that, for the duration of the activity: a) the environmental impacts and risks of the activity continue to be identified and reduced to a level that is as low as reasonably practicable; and b) control measures detailed in the environment plan are effective in reducing the environmental impacts and risks of the activity to as low as reasonably practicable and an acceptable level; and c) environmental performance outcomes and standards set out in the environment plan are being met.

The Santos management system exists to support its moral, professional and legal obligations to undertake work in a manner that does not cause harm to people or the environment. The management system is a framework of policies, standards, processes, procedures, tools and control measures that, when used together by a properly resourced and competent organisation, ensure that:

+ A common Health, Safety and Environment (HSE) approach is followed across the organisation
+ HSE is proactively managed and maintained
+ The mandatory requirements of HSE management are implemented and are auditable
+ HSE management performance is measured and corrective actions are taken
+ Opportunities for improvement are recognised and implemented
+ Workforce commitments are understood and demonstrated.

This implementation strategy is designed to meet the requirements of the EP to require that:

+ Environmental impacts and risks continue to be identified for the duration of the activity and reduced to ALARP
+ Control measures are effective in reducing environmental impacts and risks to ALARP and acceptable levels
+ Environmental performance outcomes and standards set out in this EP are met
+ Stakeholder consultation is maintained throughout the activity as appropriate.

8.2 Environmental, Health and Safety (EHS) Policy

Santos' Environmental, Health and Safety Policy (**Appendix A**) clearly sets out Santos' strategic environmental objectives and the commitment of the management team to continuous environmental performance improvement. This EP has been prepared in accordance with the fundamentals of this policy. By accepting employment with Santos, each employee and contractor is made aware during the recruitment process that he or she is responsible for the application of this policy.

8.3 Hazard Identification, Risk and Impact Assessment and Controls

Hazards and associated environmental risks and impacts for the proposed activities have been systematically identified and assessed in this EP (refer to **Sections 6** and **7**). The control measures and environmental performance standards that will be implemented to manage the identified risks and impacts, and the environmental performance outcomes that will be achieved, are detailed below.

To ensure that environmental risks and impacts remain acceptable and ALARP during the activity and for the duration of this EP, hazards will continue to be identified, assessed and controlled as described in Document Management (**Section 8.10**) and Audits and Inspections (**Section 8.11**).

Any new, or proposed amendment to a control measure, EPS or EPO will be managed in accordance with the Environment Management of Change (MoC) Procedure (EA-91-IQ-10001) (**Section 8.10.2**).

Oil spill response control measures and environmental performance standards and outcomes are listed in the OPEP.

8.4 Environmental Performance Outcomes

To ensure environmental risks and impacts will be of an acceptable level, environmental performance outcomes have been defined and are listed in **Table 8-1** for planned activities and unplanned events, those relating to oil spill response are listed in the OPEP. These outcomes will be achieved by implementing the identified control measures to the defined environmental performance standards.

Table 8-1: Environmental Performance Outcomes

Reference	Environmental Performance Outcomes
YO-EPO-01	Reduce impacts on other marine users through the provisions of information to relevant stakeholders such that they are able to plan for their activities and avoid unexpected interference
YO-EPO-02	No introduction of invasive marine species
YO-EPO-03	No loss of containment of hydrocarbon to the marine environment
YO-EPO-04	No unplanned objects, emissions or discharges to sea or air
YO-EPO-05	No injury or mortality to EPBC Act 1999 and *WA Biodiversity Conservation Act 2016* listed marine fauna during operational activities.
YO-EPO-06	Reduce impacts to air and water quality from planned discharges and emissions from the activities
YO-EPO-07	Seabed disturbance limited to planned activities and defined locations within the OAs
YO-EPO-08	Reduce impacts to marine fauna from lighting on vessels and MODU through limiting lighting to that required by safety and navigational lighting requirements
YO-EPO-09	Do not displace marine turtles from habitat critical to the survival of the species or disrupt biologically important behaviours from occurring within biologically important areas

8.4.1 Control Measures and Performance Standards

The control measures that will be used to manage identified environmental impacts and risks and the associated statements of performance required of the control measure (i.e. EPS') are listed in **Table 8-2**. Measurement criteria outlining how compliance with the control measure and the expected environmental performance could be evidenced are also listed.

All Control Measures, Environmental Performance Standards and associated measurement criteria relating to preparedness and response operations are contained within the Yoorn-1 Exploration Drilling OPEP (SO-00-BI-20003.02).

Table 8-2: Control Measures and Environmental Performance Standards for the Proposed Activity (Environment Plan)

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
Procedure for interacting with marine fauna	YO-CM-001	Vessel(s) comply with Santos' *Protected Marine Fauna Interaction and Sighting Procedure* (EA-91-11-00003) which ensures compliance with Part 8 of *Environment Protection and Biodiversity Regulations 2000* which includes controls for minimising the risk of collision with marine fauna.	YO-CM-001-EPS-01	Conformance checked on receipt of marine fauna sighting datasheets. Completed vessel statement of conformance.	YO-EPO-05
		Any vessel strikes with cetaceans will be reported in the National Ship Strike Database.	YO-CM-001-EPS-02	Conformance checked on Santo's receipt of incident report.	
		Helicopter contractor procedures comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA 91 11 00003), which ensures compliance with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000, which includes controls for minimising interaction with marine fauna.	YO-CM-001-EPS-03	Helicopter contractor procedures align with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003).	
Dropped object prevention procedures	YO-CM-002	MODU Safety Case includes the following control measures for dropped objects that reduce the risk of objects entering the marine environment:	YO-CM-002-EPS-01	NOPSEMA-accepted Safety Case. Completed inspection checklist.	YO-EPO-04

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		+ Lifting equipment certification and inspection. + Lifting crew competencies. + Heavy-lift procedures. + Preventative maintenance on cranes.		Details contained in incident documents.	
		Lifting operations managed in accordance with MODU work instructions or procedures.	YO-CM-002-EPS-02	MODU work instructions or procedures.	
		MODU objects dropped overboard are recovered to mitigate the environmental consequences from objects remaining in the marine environment, unless the environmental consequences are negligible or safety risks are disproportionate to the environmental consequences.	YO-CM-002-EPS-03	Fate of dropped objects detailed in incident documents.	
MODU move procedure	YO-CM-003	MODU move procedure contains a passage plan. No accidental contact with the seabed and subsea infrastructure during the MODU move.	YO-CM-003-EPS-01	MODU move procedure. Details contained in incident documents.	YO-EPO-04 YO-EPO-07
Waste (garbage) management procedure	YO-CM-004	Waste management procedure implemented to reduce the risk of unplanned release of waste to sea. The procedure includes standards for:	YO-CM-004-EPS-01	Completed inspection checklist	YO-EPO-04

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		+ bin types + lids and covers + waste segregation + bin storage.			
		No waste (garbage[2]) discharged to sea, unless the waste is food waste disposed in accordance with MARPOL Annex V.	YO-CM-004-EPS-02	Completed garbage disposal record book or recording system.	
		Pursuant to MARPOL Annex V, placards displayed to notify personnel of waste disposal restrictions.	YO-CM-004-EPS-03	Completed inspection checklist.	
Hazardous chemical[3] Management procedures	YO-CM-005	For hazardous chemicals including hydrocarbons, the following standards apply to reduce the risk of an accidental release to sea: + Storage containers closed when the product is not being used.	YO-CM-005-EPS-01	Completed inspection checklist.	YO-EPO-04

[2] Garbage as defined by MARPOL Annex V and excludes waste generated as part of the 'drilling' process as described in these standards.

[3] Chemical in both liquid and solid form

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		+ Storage containers managed in a manner that provides for secondary containment in the event of a spill or leak. + Storage containers labelled with the technical product name as per the safety data sheet (SDS). + Spills and leaks to deck, excluding storage bunds and drip trays, immediately cleaned up. + Storage bunds and drip trays do not contain free flowing volumes of liquid. + Spill response equipment readily available.			
Deck cleaning product selection	YO-CM-006	Deck cleaning products planned to be released to sea meet the criteria for not being harmful to the marine environment according to MARPOL Annex V.	YO-CM-006-EPS-01	SDS and product supplier supplementary data as required. Completed inspection checklist.	YO-EPO-06
Chemical selection procedure	YO-CM-007	Chemicals planned for discharge to sea from the MODU are risk assessed as per the *Drilling Fluid and Chemical Selection in Drilling Activities Procedure* (EA-	YO-CM-007-EPS-01	Completed Santos risk assessment.	YO-EPO-04

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		91-II-00007). This includes chemicals used in potable water systems.			YO-EPO-06
		Firefighting foam used on board the MODU and vessels which may be discharged to sea during testing has been risk assessed as per Santos' *Drilling Fluid and Chemical Selection in Drilling Activities Procedure* (EA-91-II-00007).	YO-CM-007-EPS-02	Completed Santos risk assessment.	
		Drilling, completions and cement chemicals potentially discharged to sea are Gold/Silver/D or E rated through OCNS, or PLONOR substances listed by OSPAR, or have a complete risk assessment as per Santos' *Drilling Fluid and Chemical Selection in Drilling Activities Procedure* (EA-91-II-00007) so that only environmentally acceptable products are used.	YO-CM-007-EPS-03	Completed Santos risk assessment. Completed operational reports.	
General chemical management procedures	YO-CM-008	SDS[4] available for all chemicals to aid in the process of hazard identification and chemical management.	YO-CM-008-EPS-01	Completed inspection checklist.	YO-EPO-04
		Chemicals managed in accordance with SDS in relation to safe handling and storage, spill response	YO-CM-008-EPS-02	Completed inspection checklist.	

[4] Safety data sheet or material safety data sheet.

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		and emergency procedures, and disposal considerations.			
Maritime Dangerous Goods Code	YO-CM-009	Dangerous goods managed in accordance with IMDG Code to reduce the risk of an environmental incident, such as an accidental release to sea or unintended chemical reaction.	YO-CM-009-EPS-01	Completed Multimodal Dangerous Goods Form. Completed inspection checklist.	YO-EPO-04
Bulk liquid transfer procedure	YO-CM-010	Bulk liquids transferred in accordance with the bulk transfer procedure to reduce the risk of a release to sea. The procedures will require: + Hose integrity: certified hoses will be used + hose flotation: bulk hoses in the water fitted with floatation collars + hose connections: hoses used for hydrocarbons fitted with hammer union connections at the MODU's manifold, self-sealing (dry-break) connections at the vessel end and self-sealing break-away connections when two or more hoses are joined together + valve alignment: a MODU supervisor checks that all valves are lined up correctly	YO-CM-010-EPS-01	Completed procedural documents, for example work permits, job safety analysis forms, checklists, etc. Spill details contained in incident documentation.	YO-EPO-04

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		+ tank venting: air vents for hydrocarbon storage tanks bunded if there is a risk of spill to deck + supervision: dedicated hose watch person while pumping bulk hydrocarbons + communications: constant radio communications between MODU control room and vessel + inventory control: MODU control room monitors tank fill levels + emergency shutdown available and tested before each transfer operation.			
Bulk solid transfer procedure	YO-CM-011	Bulk solids transferred in accordance with bulk transfer procedures to reduce the risk of an unintentional[5] release to sea. The procedures includes standards for:	YO-CM-011-EPS-01	Completed procedural documents, for example work permits, job safety analysis forms, checklists, etc.	YO-EPO-04 YO-EPO-06

[5] Tank venting and associated product loss is an intentional release to sea for safety reasons.

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		+ hose integrity: certified hoses will be used + hose flotation: bulk hoses in the water fitted with floatation collars + valve alignment: a MODU supervisor checks that all valves are lined up correctly + communications: constant radio communications between MODU control room and vessel + inventory control: MODU control room monitors tank fill levels or air vents watched to detect tank overfill + emergency shutdown available and tested before each transfer operation.		Spill details contained in incident documentation.	
MODU and support vessel spill response plans including pre-drilling source control plan	YO-CM-012	MODU and support vessel have and implement a SOPEP, or SMPEP, pursuant to MARPOL Annex I.	YO-CM-012-EPS-01	Approved SOPEP or SMPEP.	YO-EPO-03 YO-EPO-04
		SOPEP or SMPEP spill response exercises conducted at least every three months to ensure personnel are prepared.	YO-CM-012-EPS-02	Spill exercise records or evidence of a spill exercise in an operational report.	

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		Prior to the drilling each well covered under this EP, there will be a well-specific source control plan in place.	YO-CM-012-EPS-03	Source control plan.	
ROV inspection and maintenance procedures	YO-CM-013	Preventative maintenance on ROV completed as scheduled to reduce the risk of hydraulic fluid releases to sea.	YO-CM-013-EPS-01	Maintenance records or evidence of maintenance in operational reports.	YO-EPO-04
		ROV pre-deployment inspection completed to reduce the risk of hydraulic fluid releases to sea.	YO-CM-013-EPS-02	Completed pre-deployment inspection checklist.	
Maritime notices	YO-CM-014	Information provided to either AMSA, Department of Defence, AHO and/or nearest port authority on MODU arrival and departure so that the maritime industry is aware of petroleum activities.	YO-CM-014-EPS-01	Transmittal records demonstrate notification of activity prior to the activity commencing.	YO-EPO-01
Support vessel	YO-CM-015	At least one support vessel is available at all times to monitor the MODU 500 m exclusion zone to identify and communicate with any approaching third-party vessels.	YO-CM-015-EPS-01	Daily Vessel Report.	YO-EPO-01
		Support vessel(s) will be equipped with an automatic identification system (AIS) and radar.	YO-CM-015-EPS-02	Completed inspection report or statement of conformance from vessel contractor.	

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		Monitoring of surrounding marine environment is undertaken from vessel bridge.	YO-CM-015-EPS-03	Bridge log or equivalent	
Accepted OPEP	YO-CM-016	In the event of an oil spill to sea, the Santos OPEP requirements implemented to mitigate environmental impacts.	YO-CM-016-EPS-01	Completed incident documentation.	YO-EPO-06
Drilling and Completions Management Process	YO-CM-017	NOPSEMA-accepted WOMP includes control measures for well integrity including: + Measures for suspension in the event of a cyclone that reduce the risk of an unplanned release of hydrocarbons; and + The well will be plugged and abandoned in accordance with the requirements of the accepted WOMP.	YO-CM-017-EPS-01	NOPSEMA-accepted WOMP.	YO-EPO-03 YO-EPO-04
		NOPSEMA accepted Safety Case includes control measures for well control that reduce the risk of an unplanned release of hydrocarbons.	YO-CM-017-EPS-02	NOPSEMA-accepted Safety Case.	
		Santos Critical Acceptance Criteria for critical well operations and integrity aspects are achieved. Critical Acceptance Criteria will be selected based on the well objectives and Santos' Drilling and Completions Management Process technical standards, being: + location, rig moves and support	YO-CM-017-EPS-03	Completed Critical Acceptance Criteria (CAC) in well program.	

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		+ well control equipment + well barriers + drilling and completions fluids + surveying and trajectory control + casing, liner and tubing + cement + wellhead and production trees + completion components.			
MODU seismic survey procedures	YO-CM-018	VSP or check-shot survey implemented in accordance with Santos' Environmental Checklist for MODU Seismic Operations which includes controls that	YO-CM-018-EPS-01	Completed checklist.	YO-EPO-05

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		reduce the risk of harm to marine fauna. The checklist includes the following standards: + A trained crew member observing for marine fauna during daylight. + Soft start procedures enacted over 30 minutes (where equipment allows). + Continuous operations providing no marine fauna within 1 km of the MODU during soft start. + Shut down procedures enacted if marine fauna within 500 m of the MODU during continuous operations. + Daylight operations continue into night providing no more than three marine fauna shut-downs in the last 24 hours. + Night start-up using soft start procedures providing no more than three marine fauna shut-downs in the last 24 hours, or providing at least 2 hours of daylight observations within the last 24 hours and no marine fauna within 1 km of the MODU.		Completed incident documentation.	

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
Waste incineration	YO-CM-019	Waste incineration managed in accordance with MARPOL Annex VI, except incineration within the 500 m exclusion zone shall not occur.	YO-CM-019-EPS-01	Completed waste record book or recording system.	YO-EPO-04 YO-EPO-06
Fuel oil quality	YO-CM-020	MARPOL-compliant (Marine Order 97) fuel oil (diesel) will be used during the activity.	YO-CM-020-EPS-01	Fuel bunkering records and/or relevant purchase records.	YO-EPO-06
		Intermediate fuel oil or heavy fuel oil will not be used during the activity.	YO-CM-020-EPS-02		
Air pollution prevention certification	YO-CM-021	Pursuant to MARPOL Annex VI, the MODU and vessels will maintain a current International Air Pollution Prevention Certificate, which certifies that measures to prevent ODS emissions, and reduce NOx, SOx, and incineration emissions during the activity are in place.	YO-CM-021-EPS-01	Current international air pollution prevention certificate.	YO-EPO-04
Santos stakeholder consultation strategy	YO-CM-022	Santos will notify all relevant stakeholders listed, or as revised, in Section 4 of relevant activity details prior to commencement, including activity timing, vessel movements, proposed cessation date and vessel details.	YO-CM-022-EPS-01	Santos correspondence to relevant stakeholders.	YO-EPO-01
		If the MODU departs and returns from the OAs, relevant maritime notices will be updated.	YO-CM-022-EPS-02	Santos correspondence to relevant stakeholders.	

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		All correspondence with external stakeholders is recorded.	YO-CM-022-EPS-03	Saved consultation records.	
		Santos' Consultation Coordinator is contactable before, during and after completion of the planned activity to ensure stakeholder feedback is evaluated and considered during the operational activity phases.	YO-CM-022-EPS-04	Consultation Coordinator contact details provided to relevant persons in all correspondence.	
		Santos will not restrict commercial fishing access to the OAs, and is committed to concurrent operations where safety of either vessel is not compromised.	YO-CM-022-EPS-05	Incident records show nil incidents of complaints of restrictions to commercial fishing access to the OAs, and show nil incidents of vessel safety being compromised by concurrent operations.	
Compliance with the Biosecurity Act 2015	YO-CM-023	Vessels are managed to low risk in accordance with the Santos Invasive Marine Species Management Plan (EA-00-RI-10172) prior to movement or transit into or within the invasive marine species management zone, which requires:	YO-CM-023-EPS-01	Completed risk assessment demonstrating MODU, equipment and vessels are 'low risk'.	YO-EPO-02

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		+ assessment of applicable vessels using the IMSMP risk assessment + the management of immersible equipment to low risk.			
		Pursuant to the *Biosecurity Act 2015* and Australian Ballast Water Management Requirements 2017, support vessels carrying ballast water and engaged in international voyages shall manage ballast water so that marine pest species are not introduced.	YO-CM-023-EPS-02	Records show Ballast Water Management is implemented. Completed ballast water record book or log is maintained.	
		Vessels and MODU receive entry clearance from DAWE (Seaports) as necessary (or as applicable to their location and movements).	YO-CM-023-EPS-03	Records show a complete Questionnaire for Biosecurity Exemptions for Biosecurity Control Determination issued to Seaports at least one month in advance where practicable	
MODU identification system	YO-CM-024	MODU has an Automatic Identification System (AIS) to aid in its detection at sea.	YO-CM-024-EPS-01	Completed inspection report or statement of conformance supplied by MODU contractor.	YO-EPO-01

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
Anchoring	YO-CM-025	No planned anchoring of the MODU within the OAs.	YO-CM-025-EPS-01	MODU move report records no anchoring of the MODU within the OAs.	YO-EPO-07
		No planned anchoring of support vessel(s) within the OAs.	YO-CM-025-EPS-02	Daily Vessel Reports.	
Anti-foulant system	YO-CM-026	Vessel anti-foulant system maintained in compliance with *International Convention on the Control of Harmful Anti-fouling Systems on Ships.*	YO-CM-026-EPS-01	Current International Anti-Fouling System Certificate.	YO-EPO-07
Sewage treatment system	YO-CM-027	Pursuant to MARPOL Annex VI, MODU and support vessel(s) have a current International Sewage Pollution Prevention Certificate which certifies that required measures to reduce impacts from sewage disposal are in place (as applicable to vessel class).	YO-CM-027-EPS-01	Current International Sewage Pollution Prevention Certificate.	YO-EPO-04 YO-EPO-06
		Sewage discharged in accordance with MARPOL Annex IV.	YO-CM-027-EPS-02	Completed inspection checklist.	YO-EPO-04 YO-EPO-06
		Preventive maintenance on sewage treatment equipment is completed as scheduled.	YO-CM-027-EPS-03	Maintenance records.	YO-EPO-04
Oily water treatment system	YO-CM-028	Oily mixtures (bilge water) only discharged to sea in accordance with MARPOL Annex I.	YO-CM-028-EPS-01	Completed inspection checklist.	YO-EPO-04

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
				Oil record book or log.	YO-EPO-06
		Preventative maintenance on oil filtering equipment completed as scheduled.	YO-CM-028-EPS-02	Maintenance records or evidence of maintenance in operational reports.	YO-EPO-04
		Pursuant to MARPOL Annex I, a MODU and support vessel(s) will have an International Oil Pollution Prevention Certificate which certifies that required measures to reduce impacts of planned oil discharges are in place.	YO-CM-028-EPS-03	Current International Oil Pollution Prevention Certificate.	YO-EPO-04 YO-EPO-06
Cuttings management system	YO-CM-029	All well returns to the MODU are diverted to shale shakers, except if drilling with seawater. The recovered drilling fluid is recycled to the mud pits and separated drilled cuttings/solids diverted overboard. If drilling with seawater, cuttings/solids returned to the MODU are diverted overboard.	YO-CM-029-EPS-01	Daily Mud Report.	YO-EPO-06
		The shale shakers are fitted with screens that meet API standards for solids removal particle size cut points.	YO-CM-029-EPS-02	Inspection records.	
		Centrifuges are used as required to remove additional finer drilled cuttings/solids that are too small for the shale shakers to remove.	YO-CM-029-EPS-03	Daily Mud Report.	

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		Shale shakers are at regular intervals while drilling to ensure: + shakers are running and screens vibrating + shaker screens are not damaged or blinding.	YO-CM-029-EPS-04	Daily Mud Report.	
		NAF is not used during the drilling activity.	YO-CM-029-EPS-05	Completed operational reports.	
Inventory control procedure	YO-CM-030	Only residual water-based fluid systems, brine, completion chemicals, cement and cement spacer within MODU mud pits and surface tanks that is no longer required will be diverted overboard.	YO-CM-030-EPS-01	End of Well Report.	YO-EPO-04 YO-EPO-06
		Unusable inventories of bulk cement, drilling fluid solid additives, brine and drill water on-board the MODU managed according to the decision list in **Table 6-22**.	YO-CM-030-EPS-02	End of Well Report. Completed decision log.	YO-EPO-04
Lighting will be used as required for safe work conditions and navigational purposes.	YO-CM-031	Vessel/MODU navigation lighting and equipment is compliant with COLREGS/Marine Orders 30: Prevention of Collisions, and with Marine Orders 21: Safety of Navigation and Emergency Procedures.	YO-CM-031-EPS-01	Vessel certification confirms compliance with applicable regulations.	YO-EPO-08

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
No fishing from MODU or support vessels	YO-CM-032	Personnel are prohibited from recreational fishing activities on MODU or support vessels.	YO-CM-032-EPS-01	Induction records confirm no fishing prohibition is communicated to all personnel.	YO-EPO-01
MODU positioning	YO-CM-033	MODU location not within AMSA defined shipping fairway.	YO-CM-033-EPS-01	MODU records.	YO-EPO-04
Seafarer certification	YO-CM-034	Vessel crew are trained and competent, in accordance with Flag State regulations, to navigate vessels.	YO-CM-034-EPS-01	Training records.	YO-EPO-03
Marine assurance standard	YO-CM-035	Vessels selected and on-boarded in accordance with the *Offshore Marine Assurance Procedure* (SO-91-ZH-10001) to ensure contracted vessels are operated, maintained and manned in accordance with industry standards (for example, Marine Orders) and regulatory requirements (this EP) and the relevant Santos procedures mentioned in this EP.	YO-CM-035-EPS-01	Completed documentation in accordance with procedure.	YO-EPO-06
Pre- campaign commencement assurance check	YO-CM-036	Prior to each campaign commencement, an assurance check will be undertaken in accordance with Santos Environment Management of Change	YO-CM-036-EPS-01	Completed Assurance Check form.	YO-EPO-01 YO-EPO-02

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		Procedure (EA-91-IQ-10001). This involves a documented review of the EP to ensure: + the activity details are current + changes in legislation are identified + stakeholder consultation has been completed and stakeholder concerns addressed + potential impacts and risks are still relevant + oil spill scenario is appropriate + EPOs and EPSs are appropriate + activity is acceptable and ALARP in accordance with the EP. A pre-campaign check will not be required prior to the first campaign under this EP if it is commenced within 12 months of EP acceptance.			YO-EPO-03 YO-EPO-04 YO-EPO-05 YO-EPO-06 YO-EPO-07 YO-EPO-08
Refuelling and chemical transfer procedure	YO-CM-037	All vessels/MODU that are involved in at sea bunkering or chemical transfer will have appropriate procedure in place to reduce risk of spill to sea which may include requirements, as appropriate for vessel size, such as:	YO-CM-037-EPS-01	Audit Records. Inspection Records. Refuelling procedure.	YO-EPO-03

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		+ hose integrity: certified hoses will be used + hose floatation: bulk hoses in the water fitted with floatation collars + hose connections: hoses used for hydrocarbons fitted with self-sealing (dry-break) connections and self-sealing break-away connections when two or more hoses are joined together + valve alignment: a vessel supervisor checks that all valves are lined up correctly + tank venting: air vents for hydrocarbon storage tanks bunded if there is a risk of spill to deck + supervision: dedicated hose watch person while pumping bulk fuel + communications: constant radio communications between two vessels + inventory control: a vessel supervisor monitors tank fill levels			

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		+ emergency shutdown: vessel emergency pumping stop tested before each transfer operation bunkering drill requirements.			
Petroleum Safety Zone (safety) established	YO-CM-038	A 500 m PSZ is defined around the MODU during the activity.	YO-CM-0380-EPS-01	Notice to Mariners placed with AHO outlining PSZ and time frames of the activity.	YO-EPO-03
Recovery of all deployed equipment	YO-CM-039	All equipment deployed during any activity will be recovered at the end of each drilling campaign.	YO-CM-039-EPS-01	Survey records	YO-EPO-04 YO-EPO-07
MODU Planned Maintenance System (PMS)	YO-CM-040	Documented maintenance program is in place for equipment on vessels and MODU that provides a status on the maintenance of equipment.	YO-CM-040-EPS-01	MODU PMS records show equipment on vessels is maintained	YO-EPO-04 YO-EPO-05 YO-EPO-06
		Engines, machinery and equipment are maintained in accordance with MODU PMS.	YO-CM-040-EPS-02	Condition and suitability survey of the MODU demonstrates compliance with PMS.	
Vessel Planned Maintenance System (PMS) to maintain DP, engines and machinery	YO-CM-041	Documented maintenance program is in place for equipment on vessels that provides a status on the maintenance of equipment.	YO-CM-041-EPS-01	Vessel daily/weekly records	YO-EPO-04 YO-EPO-05 YO-EPO-06

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
				IMCA Common Marine Inspection Document (CMID) Vessel contractor written verification demonstrates compliance with PMS. CMMS records	
Vessel activities environmental awareness and training (inductions) covers protected marine fauna sighting procedure	YO-CM-042	Marine fauna (being whales, dolphins, turtles, dugongs and whale sharks) sightings shall be recorded on Santos WA Marine Fauna Sighting Datasheets and submitted to Santos WA.	YO-CM-042-EPS-01	Record of sightings; stored in Santos WA's Marine Fauna Sighting Database.	YO-EPO-05
Ozone Depleting Substance (ODS) handling procedure	YO-CM-043	Ozone-depleting substances (ODS) managed in accordance with MARPOL Annex VI to reduce the risk of an accidental release of ODS to air.	YO-CM-043-EPS-01	Completed ODS record book or recording system.	YO-EPO-04 YO-EPO-06
Quality control limits for Barite	YO-CM-044	The contaminant limit concentrations in barite used for the drilling meets the below standard:	YO-CM-044-EPS-01	Records show barite used for the drilling meets the below standard:	YO-EPO-04 YO-EPO-06

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		+ Mercury (Hg) – 1 mg/kg dry weight in stock barite + Cadmium (Cd) – 3 mg/kg dry weight in stock barite		+ Mercury (Hg) – 1 mg/kg dry weight in stock barite + Cadmium (Cd) – 3 mg/kg dry weight in stock barite	
		All barite is selected in accordance with API specifications which has limitations on all contaminant concentrations.	YO-CM-044-EPS-02	Mud reports show all mud is API standard.	YO-EPO-06
Implement light management actions recommended in the National Light Pollution Guidelines, including: + switch off outdoor/deck lights when not in use + use existing block-out blinds on portholes and windows	YO-CM-045	Minimise light emissions by implementing light management actions.	YO-CM-045-EPS-01	Vessel Inspection Checklists Induction records confirm actions to minimise light spill overboard are communicated to all personnel.	YO-EPO-08 YO-EPO-09

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
not necessary for safety and/or navigation at night					
Pre-campaign commencement assurance check	YO-CM-046	Prior to each campaign commencement, an assurance check will be undertaken in accordance with Santos Environment Management of Change Procedure (EA-91-IQ-10001). This involves a documented review of the EP to ensure: + the activity details are current; + changes in legislation are identified; + stakeholder consultation has been completed and stakeholder concerns addressed; + potential impacts and risks are still relevant; + oil spill scenario is appropriate; + EPOs and EPSs are appropriate; + activity is acceptable and ALARP in accordance with the EP; + A pre-campaign check will not be required prior to the first campaign under this EP if it is commenced within 12 months of EP acceptance.	YO-CM-046-EPS-01	Completed Assurance Check form.	YO-EPO-03 YO-EPO-04 YO-EPO-05

Control Measure	Control Measure Reference No.	Environmental Performance Standard	EPS Reference No.	Measurement Criteria	EPO Reference No. (Table 8-1)
		Prior to each campaign commencement, as detailed in Assurance Review 4 of the DCMP, a suitable relief well MODU will be confirmed to be available prior to drilling. The activity will not proceed if there is not a least one relief well MODU option that could execute a relief well within the timeframes committed to in Table 9 4 of the OPEP. If the preferred MODU becomes unavailable during the activity, Santos will update the SCP to identify a suitable alternative MODU.	YO-CM-046-EPS-02	Relief well capability register confirms MODU availability for the duration of each campaign. Source Control Plan updated if MODU availability changes	

8.5 Leadership, Accountability and Responsibility

OPGGS(E)R 2009 Requirements
Regulation 14(4)
The implementation strategy must establish a clear chain of command, setting out the roles and responsibilities of personnel in relation to the implementation, management and review of the environment plan, including during emergencies or potential emergencies.

While Santos' Chief Executive Officer has the overall accountability for the implementation of Santos' WA management system and Environment, Health and Safety Policy, Santos' Manager – Offshore Drilling and Completions, is accountable for ensuring implementation, management and review of this EP.

The effective implementation of this EP requires collaboration and cooperation among Santos and its contractors. The chain of command and accountabilities of personnel in relation to the implementation, management and review of the EP is outlined in **Table 8-3**. It is also outlined in the OPEP for oil spill response.

Table 8-3: Chain of Command, Key Leadership Roles and Responsibilities

Role	Responsibilities
Manager – Offshore Drilling & Completions	+ Ensures Santos' policies and standards are adhered to and communicated to all employees and contractors. + Promotes HSE as a core value integral with how Santos does its business. + Empowers personnel to 'stop-the-job' due to HSE concerns. + Provides resources for HSE management. + Ensures a high level of HSE performance and drives improvement opportunities. + Ensures emergency response plans are in place. + Maintains communication with company personnel, government agencies and the media. + Approves MoC documents, if acceptable and ALARP. + Ensures the annual HSE improvement plan is completed.
Santos Drilling Superintendent	+ Ensures conformance with environmental performance outcomes and standards in the EP. + Delegates HSE responsibility and informs these personnel of their responsibilities under the EP. + Empowers personnel to `stop-the-job' due to HSE concerns. + Ensures HSE incidents are reported, investigated, corrected and communicated. + Ensures MODU meets quarantine requirements to operate in Australian waters. + Ensures HSE inspections and audits are completed and corrective actions implemented. + Reviews MoC documents.

Role	Responsibilities
	+ Ensures personnel on the MODU have the necessary qualifications, training and/or supervision.
Company Site Representative	Has responsibility for: + implementing EP commitments + ensuring personnel competency + ensuring compliance with procedures and work instructions + being site focal point for onshore/offshore communications + reporting all incidents and potential hazards + leading site-based incident response + implementing corrective actions from environmental incidents and audits.
Santos Marine Superintendent	+ Ensures conformance with environmental performance outcomes and standards in the EP. + Delegates HSE responsibility and informs these personnel of their responsibilities under the EP. + Empowers personnel to `stop-the-job' due to HSE concerns. + Ensures HSE incidents are reported, investigated, corrected and communicated. + Ensure vessels meet quarantine requirements to operate in Australian waters. + Ensures HSE inspections and audits are completed and corrective actions implemented. + Reviews MoC documents. + Ensures personnel on the vessels have the necessary qualifications, training and/or supervision.
Santos Supervisors/ MODU Offshore Installation Manager/Vessel Masters	Has overall responsibility for: + implementation and compliance with relevant environmental legislative requirements, EP commitments and operational procedures on the vessel + maintaining clear communication with personnel on board + communicating hazards and risks to the workforce + monitoring daily activities on the vessel/MODU to ensure that the relevant environmental legislative requirements, EP commitments and operational procedures are being followed + maintaining vessels/MODU to all regulatory and class requirements + maintaining their vessel/MODU in a state of preparedness for emergency response + reporting environmental incidents to PIC and ensuring follow-up actions are performed.
Santos HSE Manager	Has overall responsibility for: + ensuring incident preparedness and response arrangements meet Santos and regulatory requirements + approving the OPEP

Role	Responsibilities
	+ providing ongoing resources to maintain compliance with the OPEP and other Santos incident response requirements.
Santos HSE Team Leader, Drilling and Completions	Has overall responsibility for: + Provide advice to ensure compliance with the Santos Environment Health and Safety Policy and this EP + Providing operational HSE oversight and advice + Facilitating the development and implementation of environmental management of change documents + Ensuring EP-required reporting is accurate and timely + Ensuring environmental incidents are appropriately investigated + Ensuring that appropriate enforcement mechanisms to prevent breaches of this EP are implemented + Providing advice to ensure environmental incident reporting meets regulatory requirements (as outlined in the EP) and the Santos internal incident reporting and investigation procedure.
Senior Stakeholder Adviser	+ Ensures relevant stakeholders are identified throughout the life of the EP + Maintains a stakeholder contact and information database + Maintains a Stakeholder Notification Log specific to the EP + Maintains records of all stakeholder correspondence specific to the EP + Prior to commencement of the activity and on advice of HSE Team Lead, provides a notification to all relevant stakeholders listed, or as revised, in **Table** 8-4. The notification will include information on activity timing, vessel movements and vessel details + On advice of HSE Team Lead, provide cessation notifications to relevant stakeholders identified in **Table 8-4** + Is available before, during and after the activity to ensure opportunities for stakeholders to provide feedback are available + Prepares and distributes quarterly consultation updates to relevant stakeholders
Santos HSE Coordinator(s)	+ Ensures the EP is managed and reviewed: monitors conformance with EPOs and EPSs, and the implementation strategy in the EP. + Prepares, maintains and distributes the environmental compliance register. + Completes regular HSE reports, inspections and audits. + Completes HSE inductions and promotes general awareness. + Collates HSE data and records. + Contributes to HSE incident management and investigations. + Provides operational HSE oversight and advice. + Facilitates the development and implementation of MoC documents. + Provides incident reports, compliance reports and notifications to NOPSEMA. + Ensures stakeholder consultation and communication requirements have been fulfilled.

Role	Responsibilities
	+ Ensures subcontractors are communicated the EP requirements.
HSE Team Lead – Security and Emergency Response	Has overall responsibility for: + overarching incident and crisis management responsibility + managing the Crisis Management Team and IMT personnel training program + reviewing and assessing competencies for Crisis Management Team, IMT, and field-based Incident Response Team members + managing the Duty roster system for Crisis Management Team and IMT personnel + managing the maintenance and readiness of incident response resources and equipment.
Senior Oil Spill Response Advisor	Has overall responsibility for: + providing upfront and ongoing guidance, framework, and direction on preparation of this OPEP + developing and maintaining arrangements and contracts for incident response support from third-parties + developing and defining objectives, strategies and tactical plans for response preparedness defined in this OPEP and IRP + undertaking assurance activities on arrangements outlined within the OPEP.

8.6 Workforce Training and Competency

OPGGS(E)R 2009 Requirements
Regulation 14(5)
The implementation strategy must include measures to ensure that each employee or contractor working on, or in connection with, the activity is aware of his or her responsibilities in relation to the environment plan, including during emergencies or potential emergencies, and has the appropriate competencies and training.

8.6.1 Activity Inductions

All offshore personnel on the MODU and support vessels will complete an induction that will include a component addressing their EP responsibilities. Induction attendance records for all personnel will be maintained. Inductions will include information on:

+ Santos' Environment, Health and Safety Policy
+ Regulatory regime (NOPSEMA regulations)
+ EPBC Act Policy Statement 2.1 and how it applies to the activity
+ operating environment (e.g., nearby protected marine areas, sensitive environmental periods)

- interaction with other marine users (i.e., topic to reinforce the importance of marine communications regarding any potential interactions with active commercial fishing)
- activities with highest risk (e.g., invasive marine species and hydrocarbon releases)
- EP commitments (e.g., **Table 8-1** and **Table 8-2**)
- incident reporting and notifications
- regulatory compliance reporting
- management of change process for changes to EP activities
- oil pollution emergency response (e.g., OPEP requirements).

8.6.2 Training and Competency

All members of the workforce on the MODU and support vessels will complete relevant training and hold qualifications and certificates for their role.

Santos and its contractors are individually responsible for ensuring that their personnel are qualified and trained. The systems, procedures and responsible persons will vary and will be managed through the use of online databases, desktop matrix, staff on-boarding processes, training departments, etc.

Personnel qualification and training records will be sampled before and/or during an activity. Such checks will be performed during the procurement process, facility acceptance testing, inductions, crew change, and operational inspections and audits.

8.6.3 Workforce Involvement and Communication

Daily operational meetings will be held offshore at which HSE will be a standing agenda item. It is a requirement that supervisors attend daily operational meetings and that all personnel attend daily toolbox or pre-shift meetings. Toolbox meetings will be regularly held offshore to plan jobs and discuss work tasks, including HSE risks and controls.

HSE performance will be monitored and reported during the activity, and performance metrics (such as the number of environmental incidents) will be regularly communicated to the workforce. Workforce involvement and environmental awareness will also be promoted by encouraging offshore personnel to report marine fauna sightings and marine pollution (e.g., oil on water, dropped objects).

8.7 Emergency Preparedness and Response

OPGGS(E)R 2009 Requirements
Regulation 14(8)
The implementation strategy must contain an oil pollution emergency plan and provide for the updating of the plan.

MODU and vessels are required to have and implement incident response plans, such as an emergency response plan and SMPEP or SOPEP. Regular incident response drills and exercises (for example, as defined in an emergency response plan, SMPEP or SOPEP) are performed to refresh the crew in using equipment and implementing incident response procedures.

Santos will implement the OPEP (SO-91-BI-20003.02) in the event of a hydrocarbon spill. The OPEP details how Santos will prepare and respond to a spill event and meets the requirement of the OPGGS(E)R 2009.

8.8 Incident Reporting, Investigation and Follow-up

OPGGSR 2009 Requirements
Regulation 14(2)
The implementation strategy must: (a) state when the titleholder will report to the Regulator in relation to the titleholder's environmental performance for the activity; and (b) provide that the interval between reports will not be more than 1 year. Note: Regulation 26C requires a titleholder to report on environmental performance in accordance with the timetable set out in the environment plan.
Regulation 14(7)
The implementation strategy must provide for sufficient monitoring of, and maintaining a quantitative record of, emissions and discharges (whether occurring during normal operations or otherwise), such that the record can be used to assess whether the environmental performance outcomes and standards in the environment plan are being met.

All personnel will be informed through inductions and daily operational meetings of their duty to report HSE incidents and hazards. Reported HSE incidents and hazards will be shared during daily operational meetings and will be documented in the incident management systems as appropriate. HSE incidents will be investigated using root cause analysis.

Environmental recordable and reportable incidents will be reported to NOPSEMA as required, in accordance with **Table 8-4**. The incident reporting requirements will be provided to all crew on board the facilities and support vessels with special attention to the reporting time frames to provide for accurate and timely reporting.

For the purposes of this activity, in accordance with OPGGS(E) Regulations:

+ a recordable incident, for an activity, means a breach of an EPO or EPS, in the EP that applies to the activity, that is not a reportable incident
+ a reportable incident, for an activity, means an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage.

For the purposes of this EP, a reportable incident is an incident that is assessed to have an environmental consequence of moderate or higher in accordance with the Santos environmental impact and risk assessment process outlined in **Section 5**. Of the planned and unplanned events assessed within this EP, the following were identified to have a potential consequence level of Moderate or higher if the event were to occur and would therefore be a reportable incident:

+ Introduction of invasive marine species (Moderate)

- Marine fauna interaction (Moderate)
- Hydrocarbon release (surface and subsurface) from LOWC (Major)
- Hydrocarbon release (marine diesel oil) (Moderate).

8.9 Reporting and Notifications

OPGGSR 2009 Requirements
Regulation 14(2)
The implementation strategy must: (a) state when the titleholder will report to the Regulator in relation to the titleholder's environmental performance for the activity; and (b) provide that the interval between reports will not be more than 1 year.
Regulation 14(7)
The implementation strategy must provide for sufficient monitoring of, and maintaining a quantitative record of, emissions and discharges (whether occurring during normal operations or otherwise), such that the record can be used to assess whether the environmental performance outcomes and standards in the environment plan are being met.

8.9.1 Notification and Compliance Reporting

Regulatory, other notification and compliance reporting requirements are summarised in **Table 8-4**.

Table 8-4: Activity Notification and Reporting Requirements

Initiation	Required Information	Timing	Type	Recipient
Before the Activity				
AHO Notification – as requested by Defence and AMSA during consultation.	Pre-start notification.	At least four weeks before the activity commences where practicable.	Written	AHO at datacentre@hydro.gov.au
Pilbara Ports Authority	Pre-start notification.	At least two weeks before the activity commences where practicable.	Written	Pilbara Port Authority: shipping@pilbaraports.com.au
DMIRS requirement requested during consultation	Pre-start notification.	At least two weeks before the activity commences where practicable	Written	DMIRS petroleum.environment@dmirs.wa.gov.au
DBCA requirement requested during consultation	Pre-start notification.	At least two weeks before the activity commences where practicable	Written	DBCA EMBAdmin@dbca.wa.gov.au
DAWE (Fisheries) requirement requested during consultation	Pre-start notification.	At least two weeks before the activity commences where practicable	Written	DAWE Petroleum&Fisheries@agriculture.gov.au
DAWE – Biosecurity (vessels, aircraft, and personnel) - as requested by DAWE during consultation	Application to the department (using form provided) for the MODU and associated vessel/s biosecurity risk to be assessed as low.	At least one month prior to the commencement of the activity	Written	DAWE: seaports@agriculture.gov.au
Director of National Parks (DNP)	Requests notification if the EP is approved by NOPSEMA.	Following acceptance by NOPSEMA	Written	

Initiation	Required Information	Timing	Type	Recipient
	Pre-start notification	10 days prior to activities commencing	Written	DNP marineparks@awe.gov.au
WAFIC and commercial fishers notification - requested during consultation	Pre-start notification provided to relevant commercial fishing stakeholders, as agreed with WAFIC, or relevant industry body.	At least two weeks before the activity commences where practicable	Written	WAFIC oilandgas@wafic.org.au
OPGGS(E) Regulation 29 & 30 – Notifications NOPSEMA must be notified that the activity is to commence.	Complete NOPSEMA's Regulation 29 Start or End of Activity Notification form prior to each campaign.	At least ten days before the activity commences.	Written	NOPSEMA website
AMSA JRCC Notification – as requested by AMSA during consultation.	Pre-start notification.	24 to 48 hrs prior to activity commencement.	Written	AMSA's JRCC rccaus@amsa.gov.au
During the Activity				
OPGGS(E) 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.	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.	Written	NOPSEMA website
	The oral notification must contain:	As soon as practicable, and in any case not later than two	Oral	NOPSEMA

Initiation	Required Information	Timing	Type	Recipient
<u>OPGGS(E) Regulation 16(c), 26 & 26A – Reportable Incident</u> 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.	+ 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 any adverse environmental impacts of the reportable incident + the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.	hours after the first occurrence of a reportable incident, <u>or</u> if the incident was not detected at the time of the first occurrence, at the time of becoming aware of the reportable incident.		
	A written record of the oral notification must be submitted. The written record is not required to include anything that was not included in the oral notification.	As soon as practicable after the oral notification.	Written	NOPSEMA National Offshore Petroleum Titles Administrator
	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 any adverse environmental impacts of the reportable incident + the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident	Must be submitted as soon as practicable, and in any case not later than three days after the first occurrence of the reportable incident unless NOPSEMA specifies otherwise. Same report to be submitted to within seven days after giving the written report to NOPSEMA.	Written	NOPSEMA National Offshore Petroleum Titles Administrator

Initiation	Required Information	Timing	Type	Recipient
	+ the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future. Consider reporting using NOPSEMA's Report of an Accident, Dangerous Occurrence or Environmental Incident form.			
OPGGS(E) Regulation 26C –Environmental Performance NOPSEMA must be notified of the environmental performance at the intervals provided for in the EP.	Report must contain sufficient information to determine whether or not environmental performance outcomes and standards in the EP have been met.	A detailed environmental performance report will be submitted within three months of submission of Regulation 29(2).	Written	NOPSEMA
AMSA Reporting Under the MoU between Santos and AMSA and as requested by AMSA during consultation	Any changes to the intended operations.	As soon as practicable.	Written	AMSA's JRCC rccaus@amsa.gov.au
	Titleholder agrees to notify AMSA of any marine pollution incident[6].	Within two hours of incident.	Oral	AMSA
	POLREP and SITREP available online (refer OPEP).	POLREP as requested by AMSA following verbal notification. SITREP as requested by AMSA within 24 hours of request.	Written	AMSA

[6] For clarity and consistency across Santos regulatory reporting requirements Santos will meet the requirement of reporting marine oil pollution by reporting oil spills assessed to have an environmental consequence of moderate or higher in accordance with Santos environmental impact and risk assessment process outlined in **Section 5**.

Initiation	Required Information	Timing	Type	Recipient
AHO Notification – as requested by Defence and AMSA during consultation.	Any changes to the intended operations	As soon as practicable.	Written	AHO at datacentre@hydro.gov.au
Santos' commitment to include activity in Quarterly Consultation Update until activity ends.	The Quarterly Consultation Update will include the activity. This consultation will cease once the activity has ended.	Quarterly.	Written	The Quarterly Consultation Update is circulated to a broad group of Santos stakeholders, including many of the stakeholders identified in **Table 4-2**.
Director of National Parks Reporting Notification of the event of oil pollution within a marine park or where an oil spill response action must be taken within a marine park; or if any changes to intended operations (requested through consultation).	The DNP should be made aware of oil/gas pollution incidences which occur within a marine park or are likely to impact on a marine park as soon as possible. Notification should be provided to the 24-hour Marine Compliance Duty Officer on 0419 293 465. The notification should include: + titleholder details + time and location of the incident (including name of marine park likely to be affected) + proposed response arrangements as per the OPEP (such as dispersant, containment) + confirmation of providing access to relevant monitoring and evaluation reports when available	So far as reasonably practicable prior to response action being written.	Oral and written	Director of National Parks

Initiation	Required Information	Timing	Type	Recipient
	+ contact details for the response coordinator. Note that the DNP may request daily or weekly Situation Reports, depending on the scale and severity of the pollution incident.			
	Notify if details regarding the activity change and result in an overlap with or new impact to a marine park.	As soon as practicable.	Written	DNP marineparks@awe.gov.au
DPIRD Reporting If marine pests or disease are suspected this must be reported to DPIRD.	Notification of any suspected marine pests or diseases including any organism listed in the Western Australian Prevention List for Introduced Marine Pests and any other non-endemic organism that demonstrates invasive characteristics.	Within 24 hours.	Oral	DPIRD FishWatch
DAWE Reporting + Any harm or mortality to EPBC Act-listed threatened marine fauna. + Marine Fauna Sighting Data.	Notification of any harm or mortality to an EPBC listed species of marine fauna whether attributable to the activity or not.	Within seven days to EPBC.permits@environment.gov.au	Written	DAWE
	Marine fauna sighting data recorded in the marine fauna sighting database.	As soon as practicable, in any case no later than three months of the end of the activity.	Written	DAWE
Any harm or mortality to fauna listed as threatened under the *WA Biodiversity Conservation Act 2016*.	Notification of any harm or mortality to fauna listed as a threatened species under the *WA Biodiversity Conservation Act 2016* as a result of Santos activities.	A fauna report will be submitted to DBCA within seven days to fauna@dbca.wa.gov.au.	Written	DBCA fauna@dbca.wa.gov.au

Initiation	Required Information	Timing	Type	Recipient
Australian Marine Mammal Centre Reporting Any ship strike incident with cetaceans will also be reported to the National Ship Strike database.	Ship strike report provided to the Australian Marine Mammal Centre: https://data.marinemammals.gov.au/report/shipstrike.	As soon as practicable.	Written	DAWE https://data.marinemammals.gov.au/report/shipstrike
Department of Biodiversity, Conservation and Attractions Reporting Impacts to marine mammals or turtles in reserves.	Notification of any incidence of entanglement, boat collisions and stranding of marine mammals in the reserves and any incident of turtle mortality and incidents of entanglement in the reserves as detailed in the Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves.	Within 48 hours.	Written	DBCA
Department of Biodiversity, Conservation and Attractions Reporting Notification of the event of a hydrocarbon release.	Notification of actual or impending spillage.	As soon as practicable.	Oral or Written	DBCA Pilbara regional office
Department of Transport Reporting All actual or impending MOP incidents that are in, or may impact, State	Notification of actual or impending spillage, release or escape of oil or an oily mixture that is capable of causing loss of life, injury to a person or damage to the health of a person, property or the environment	Within two hours.	Oral	DoT

Initiation	Required Information	Timing	Type	Recipient
waters resulting from an offshore petroleum activity.	WA DoT POLREP and SITREP available online (refer OPEP).	As requested by DoT following verbal notification.	Written	DoT
End of Activity				
OPGGS(E) Regulation 29 – 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 ten days after cessation of each campaign.	Written	NOPSEMA
AHO AMSA JRCC DAWE DBCA DMIRS Pilbara Ports Authority DNP	Activity Cessation Notification.	Within ten days after cessation of each campaign.	Written	AHO: datacentre@hydro.gov.au AMSA's JRCC: rccaus@amsa.gov.au DAWE: Petroleum&Fisheries@agriculture.gov.au DBCA: EMBAdmin@dbca.wa.gov.au DMIRS: petroleum.environment@dmirs.wa.gov.au PPA: shipping@pilbaraports.com.au DNP: marineparks@awe.gov.au
Commercial fishers notification - requested during consultation	Activity Cessation Notification provided to relevant commercial fishing stakeholders, as agreed with WAFIC or relevant industry body	Within ten days after cessation of each campaign.	Written	WAFIC oilandgas@wafic.org.au
OPGGS(E) Regulation 14(2) & 26C – Environmental Performance	Report must contain sufficient information to determine whether or not environmental performance outcomes and standards in the EP have been met.	An environmental performance report will be submitted within three months of completion of each campaign	Written	NOPSEMA

Initiation	Required Information	Timing	Type	Recipient
NOPSEMA must be notified of the environmental performance of the activity.				
OPGGS(E) Regulation 25A EP ends when titleholder notifies completion and the Regulator accepts the notification. NOPSEMA must be notified that the activity has ended and all EP obligations have been completed.	Notification advising NOPSEMA of end of all activities to which the EP relates and that all obligations have been completed.	Within six months of the final Regulation 29 (2) notification.	Written	NOPSEMA

8.9.2 Monitoring and Recording Emissions and Discharges

OPGGS(E)R 2009 Requirements
Regulation 10A(e)
Includes an appropriate implementation strategy and monitoring, recording and reporting arrangements.
Regulation 14(7)
The implementation strategy must provide for sufficient monitoring of, and maintaining a quantitative record of, emissions and discharges (whether occurring during normal operations or otherwise), such that the record can be used to assess whether the environmental performance outcomes and standards in the environment plan are being met.

Vessel-based discharges to the marine environment, associated with this activity will be recorded and controlled in accordance with requirements under relevant marine orders.

Santos and support vessel contractors will maintain records so that emissions and discharges can be determined or estimated. Such records will be maintained for a period of five years. Contractors are required to make these records available upon request. Santos' records discharges or emissions (where practicable), to the environment as described in **Table 8-5**.

Table 8-5: Monitoring Methods for Emissions and Discharges

Discharge/emission	Parameter	Quantitative Record	Recording frequency
Chemicals (discharged to marine environment as per **Section 6.7**)	Volume	Chemical Risk Assessment Volumes used will be estimated based on known inventories	For every chemical use with a fate to the marine environment
Oily water	Volume and location	Oil Record Book* or equivalent report	For every discharge
Garbage (including food scraps)	Volume and location	Garbage Record Book*	For every discharge
Sewage	Volume and location	Sewage Record Book*	For every discharge
Ballast water	Volume and location	Ballast water record book or log**	For every discharge
Unplanned discharge of solid objects	Volume	Incident report	For every discharge
Unplanned discharge of hazardous liquids	Volume	Incident report	For every discharge
Unplanned hydrocarbon release	Volume	Incident report	For every discharge

*Maintained as per vessel class in accordance with relevant Marine Orders.

** Maintained as per Australian Ballast Water Management Requirements 2017.

8.10 Document Management

8.10.1 Information Management and Document Control

This EP and OPEP, as well as approved management of change documents, are controlled documents; and current versions will be available on Santos' intranet. Santos contractors are also required to maintain current versions of these documents.

Environmental performance outcomes and standards will be measured based on the measurement criteria listed in **Table 8-2**. Such records will be maintained for a period of five years. Contractors are required to make these records available upon request.

8.10.2 Management of Change

The MoC process provides a systematic approach to initiate, assess, document, approve, communicate and implement changes to EPs and OPEPs.

The MoC process considers Regulations 7, 8 and 17 of the OPGGS(E)R 2009 and determines if a proposed change can proceed and the manner in which it can proceed. The MoC procedure will determine whether a revision of the EP is required and whether that revision is to be submitted to NOPSEMA. For a change to proceed, the associated environmental impacts and risks must be demonstrated to be acceptable and ALARP. Additional stakeholder consultation may be required, depending on the nature and scale of the change. Additional information about the MoC process is provided in **Figure 8-1**.

The MoC procedure also allows for the assessment of new information that may become available after EP acceptance, such as new management plans for AMPs, new recovery plans or conservation advice for species, and changes to the EPBC Protected Matters Search results. If a review identifies new information, this is treated as a "Change that has an impact on EP", and the MoC process is followed accordingly.

The MoC procedure also includes an assurance check process which applies the MoC process to long term (usually five year multi-activity EPs) EPs that may have lengthy periods of time between use or acceptance and activity commencement. Applying this Assurance Check to this EP (refer to YO-CM-036) helps Santos determine whether the activity will still comply with the EP and is still acceptable, or, if there are any changes to what is covered by the relevant EP. Where there is an identified change from the accepted EP content, a check is done to test the 'significance' of the change, to determine whether it can be accommodated which may then result in an MoC as described above.

Accepted MoCs become part of the in-force EP or OPEP, are tracked on a register and are made available on Santos' intranet. Where appropriate, the EP compliance register will be updated so that CM or EPS changes are communicated to the workforce and implemented. Any MoC will be distributed to the management people identified in **Table 8-3** (excluding the Chief Executive Officer and Directors), and the most relevant management position will ensure the MoC is communicated and implemented, which may include crew meetings, briefings or communications as appropriate for the change.

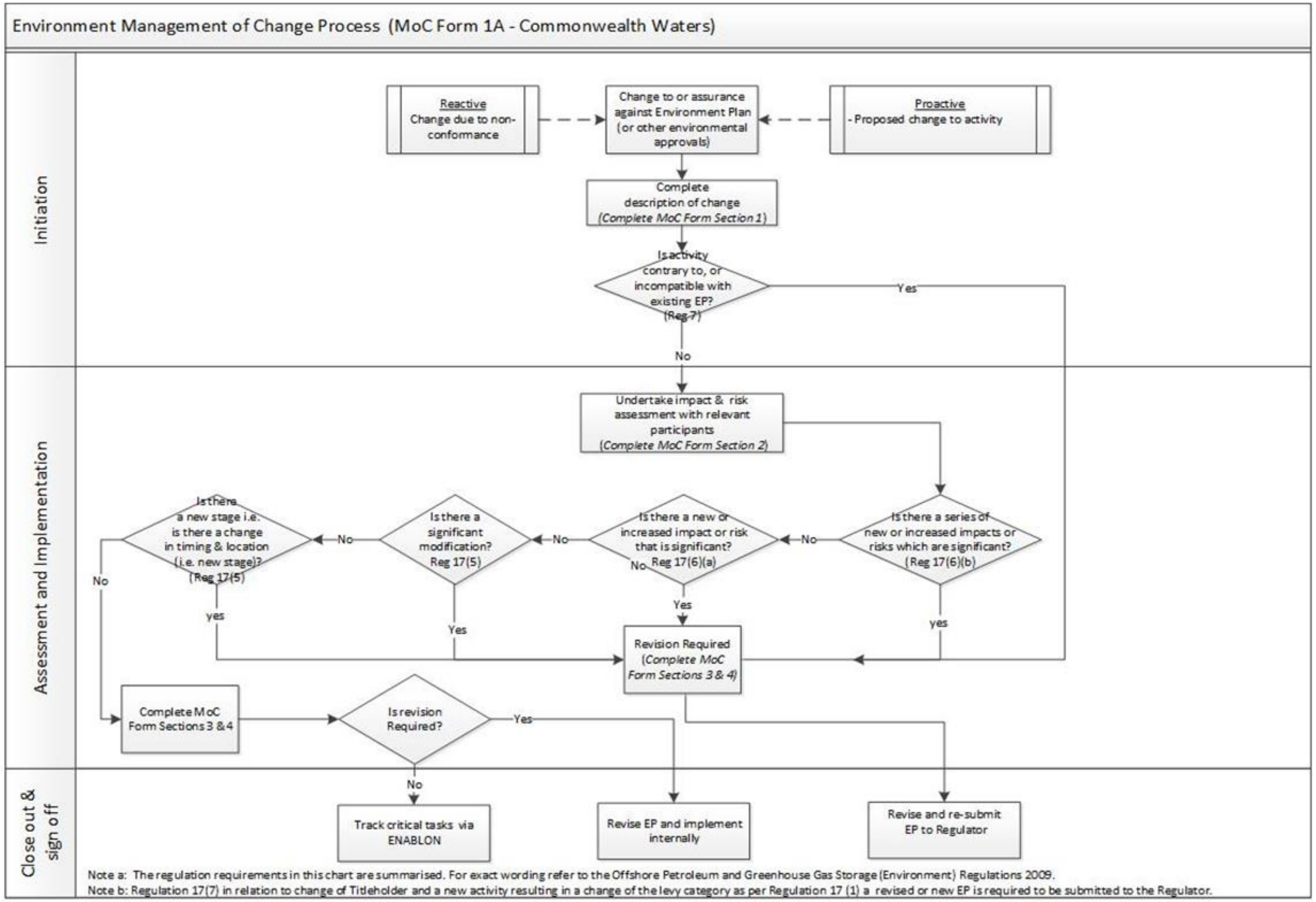

Figure 8-1: Environment Management of Change Process

8.10.3 Reviews

This EP has assessed impacts and risk across the OA, during any time of the year, for planned and unplanned events given the nature of the 24/7 operations.

It is recognised that the over the validity of this EP things may change, such as:

+ legislation
+ businesses conditions, activities, systems, processes and people
+ industry practices
+ science and technology
+ societal and stakeholder expectations.

To ensure Santos maintains up-to-date knowledge of the industry, legislation and conservation advice, the following tasks are undertaken:

+ Maintain membership of APPEA (Australian Petroleum Production & Exploration Association), which provides a mechanism for communicating potential changes in legislation, industry practice and other issues that may affect EP implementation to relevant personnel in Santos.
+ Undertake annual spill response exercises to check spill response arrangements and capability are adequate.
+ Identify stakeholders prior to the activity commencing under this EP via the mechanisms outlined in **Section 4**.
+ Review the Values and Sensitivities within the EMBA which includes completing a new EPBC Protected Matters Search, reviewing **Appendix D** against relevant legislation to capture and review any relevant updates and incorporate as required, and reviewing any recently known published relevant scientific papers.
+ Subscribe to various regulator updates.
+ Have regular liaison meetings with Regulators.

Through maintenance of up-to-date knowledge, these changes are identified. If the changes have an impact on the activity or risks described and assessed in this EP, the EP will be reviewed, and any changes required documented in accordance with Santos' MoC procedure (**Section 8.10.2**).

8.11 Audits and Inspections

OPGGS(E)R 2009 Requirements
Regulation 14(6)
The implementation strategy must provide for sufficient monitoring, recording, audit, management of nonconformance and review of the titleholder's environmental performance and the implementation strategy to ensure that the environmental performance outcomes and standards in the environment plan are being met.

8.11.1 Audits

Santos audit plans and schedules are reviewed and updated at the beginning of each calendar year and cover all Santos facilities and activities. Santos' audit schedule may be amended to accommodate operational priorities, activity risk, personnel availability or high audit demand during certain periods (for example, regulatory audits, contractor audits). Santos will determine if a vessel audit is required following contract award and vessel confirmation.

Audits will be undertaken in a manner consistent with Santos' Management Standard for Assurance SMS MS15.

Audit scope typically includes a selection of CMs and EPSs and EPOs. However, audits may also include other parts of the EP.

Audits findings may include opportunities for improvement and non-conformances. Audit non-conformances are managed as described in **Section 8.11.3**.

8.11.2 Inspections

During an activity, HSE inspections (desktop or vessel based) will be conducted at least once during the activity to identify hazards, incidents and EP non-conformances. These inspections will also check compliance against all the EPOs and EPSs of this EP (**Table 8-2**) and inform end of activity reporting (**Table 8-4**). Any in field opportunities for improvement or corrective actions will be discussed during the inspection with the Vessel Master or Offshore Installation Manager.

8.11.3 Non-conformance Management

EP non-conformances will be addressed and resolved by a systematic corrective action process as outlined in Santos' Management Standard for Assurance (MS15) and the Assurance Procedure (ST01). Non-conformances arising from audits and inspections will be entered into Santos' incident and action tracking management system (i.e., HSE Toolbox). Once entered, corrective actions, time frames and responsible persons (including action owners and event validators) will be assigned. Corrective action 'close out' will be monitored using a management escalation process.

8.11.4 Continuous Improvement

For this EP, continuous improvement will be driven by the list below, and may result in a review of the EP with changes applied in accordance with **Section 8.10.2**:

- Improvements identified from the review of business-level HSE key performance indicators.
- Actions arising from Santos and departmental HSE improvement plans.
- Corrective actions and feedback from HSE audits and inspections, incident investigations and after-action reviews.
- Opportunities for improvement and changes identified during pre-activity reviews and MoC documents.
- Actions taken to address concerns and issues raised during the ongoing stakeholder management process (**Section 4**).

Identified continuous improvement opportunities will be assessed in accordance with the MoC process to ensure any potential changes to this EP, or OPEP, are managed in accordance with the OPGGS(E)R 2009 and in a controlled manner.

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Appendix A – Santos EHS Policy

Environment, Health & Safety

Santos

Policy

Our Commitment

Santos is committed to being the safest gas company wherever we have a presence and preventing harm to people and the environment

Our Actions

We will:

1. Integrate environment, health and safety management requirements into the way we work
2. Comply with all relevant environmental, health and safety laws and continuously improve our management systems
3. Include environmental, health and safety considerations in business planning, decision making and asset management processes
4. Identify, control and monitor risks that have the potential for harm to people and the environment, so far as is reasonably practicable
5. Report, investigate and learn from our incidents
6. Consult and communicate with, and promote the participation of all workers to maintain a strong environment, health and safety culture
7. Empower our people, regardless of position, to "Stop the Job" when they feel it necessary to prevent harm to themselves, others or the environment
8. Work proactively and collaboratively with our stakeholders and the communities in which we operate
9. Set, measure, review and monitor objectives and targets to demonstrate proactive processes are in place to reduce the risk of harm to people and the environment
10. Report publicly on our environmental, health and safety performance

Governance

The Environment Health Safety and Sustainability Committee is responsible for reviewing the effectiveness of this policy.

This policy will be reviewed at appropriate intervals and revised when necessary to keep it current.

Kevin Gallagher

Managing Director & CEO

Status: APPROVED

Document Owner:	Jodie Hatherly, General Counsel and VP Legal, Risk and Governance		
Approved by:	The Board	Version:	3

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Appendix B – Legislative Requirements Relevant to the Activity

Requirement Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
Aboriginal and Torres Strait Islander Heritage Protection Act 1984	This Act provides for the preservation and protection from injury or desecration areas and objects that are of significance to Aboriginal people, under which the Minister may make a declaration to protect such areas and objects. The Act also requires the discovery of Aboriginal remains to be reported to the Minister.	Yes	Commonwealth – Department of Agriculture, Water and the Environment	No activity being undertaken on land or near shore. No known sites of Aboriginal Heritage Significance within the OA. May be relevant in the event of a hydrocarbon spill requiring shoreline access (e.g. shoreline clean-up)	**Section 3.2.2** – Protected/significant areas
Australian Ballast Water Management Requirements, Version 8	Australian Ballast Water Management Requirements outline the mandatory ballast water management requirements to reduce the risk of introducing harmful aquatic organisms into Australia's marine environment through ballast water from international vessels. These requirements are enforceable under the Biosecurity Act 2015.	Yes	Commonwealth – Department of Agriculture and Water Resources	Potential internationally sourced vessel operating in Australian Waters which could have the potential for introduction of IMS and potential ballast water exchange	**Section 7.7** – Introduction of invasive marine species
Australian Heritage Council Act 2003	This Act identifies areas of heritage value listed on the Register of the National Estate and sets up the Australian Heritage Council and its functions.	No	Australian Heritage Council	There are seven heritage places found on the National Heritage List, within the EMBA that could potentially be impacted by unplanned events.	**Section 3.2.2** – Protected/significant areas **Section 7** – Unplanned events
Australian Maritime Safety	This Act specifies that the Australian Maritime Safety Authority's (AMSA) role includes protection of the marine environment from pollution from ships and other environmental	Yes	AMSA	This Act applies to the use of any vessel associated with operations and is relevant to the activity in	**Section 7.3** – Marine Diesel Oil (MDO)

Requirement Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
Authority Act 1990 (AMSA Act)	damage caused by shipping. AMSA is responsible for administering the Marine Order in Commonwealth waters. This Act facilitates international cooperation and mutual assistance in preparing and responding to a major oil spill incident and encourages countries to develop and maintain an adequate capability to deal with oil pollution emergencies. Requirements are given effect through AMSA. AMSA is the lead agency for responding to oil spills in the marine environment and is responsible for the Australian National Plan for Maritime Environmental Emergencies.			regard to the unplanned pollution from ships.	**Section 7.4** – Minor hydrocarbon release
Aquatic Resources Management Act 2016	This Act will be the primary legislation used to manage fishing, aquaculture, pearling and aquatic resources in Western Australia. The Act was scheduled for commencement on 1 January 2019; however, this has been deferred while an amendment to the Act is progressed.	Yes	Department of Primary Industries and Regional Development	Vessel movements have the potential to introduce IMS (IMS). This Act was considered during development of the Santos IMS Management Zone (IMSMZ) and IMS Management Plan (EA-00-RI-10172).	**Section 7.7** – Introduction of invasive marine species
Marine Orders	Marine Orders (MO) are subordinate rules made pursuant to the Navigation Act 2012 and Protection of the Sea (Prevention of Pollution from Ships) Act 1983 affecting the maritime industry. They are a means of implementing	Yes	AMSA	Vessel movements, safety, discharges and emissions	**Section 6** and **7** – planned and unplanned events

Requirement Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
	Australia's international maritime obligations by giving effect to international conventions in Australian law.				
Maritime Powers Act 2013	Protects the heritage values of shipwrecks and relics for shipwrecks over 75 years. It is an offence to interfere with a shipwreck covered by this Act. Available historic shipwreck locations covered by international conventions enacted by this legislation have been identified and assessed (as applicable) within this EP.	No	The Department of Immigration and Border Protection	No planned interaction or interference. Potential impact could be due to a hydrocarbon spill, but the credible spill is to surface, and therefore shipwrecks are highly unlikely to be impacted.	N/A
Biosecurity Act 2015 Biosecurity Regulations 2016	This Act provides the Commonwealth with powers to take measures of quarantine, and implement related programs as are necessary, to prevent the introduction of any plant, animal, organism or matter that could contain anything that could threaten Australia's native flora and fauna or natural environment. The Commonwealth's powers include powers of entry, seizure, detention and disposal. This Act includes mandatory controls on the use of seawater as ballast in ships and the declaration of sea vessels voyaging out of and into Commonwealth waters. The Regulations stipulate that all information regarding the	Yes	Commonwealth – Department of Agriculture and Water Resources	This Act applies to all internationally sources vessels operating in Australian Waters which could have the potential for the introduction of IMS and potential ballast water exchange.	**Section 7.7** – Introduction of invasive marine species

Requirement Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
	voyage of the vessel and the ballast water is declared correctly to the quarantine officers.				
Corporations Act 2001	This Act is the principal legislation regulating matters of Australian companies, such as the formation and operation of companies, duties of officers, takeovers and fundraising.	Yes	Commonwealth – Australian Securities and Investments Commission	The titleholder has provided ACN details within the meaning of the Act	**Section 1.4**
Environment Protection and Biodiversity Conservation Act 1999 Environment Protection and Biodiversity Conservation Amendment Regulations 2006	The National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) is the sole assessor for offshore petroleum activities in Commonwealth water (as of 28 February 2014). Under the new arrangements, environmental protection will be met through NOPSEMA's decision-making processes. This Act is the Australian Government's key piece of environmental legislation. The Act focuses on the protection of matters of national environmental significance (MNES). Australian Marine Park Management Plans were also developed under this Act.	Yes	Commonwealth – Department of Agriculture, Water and the Environment	This Act applies to all aspects of the activity that have the potential to impact MNES. Appropriate environmental approvals will be sought from NOPSEMA for all operations (this EP) which outlines compliance with the relevant regulations and plans under the Act. Where activities have existing approvals under the Act, these will continue to apply.	**Section 6.3** – Light emissions **Section 6.4** - Noise emissions **Section 6.6** – Planned Operational Discharges **Section 7.2** and **7.3** – Hydrocarbon release **Section 7.8** – Marine Fauna Interactions
Fish Resources Management Act 1994 *Fish Resources Management*	This Act establishes a framework for management of fishery resources and is the nominated lead agency responsible for implementing Western Australian marine biosecurity management requirements through	Yes	Department of Primary Industries and Regional	Introduction of invasive marine species.	**Section 7.7** – Introduction of Invasive Marine Species

Requirement Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
Regulations (1995)	implementation of the Fish Resources Management Act 1994 (FRMA 1994) and associated regulations.		Development (DPIRD)		
Underwater Cultural Heritage Act 2018 *Underwater Cultural Heritage (Consequential and Transitional Provisions) Act 2018*	This Act replaces the Historic Shipwrecks Act 1976 and extends protection to other wrecks such as submerged aircraft and human remains. It also increases penalties applicable to damaged sites. The Act came into effect on 1 July 2019.	Yes	Commonwealth – Department of Agriculture, Water and the Environment	Anyone who finds the remains of a vessel or aircraft, or an article associated with a vessel or aircraft, needs to notify the relevant authorities, as soon as possible but ideally no later than after one week, and to give them information about what has been found and its location.	**Section 3.2.4** – Other Socio-Economic Receptors **Section 7.2** to **7.5** – unplanned hydrocarbon spills
National Biofouling Management Guidance for the Petroleum Production and Exploration Industry 2009	The guidance document provides recommendations for the management of biofouling hazards by the petroleum industry.	Yes	Commonwealth – Department of Agriculture, Water and the Environment	Applying the recommendations within this document and implementing effective biofouling controls can reduce the risk of the introduction of an introduced marine species.	**Section 7.7** – Introduction of invasive marine species
National Environment Protection Measures (Implementation) Act 1998 (and	The Act provides for the implementation of national environment protection measures (NEPMs) in respect of certain activities carried on by or on behalf of the Commonwealth and Commonwealth authorities, and for related purposes. Specific objects of the Act are:	Yes	Commonwealth – Department of Agriculture, Water and the Environment	The act enables implementation of National Environment Protection Measures (NEPMs), which are a set of national objectives designed to assist in protecting or managing aspects of the environment.	**Section 6.5** – Atmospheric Emissions

Requirement Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
associated regulations)	+ to make provision for the implementation of national environment protection measures in respect of certain activities carried on, by or on behalf of the Commonwealth and Commonwealth authorities + to protect, restore and enhance the quality of the environment in Australia, having regard to the need to maintain ecologically sustainable development + to ensure that the community has access to relevant and meaningful information about pollution.			National objectives are concerned with; air toxics, ambient air quality, assessment of site contamination, diesel vehicle emissions, movement of controlled waste, national pollutant inventory and used packaging. Demonstration that the activity will be undertaken in line with the principles of ecologically sustainable development, and that impacts and risks resulting from these activities relevant to NEPM national objectives are ALARP and acceptable.	
National Greenhouse and Energy Reporting Act 2007	Introduces a single national reporting framework for the reporting and dissemination of information about greenhouse gas emissions, greenhouse gas projects and energy use and production of corporations.	Yes	Commonwealth – Department of Agriculture, Water and the Environment Climate Change Authority	This Act applies to the atmospheric emissions through combustion engine use to operate the vessels associated with the activity. Implementation of the Act will reduce the impact of GHG emissions associated with vessel use for the installation and commissioning activity, through compliance with MARPOL Annex VI (Marine Order Part 97: Marine Pollution Prevention – Air	**Section 6.5** – Atmospheric emissions

Requirement Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
				Pollution) and require the use of low sulphur fuel.	
Maritime Legislation Amendment (Prevention of Air Pollution from Ships) Act 2007	This Act implements the requirements of MARPOL 73/78 Annex VI for shipping in Commonwealth waters.	Yes	Commonwealth, Department of Infrastructure and Regional Development.	Implementation of this Act reduces the impact of GHG emissions associated with vessel use for the installation and commissioning activity, through compliance with MARPOL Annex VI (Marine Order Part 97: Marine Pollution Prevention – Air Pollution) and require the use of low sulphur fuel.	**Section 6.5** – Atmospheric emissions
Marine Safety (Domestic Commercial Vessel) National Law Act 2012	This Act is a single regulatory framework for the certification, construction, equipment, design and operation of domestic commercial vessels inside Australia's exclusive economic zone.	Yes	Commonwealth – Australian Maritime Safety Authority (AMSA)	All vessel movements associated with the activity will be governed by AMSA marine safety regulations under the Act.	**Section 7.7** – Interaction with other marine users **Section 7.3** – Hydrocarbon Spill MDO
Navigation Act 2012	An act regulating navigation and shipping including Safety of Life at Sea (SOLAS). A number of Marine Orders enacted under this Act apply directly to offshore petroleum exploration and production activities: + Marine Order 21: Safety and Emergency Arrangements + Marine Order 27: Safety of Navigation and Radio Equipment	Yes	AMSA (operational) Department of Infrastructure and Regional Development Minister for Infrastructure	All vessel movements associated with the activity will be governed by marine safety regulations and Marine Orders under the Act.	**Section 7.7** – Interaction with other marine users **Section 7.3** – Hydrocarbon release MDO

Requirement Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
	+ Marine Order 30: Prevention of collisions + Marine Order 58: Safe Management of Vessels + Marine Order 70 – Seafarer Certification		and Regional Development		
Offshore Petroleum and Greenhouse Gas Storage Act 2006 Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009	Petroleum exploration and development activities in Australia's offshore areas are subject to the environmental requirements specified in the OPGGS Act and associated Regulations. The OPGGS Act contains a broad requirement for titleholders to operate in accordance with "good oil-field practice". Specific environmental provisions relating to work practices essentially require operators to control and prevent the escape of wastes and petroleum. The Act also requires that activities are carried out in a manner that does not unduly interfere with other rights or interests, including the conservation of the resources of the sea and sea-bed, such as fishing or shipping. In some cases, where there are particular environmental sensitivities or multiple use issues it may be necessary to apply special conditions to an exploration permit area. The holder of a petroleum title must maintain	Yes	NOPSEMA	Drilling activities in Commonwealth waters are to be carried out: + Consistent with the principles of ecologically sustainable development as set out in section 3A of the EPBC Act. + So that environmental impacts and risks of the activity are reduced to ALARP and are of an acceptable level. + Demonstrate that the activity will be undertaken in line with the principles of ecologically sustainable development, and that impacts and risks resulting from these activities are ALARP and acceptable.	**Section 6** – Risk Assessments for Planned Events **Section 7** – Risk Assessments for Unplanned Events

Requirement Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
	adequate insurance against expenses or liabilities arising from activities in the title, including expenses relating to clean-up or other remedying of the effects of the escape of petroleum. The OPGGS Environment Regulations provide an objective based regime for the management of environmental performance for Australian offshore petroleum exploration and production activities in areas of Commonwealth jurisdiction. Key objectives of the Environment Regulations include: + to ensure operations are carried out in a way that is consistent with the principles of ecologically sustainable development + to adopt best practice to achieve agreed environment protection standards in industry operations + to encourage industry to continuously improve its environmental performance.				
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 (and	Regulates the manufacture, importation and use of ozone depleting substances (ODS) (typically used in fire-fighting equipment and refrigerants). Applicable to the handling of any ODS.	Yes	Commonwealth - Department of Agriculture, Water and the Environment	The activity does not include import, export or manufacture activities of ODS. This Act applies where ODS is found on vessel refrigeration	**Section 6.5** – Atmospheric emissions

Requirement Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
associated regulations)				systems, however, this is a rare occurrence.	
Protection of the Sea (Powers of Intervention) Act 1981 Protection of the Sea (Powers of Intervention) Regulations 1983	The Act authorises the Commonwealth to take measures for the purpose of protecting the sea from pollution by oil and other noxious substances discharged from ships and provides legal immunity for persons acting under an AMSA direction.	Yes	Commonwealth – Department of Infrastructure and Regional Development.	This Act applies to vessel discharges and movements associated with the activity. The Act is relevant to the extent that Santos WA will comply with MARPOL through the following relevant Marine Orders relating to marine pollution prevention have been put in place to give effect to relevant regulations of Annexes I, II, III, IV, V and VI of MARPOL 73/78: + Marine Order 91: Marine Pollution Prevention - Oil + Marine Order 93: Marine Pollution Prevention - Noxious Liquid Substances + Marine Order 94: Marine Pollution Prevention – Packaged Harmful Substances + Marine Order 95: Marine Pollution Prevention – Garbage + Marine Order 96: Marine Pollution Prevention – Sewage	**Section 6.1** – Interaction with other marine users **Section 6.6** – Planned operational discharges **Section 7.2** to **7.**5 – for unplanned hydrocarbon and non-hydrocarbon/chemical spills **Section 7.7** – Introduction of IMS

Requirement Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations 1994	This Act relates to the protection of the sea from pollution by oil and other harmful substances discharged from ships. This Act disallows any harmful discharge of sewage, oil and noxious substances into the sea and sets the requirements for a shipboard waste management plan. The following Marine Orders relating to marine pollution prevention have been put in place to give effect to relevant regulations of Annexes I, II, III, IV, V and VI of MARPOL 73/78: + Marine Order 91: Marine Pollution Prevention - Oil + Marine Order 93: Marine Pollution Prevention - Noxious Liquid Substances + Marine Order 94: Marine Pollution Prevention - Packaged Harmful Substances + Marine Order 95: Marine Pollution Prevention – Garbage + Marine Order 96: Marine Pollution Prevention – Sewage + Marine Order 97: Marine Pollution Prevention - Air Pollution	Yes	Commonwealth – Department of Infrastructure and Regional Development	This Act applies to vessel discharges and movements associated with the activity. The Act is relevant to the extent that Santos WA will comply with MARPOL through the following relevant Marine Orders relating to marine pollution prevention have been put in place to give effect to relevant regulations of Annexes I, II, III, IV, V and VI of MARPOL 73/78: + Marine Order 91: Marine Pollution Prevention - Oil + Marine Order 93: Marine Pollution Prevention - Noxious Liquid Substances + Marine Order 94: Marine Pollution Prevention – Packaged Harmful Substances + Marine Order 95: Marine Pollution Prevention – Garbage + Marine Order 96: Marine Pollution Prevention – Sewage	**Section 6.6** – Planned operational discharges **Section 7.2** to **7.5** – for unplanned hydrocarbon and non-hydrocarbon/chemical spills **Section 7.7** – Introduction of IMS

Requirement Legislation	Summary	Relevant to activity?	Administering Authority	Relevant aspects of the activity	EP Section
Protection of the Sea (Civil Liability of Bunker Oil Pollution Damage) Act 2008	This Act implements the requirements for the International Convention on Civil Liability for Bunker Oil Pollution Damage.	No	AMSA	This Act applies to diesel refuelling which may occur within the OA	**Section 7.3** – Hydrocarbon Spill MDO
Protection of the Sea (Harmful Antifouling Systems) Act 2006	This Act relates to the protection of the sea from the effects of harmful anti-fouling systems. It prohibits the use of harmful organotins in ant-fouling paints used on ships. This is enacted by Marine Order 98 (Marine Pollution – Anti-fouling Systems) 2013	Yes	Commonwealth, Department of Infrastructure and Regional Development and AMSA	This Act applies to vessel movements in Australian Waters associated with the activity. Vessels are required to have biofouling systems in place to prevent introduction of IMS / harmful impact on Australian biodiversity. This is enacted by Marine Order 98 (Marine Pollution – Anti-fouling Systems) 2013	**Section 7.7** – Introduction of IMS

International Agreements and Conventions	Summary	Relevant to Activity?	Relevant Aspects	EP Section
1996 Protocol to The Convention on The Prevention Of Marine Pollution By Dumping Of	Implemented in WA *Marine (Sea Dumping) Act* and *Environmental Protection (Sea Dumping) Act 1981.*	Yes	+ Sewage, grey water, and putrescible wastes generated from the MODU and support vessels	**Section 6.6** – Operational discharges

International Agreements and Conventions	Summary	Relevant to Activity?	Relevant Aspects	EP Section
Wastes And Other Matter, 1972.			+ Deck drainage/deck wash-down, cooling, brine, ballast and bilge water from support vessels + Hydraulic fluid released by valve operation on subsea infrastructure + Various discharges from planned maintenance activities.	
Agreement Between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and Their Environment 1974 (commonly referred to as the Japan Australia Migratory Bird Agreement or JAMBA)	This agreement recognises the special international concern for the protection of migratory birds and birds in danger of extinction that migrate between Australia and Japan. Implemented in *EPBC Act 1999.*	Yes	Only relevant in so far as the credible spill scenario may result in impact to migratory seabirds foraging in area.	**Section 7.2** to **7.5** – unplanned hydrocarbon spills
Agreement Between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and Their Environment 1986 (commonly referred to as the China Australia	This agreement recognises the special international concern for the protection of migratory birds and birds in danger of extinction that migrate between Australia and China. Implemented in *EPBC Act 1999.*	Yes	Only relevant in so far as the credible spill scenario may result in impact to migratory seabirds foraging in area.	**Section 7.2** to **7.5** – unplanned hydrocarbon spills

International Agreements and Conventions	Summary	Relevant to Activity?	Relevant Aspects	EP Section
Migratory Bird Agreement or CAMBA)				
Convention for the Control of Transboundary Movements of Hazardous Wastes and Their Disposal 1989 (Basel Convention)	This convention deals with the transboundary movement of hazardous wastes, particularly by sea. Implemented in *Hazardous Waste (Regulation of Exports and Imports) Act 1989.*	No	Activity does not involve transboundary movement of hazardous wastes.	N/A
United Nations Convention on Biological Diversity - 1992	An international treaty to sustain life on earth.	Yes	Relevant only insofar as the activity may interact with MNES (threatened and migratory species) protected under the EPBC Act.	**Section 6.4** – Noise emissions **Section 6.3** – Light emissions **Section 6.2** – Seabed and benthic habitat disturbance **Section 7.8** – Marine Fauna Interaction **Section 7.2** to **7.5** – for unplanned releases

International Agreements and Conventions	Summary	Relevant to Activity?	Relevant Aspects	EP Section
Convention on Oil Pollution Preparedness, Response and Co-operation 1990 (OPRC 90)	This convention comprises national arrangements for responding to oil pollution incidents from ships, offshore oil facilities, sea ports and oil handling. The convention recognises that in the event of pollution incident, prompt and effective action is essential.	Yes	In the event that worse-case credible spill scenarios may enact a national arrangement for response.	**Section 7.2** to **7.5** – for unplanned releases **Section 6.8** – Spill response operations
Convention on the Conservation of Migratory Species of Wild Animals 1979 (Bonn Convention)	The Bonn Convention aims to improve the status of all threatened migratory species through national action and international agreements between range states of particular groups of species.	Yes	Only relevant in so far as the credible spill scenario may result in impact to MNES protected migratory species.	**Section 7.2** to **7.5** – for unplanned releases **Section 6.8** – Spill response operations
International Convention for the Establishment of an International Fund for Compensation for Oil Pollution Damage (Fund 92)	This convention ensures compensation is provided for damage caused by oil pollution.	No	Relevant to oil tankers, not supply or support vessels.	N/A
International Convention for the Prevention of Pollution from Ships 1973/1978 (MARPOL 73/78)	This Convention and Protocol (together known as MARPOL 73/78) build on earlier conventions in the same area. MARPOL is concerned with operational discharges of pollutants from ships. It contains six Annexes, dealing respectively with oil, noxious	Yes	Already dealt with through the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* – refer to legislation table above.	N/A

International Agreements and Conventions	Summary	Relevant to Activity?	Relevant Aspects	EP Section
	liquid substances, harmful packaged substances, sewage, garbage and air pollution. 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.			
International Convention for the Safety of Life at Sea 1974	This convention is generally regarded as the most important of all international treaties concerning the safety of merchant ships Implemented in the *Air Navigation Act 1920.*	Yes	Only relevant in so far as SOLAS relates to safety aspects of the activity, such as navigation aids which reduce potential for vessel collision and hydrocarbon release to the environment.	**Section 6.1** – Interaction with other marine users
International Convention on Civil Liability for oil pollution damage (1969)	This convention provides a mechanism for ensuring the payment of compensation for oil pollution damage.	No	Relevant to oil tankers	N/A
International Convention for *the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention) 2004*	The IMO has been addressing the problem of invasive marine species in ship's ballast water since the 1980s. Ballast water and sediments guidelines were adopted in 1991 and the ballast water convention was adopted in 2004. Recent accession by Finland has triggered the final entry into force of these international requirements. As a result, the International Convention for the Control and Management of Ships Ballast Water and Sediment will enter into force on 8th	Yes	Potential internationally sourced vessel operating in Australian Waters which could have the potential for introduction of Invasive Marine Species and potential ballast water exchange	**Section 7.7** – Introduction of invasive marine species

International Agreements and Conventions	Summary	Relevant to Activity?	Relevant Aspects	EP Section
	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.			
Minamata Convention on Mercury (Australia ratified the convention on 7 December 2021)	The Minamata Convention on Mercury is an international treaty that seeks to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. The Convention covers all aspects of the life cycle of mercury, controlling and reducing mercury across a range of products, processes and industries.	Yes	Relevant to the contaminant limit concentrations in barite. Santos have committed to YO-CM-044 Quality Control limits for Barite (relevant to mercury): Mercury (Hg) – 1 mg/kg dry weight in stock barite	**Section 6.7 – Planned Drilling Discharges**
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	Yes	Only relevant to the extent that Santos WA will comply with MARPOL through the following relevant Marine Orders relating to marine pollution prevention have been put in place to give effect to relevant regulations of Annexes I, II, III, IV, V and VI of MARPOL 73/78: + Marine Order 91: Marine Pollution Prevention - Oil	**Section 6.6** – Operational discharges **Section 7.2** to **7.5** – for unplanned releases **Section 7.7** –

International Agreements and Conventions	Summary	Relevant to Activity?	Relevant Aspects	EP Section
	to the implementation of Part XI of the Convention in 1982, and UNCLOS in 1994.		+ Marine Order 93: Marine Pollution Prevention - Noxious Liquid Substances + Marine Order 94: Marine Pollution Prevention – Packaged Harmful Substances + Marine Order 95: Marine Pollution Prevention – Garbage + Marine Order 96: Marine Pollution Prevention – Sewage + Marine Order 97: Marine Pollution Prevention - Air Pollution	Introduction of invasive marine species
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.	Yes	Only relevant to the extent that to reduce impact of GHG emissions associated with vessel use, Santos WA will comply with MARPOL Annex VI (Marine Orders Part 97: Marine Pollution Prevention – Air Pollution) and require the use of low sulphur fuel. The MODU and support vessels will use diesel, which is a low sulphur fuel.	**Section 6.5** – Atmospheric emissions

Appendix C – Santos' Values and Sensitivities of the Western Australian Marine Environment (EA-00-RI-10062)

EA-00-RI-10062

Santos

Values and Sensitivities of the Marine and Coastal Environment

PROJECT / FACILITY	All
REVIEW INTERVAL (MONTHS)	12 Months
SAFETY CRITICAL DOCUMENT	NO

Rev	Owner	Reviewer/s Managerial/Technical/Site	Approver
	Senior Environmental Approvals Adviser	Senior Environmental Approvals Adviser	Team Leader- Regulatory Approvals
9	Joanna Edwards	Annette McGovern	Daniel Thompson
	JMEdwards	AMG	

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Rev	Rev Date	Author / Editor	Amendment
A	13/0520/14	Oceanica	Technical review
B	13/05/2014	Oceanica	Editorial review
0	30/0720/14	EG/GG	Final
1	30/12/2014	GG	Updated
2	28/07/2016	Jacobs	Updated
3	28/11/2017	Jacobs	Updated
3.1	11/12/2018	Jacobs	Issued for technical review
4	17/12/2018	Jacobs	Issued for use
4.1	09/01/2019	Jacobs	Issued for technical review
5	14/02/2019	Santos	Issued for use
5.1	15/01/2020	CDM Smith	Issued for technical review
6	19/03/2020	CDM Smith	Issued for use
6A	15/11/2020	Astron	Issued Technical review
7	30/11/2020	Astron	Issued for use
7A	25/02/2021	Advisian	Issued for Technical review
8	31/03/2021	Advisian	Issued for use
8A	02/07/2021	Advisian	Issued for technical review
9	09/07/21	Advisian	Issued for use

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Appendices

1. Introduction

Santos WA Energy Limited (Santos) is the titleholder of multiple petroleum titles for exploration, development and operational activities located in marine waters off north-western Western Australia. With the exception of Bayu Undan, this document describes the combined existing environment that may be affected (EMBA) by these petroleum activities and includes details of the relevant values and sensitivities of that environment as required by the Commonwealth *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* and State *Western Australian Petroleum (Submerged Lands) (Environment) Regulations 2012.*

The combined EMBA represents the largest possible spatial extent that could be contacted by combining the worst-case spill event modelled for Santos activities to date.

The combined EMBA encompasses the full range of environmental receptors that might be contacted by surface and subsurface hydrocarbons in the highly unlikely event of any worst case oil spill from Santos's activities. The low hydrocarbon exposure values as defined in NOPSEMA's '*Environmental Bulletin – Oil Spill Modelling*' (April 2019), are used as a predictive tool to set the outer boundaries of the combined EMBA.

The combined EMBA does not represent the worst case loss of well control event of any one activity .

This document is informed by searches of the protected matters search tool (PMST) provided by the WA Department of Agriculture, Water and the Environment (DAWE) (previously the Department of the Environment and Energy (DoEE) (in December 2020 and June 2021 and provided in **Appendix A**), as well as published scientific literature and studies, and other State and Territory protected species databases where applicable. Descriptions of all fauna are provided, with a focus on protected species that are threatened and migratory. The PMST is performed annually and any changes from this updated search are detailed in a change register (**Appendix B**). This document is then reviewed annually and updated accordingly.

The PMST searches are completed using the exact coordinates that are utilised to produce the figures throughout Section 3 of the EP, ensuring that the combined EMBA encompasses the full range of environmental receptors that might be contacted by surface and subsurface hydrocarbons at the low exposure level in the highly unlikely event of a worst case oil spill.

On the first page of the PMST report, is a coarse graphic showing the area over which the search has been conducted. However, the granularity of this can make the output look different to the spatial area represented on figures.

The co-ordinates are also provided within the PMST report to allow for duplication of the searches and verification if required. Santos do not have control over the PMST search tool output, but instead have provided the reports and coordinates to ensure transparency.

Figures provided throughout this document are zoomed to the relevant data represented to allow detail to be shown at a readable scale.

1.1 Geographical Extent

The combined EMBA, includes the coastal waters and shoreline habitats of Western Australia (WA) and part of the Northern Territory (NT), encompassing the south of WA to the most northern coastlines of the NT in the north (**Appendix A**). This area largely approximates the Commonwealth North-West Marine Region (NWMR), the South-West Marine Region (SWMR) and the North Marine Region (NMR). Based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4.0, there are 18 bioregions that occur within the combined EMBA. These bioregions are based on fish, benthic habitat and oceanographic data (IMCRA v. 4.0). Where relevant, the physical, biological and social environments within the combined EMBA are discussed with reference to the IMCRA Provincial Bioregions. The provinces of most relevance (**Figure 1-1**) are:

North-west Marine Region

- Northwest Shelf Transition;
- Timor Province;

- Northwest Transition;
- Northwest Province;
- Northwest Shelf Province;
- Central Western Transition;
- Central Western Shelf Transition; and
- Central Western Shelf Province.

South-west Marine Region

- Central Western Province;
- Southwest Shelf Transition;
- Southwest Transition;
- Southwest Shelf Province;
- Southern Province; and
- Great Australian Bight Shelf Transition.

North Marine Region

- Northwest Shelf Transition (as above);
- Timor Transition; and
- Northern Shelf Province.

Other IMCRA 4.0 bioregions of interest include: Christmas Island Province and Cocos (Keeling) Island Province.

The international waters of south west Indonesia and Timor-Leste (in part) are also included in the combined EMBA and described where relevant throughout this document.

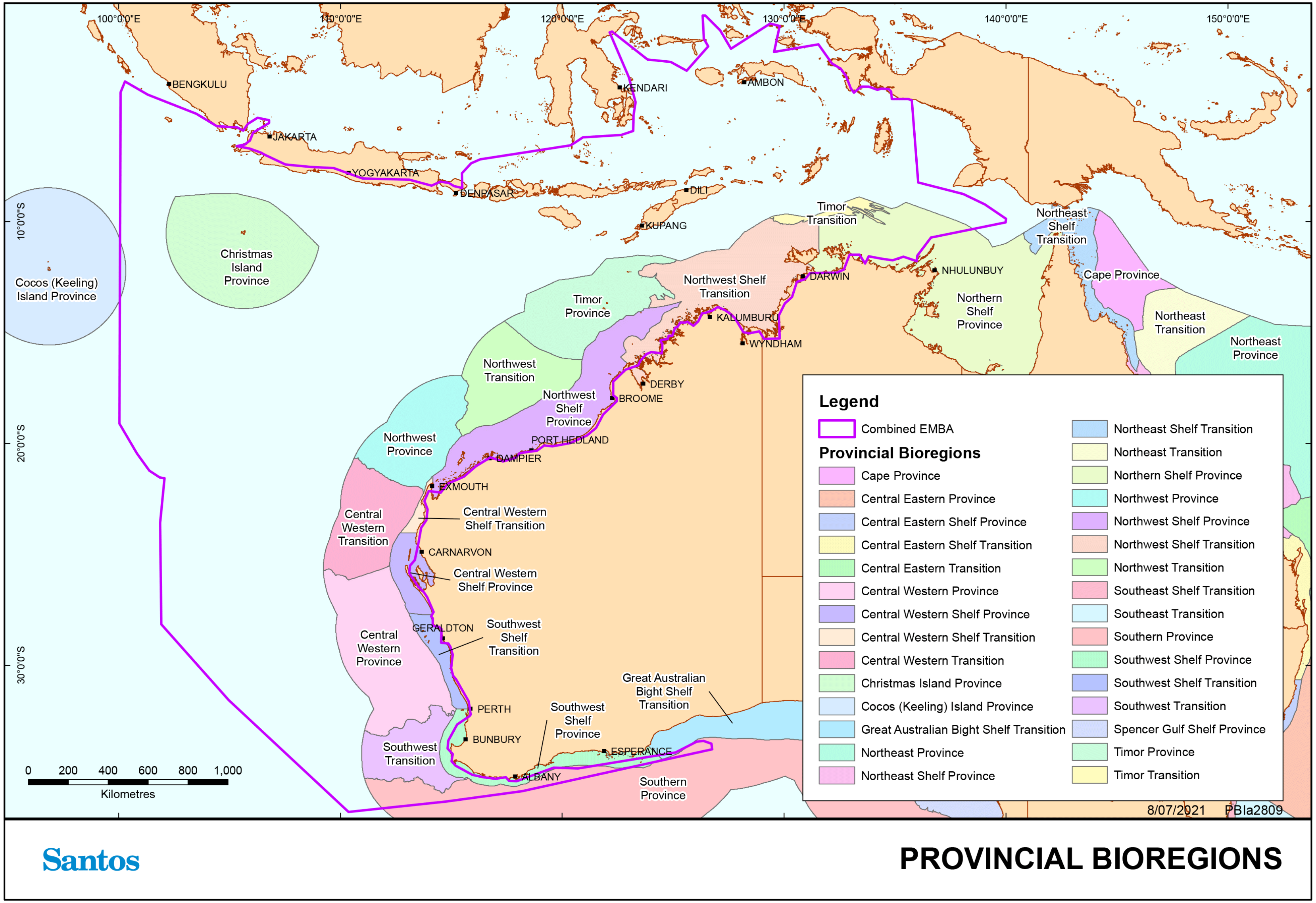


Figure 1-1: EMBA within IMCRA 4.0 Provincial Bioregion

2. Physical Environment

2.1 Geomorphology

2.1.1 Formation History

Approximately 550–160 million years ago, northern and western parts of Australia formed part of the northern margin of Gondwana. About 300 million years ago, crustal stretching, rifting and breakup initiated development of an extensive basin that became the site for deposition of sediments (Baker *et al*. 2008 in Department of the Environment, Heritage, Water and the Arts (DEWHA) 2008a). Approximately 135 million years ago the continent broke up resulting in the separation of greater India and Australia. Ocean spreading associated with the continental break-up resulted in the creation of the Argo and Cuvier abyssal plains. Subsidence of the rifted margin resulted in the formation of the Exmouth and Scott plateaux and the Rowley Terrace. The narrow shelf south of North West Cape was formed approximately 130 million years ago as a result of the separation of India and seafloor spreading (Baker *et al*. 2008 in DEWHA 2008a).

The South-west region has been relatively stable throughout its recent geological past. This has shaped a continental shelf that has high wave exposure and is punctuated with coastal features such as island groups and fringing coastal reefs providing sheltered habitats for marine communities (2008a).

2.1.2 Present Day Geological Features

The EMBA consists of five major landform features: continental shelf, continental slope, continental rise, Exmouth plateau and abyssal plain. The majority of the area consists of either continental shelf or continental slope (DEWHA 2008a).

Limited surveys have shown that the continental slope in the combined EMBA comprises diverse geological features such as canyons, plateaux, terraces, ridges, reefs, banks and shoals (DEWHA (2008) (**Figure 2-1** and **Figure 2-2**). These features are significant in that over half of the total area of banks and shoals across Australia's entire marine jurisdiction occurs in the Commonwealth waters from the South Australian border to the Northern Territory border, as well as 39% of terraces and 56% of deeps, holes and valleys (DEWHA 2008a).

An important characteristic of the combined EMBA is the significant narrowing of the continental shelf around North West Cape from the broad continental shelf in the north (**Figure 2-3**). For example, in the Joseph Bonaparte Gulf (at the NT boundary), the continental shelf is around 400 km wide, whereas at North West Cape the shelf is only 7 km wide – the narrowest of anywhere on the Australian continental margin (DEWHA 2008a). Shelf width affects oceanography with flow on effects to productivity and ecosystem functioning.

The continental shelf north of Cape Leveque is characterised by a rimmed ramp where the waters over the outer margins of the shelf (approximately 50 to 100 m waters depth) are shallower than the middle portions (up to 150 m water depth). The rim at its outer edge is the site of a number of coral reefs including Ashmore, Cartier, Scott and Seringapatam (DEWHA 2008a).

The Indonesian archipelago lies between the Pacific and Indian oceans, and bridges the continents of Asia and Australia. The archipelago is divided into several shallow shelves and deep-sea basins.

Several geomorphic formations within the combined EMBA have been associated with Key Ecological Features (DEWHA 2008a) and these are discussed in **Section 10**.

2.1.3 Southwest Transition

The Southwest Transition is an offshore deep-water bioregion with a submerged continental fragment as its dominant seafloor feature – the Naturaliste Plateau. The Plateau extends across an area of 90,000 km^2 of which only 29,825 km^2 is within Commonwealth waters. It is located west of Cape Leeuwin and Cape Naturaliste in water depths ranging from 2,000–5,000 m. It is relatively flat with a slight northward dip, and has steep southern and western sides and a more gently sloping northern side. The Plateau is separated from the

Australian continent by the Naturaliste Trough and two offshore terraces on the continental slope (average depth 780 m). Submarine canyons incise the northern parts of the slope and parts of the Naturaliste Plateau.

2.1.4 Southwest Shelf Province

The Southwest Shelf Province consists of an area of narrow continental shelf from Rottnest to Point Dempster. For the purposes of this document (EMBA), the northern and western limits of the bioregion are the main focus because it is this portion that falls within the combined EMBA, which are an extension of the seafloor described in the Southwest Shelf Transition (below). It includes features such as limestone ridges, depressions defining an inshore lagoon and a relatively smooth inner shelf plain that meets the South Bank Ridge on the outer shelf, and islands providing important habitat, such as Rottnest Island. The shelf progressively broadens to form the relatively sheltered waters of Geographe Bay before narrowing once again at Cape Mentelle.

2.1.5 Southwest Shelf Transition

This bioregion consists of a narrow continental shelf, ranging from approximately 40-80 km wide that is noted for its physical complexity. It includes a series of nearshore ridges and depressions that form inshore lagoons, a smooth inner shelf plain, a series of offshore ridges and a steep, narrow outer shelf. The near-shore ridges are formed by eroded limestone reefs and pinnacles that stand 10-20 m above the seafloor. The edge of the inner shelf plain is marked by a series of broken offshore ridges that extend north to the northern limits of the bioregion, where they emerge to support the tropical carbonate reef growth of the Houtman Abrolhos Islands (DEWHA, 2008b).

2.1.6 Southern Province

The Southern Province is the largest bioregion within Australia's waters stretching from the shelf break south of Kangaroo Island to the southern edge of the Naturaliste Plateau. The bioregion includes the deepest ocean areas within the Australian Exclusive Economic Zone (approximately 5,900 m maximum water depth) and consists of a long continental slope incised by numerous well-developed submarine canyons. Several key ecological features are present within the combined EMBA and include the Albany Canyons Group, the Ceduna and Eyre Terraces (covering approximately 147,150 km^2) and the Diamantina Fracture Zone.

2.1.6.1 Great Australian Bight

The Great Australian Bight Shelf Transition is characterised by the largest seafloor feature of the Region – an extensive flat continental shelf covering 177 130 km^2. The centre of the shelf reaches widths of 260 km narrowing to 80 km at its margins. Geomorphology, sedimentology and hydrodynamics interact to create ideal conditions for carbonate organisms such as molluscs and bryozoans to flourish without being smothered or buried. As a result carbonate sediments derived from invertebrate skeletons and shells make up over 80 per cent of shelf sediments, making the Bight part of the world's largest modern cool-water carbonate bioregion that extends along Australia's southern margin. Within the wave abrasion zone (0-120 m) sediments are typically rippled and coarse grained, forming a 'shaved shelf' where carbonate accumulation is less than the amount of active erosion and therefore there is a net loss of sediment from the shelf (DEWHA, 2008b).

2.1.7 Central Western Province

This bioregion is characterised by a narrow continental slope that is heavily incised by many submarine canyons as far north as Kalbarri. The Perth Canyon, located at the southern margin of the bioregion, is an order of magnitude larger than any other canyon in the Region (Figure 2.11). The Perth Canyon, formed by erosive processes associated with the ancient Swan River, cuts into the continental shelf at approximately the 150 m depth contour, north-east of Rottnest Island. Other relatively large canyons, such as the Murchison Canyon, occur in the bioregion but little is known about them as they have not yet been studied (DEWHA, 2008b).

The bioregion contains the most extensive area (52 185 km2) of continental rise on the Australian margin. The continental rise is located on the edge of the Perth Abyssal Plain (103 911 km2). There is a large terrace known as the Carnarvon Terrace on the continental slope, extending north from the Houtman Abrolhos Islands at an average of 780 m water depth (DEWHA 2008b).

2.1.8 Central Western Shelf Province

This bioregion is located on the Dirk Hartog Shelf and is generally very flat. It varies in width from less than 20 km in the north to around 125 km in the vicinity of Shark Bay. A small area of reef and tidal sandwaves or sandbanks occur at the entrance to Shark Bay and within its vicinity. Other topographic features of the bioregion include a deep hole and associated area of banks and shoals offshore of Kalbarri. The banks and shoals in this bioregion are of note because they occur at latitudes significantly south of banks and shoals elsewhere in the North-west Marine Region (DEWHA, 2008a).

2.1.9 Central Western Transition

The Central Western Transition is characterised by large areas of continental slope, with sediments dominated by muds and sands that decrease in grain size with increasing depth. The slope is incised by numerous topographic features such as terraces (i.e. the Carnarvon Terrace), canyons (i.e. Cloates Canyon and Carnarvon Canyon) and rises. A large part of the bioregion consists of the Cuvier Abyssal Plain. The Wallaby Saddle is another important feature of this bioregion and it is the most extensive area of this type of topographic feature in the North-west Marine Region (DEWHA, 2008a).

2.1.10 Central Western Shelf Transition

The Central Western Shelf Transition is located entirely on the continental shelf and is comprised mainly of sandy sediments. The close proximity of the coast to the shelf break is a significant feature of this bioregion and is an important factor in determining its biodiversity (DEWHA, 2008a).

Ningaloo Reef is the most significant geomorphic feature in the bioregion. It extends south of North West Cape along the Cape Range Peninsula, and stretches for over 260 km. It is the only example in the world of an extensive fringing coral reef on the west coast of a continent (DEWHA, 2008a).

2.1.11 Northwest Province

The bioregion occurs entirely on the continental slope and is comprised of muddy sediments. It is distinguished by a number of topographic features, such as the Exmouth Plateau, terraces and canyons (including the Swan and Cape Range canyons), as well as deep holes and valleys on the inner slope. The Montebello Trough occurs on the eastern side of the Exmouth Plateau and represents more than 90 per cent of the area of troughs in the North-west Marine Region. Significantly, this bioregion contains the steepest shelf break of the North-west Marine Region, along the Cape Range Peninsula near Ningaloo Reef (DEWHA, 2008a).

2.1.12 Northwest Transition

The majority (52 per cent) of the Northwest Transition bioregion occurs on the continental slope, with smaller areas in the north-west of the bioregion located on the Argo Abyssal Plain and continental rise. The sediments of the slope are dominated by sands, whereas the sediments of the abyssal plain/deep ocean floor are dominated by muds. More than 60 per cent of the Argo Abyssal Plain occurs within this bioregion and much of the Northwest transition occurs in water over 4000 m deep (DEWHA, 2008a).

Other topographic features within the bioregion include areas of rise, ridges, canyons and apron/fans. The bioregion also has reefs such as Mermaid, Clerke and Imperieuse reefs, which are collectively known as the Rowley Shoals (DEWHA, 2008a).

2.1.12.1 Northwest Shelf Province

The Northwest Shelf Province is located almost entirely on the continental shelf, except for a small area to the north of Cape Leveque that extends onto the continental slope. This bioregion includes more than 60% of the continental shelf in the North-west Marine Region (DEWHA, 2008a). The shelf gradually slopes from the coast to the shelf break, but displays a number of seafloor features such as banks/shoals and holes/valleys. These are thought to be morphologically distinct from other features of these types found elsewhere in the North-west Marine Region, and have a different sedimentology (DEWHA, 2008a). For example, the Glomar Shoals occur approximately 30–40 km offshore of Dampier in water depths of between 26–70 m and are distinguished by highly fractured molluscan debris, coralline rubble and coarse carbonate sand. The province also includes the

Leveque Rise, a large plateau, and one of only two shelf plateaux within the North-west Marine Region (DEWHA, 2008a).

2.1.12.2 Northwest Shelf Transition

The Northwest Shelf Transition is predominantly located on the continental shelf with a small portion extending onto the continental slope causing waters in the area to be relatively shallow, only up to 330 m. It also consists of geomorphic features that are unique to the Northwest Shelf Transition and not found elsewhere in the North-west Marine Region (DEWHA, 2008a). An example of this is that 90% of the Region's carbonate banks are located within the Northwest Shelf Transition (DEWHA, 2008a).

The Bonaparte Depression lies within the Northwest Shelf Transition, which is a 45 000 km^2 geomorphic basin that is the only occurrence of its type in the North-west Marine Region (DEWHA, 2008a). The Bonaparte Depression is a relatively flat feature with a higher content of mud and gravel than what is found elsewhere in the Northwest Shelf Transition and it has a number of pinnacles of which form the key ecological feature 'pinnacles of the Bonaparte Basin' (see **Section 9.8**).

2.1.12.3 Timor Province

The Timor Province is located on the continental slope. The notable topographical features include the Scott Plateau, the Ashmore Terrace and part of the Rowley Terrace and Argo Abyssal Plain (DEWHA, 2008a). Of these, the Scott Plateau is particularly significant with water depths of up to 3000 m and being fringed by spurs and valleys (DEWHA, 2008a). The Scott Plateau is also separated from Rowley Terrace by canyons that are up to 50 million years old (DEWHA, 2008a).

The Timor Province encompasses almost half of the reefs in the North-west Marine Region, including Scott Reef, Seringapatam Reef and Ashmore Reef which are all within the combined EMBA (DEWHA 2008a).

2.1.12.4 Timor Transition

The Timor Transition is predominantly shelf terrace and slope, which extend into waters that are 200-300 m deep. The deepest point (300 m) is the Arafura Depression. The Timor Transition is also dominated by a series of canyons that represent a drowned river system from the Pleistocene era (DEWHA, 2008c). The canyons are approximately 80-100 m deep and up to 20 km wide (DEWHA, 2008c).

2.1.12.5 Northern Shelf Province

The Northern Shelf Province consists of large areas of relatively featureless sandy and muddy sediments (DWEHA, 2008c). A significant feature of the Northern Shelf Province is the Gulf of Carpentaria, which is outside the combined EMBA, the majority of the reefs in the Northern Shelf Province are also outside the combined EMBA and form a broken margin around the Gulf of Carpentaria. However, within the combined EMBA is the Arafura Shelf which is characterised by continental shelf, canyons, terraces, the Arafura Sill and the Arafura Depression (DEWHA, 2008c).

2.1.12.6 Christmas Island Province

This bioregion contains the 4th largest abyssal plain/deep ocean floor area and smallest area of slope of all the National Benthic Marine Bioregionalisation (NBMB) bioregions (DEH, 2005a). 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 Cocos (Keeling) Island bioregion.

2.1.12.7 Cocos (Keeling) Island Province

This bioregion contains the largest abyssal plain/deep ocean floor area of all the NBMB bioregions and is the deepest NBMB bioregion on average due to the relatively large areas of abyssal plain/deep ocean floor (DEH, 2005b). 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. The Cocos basin comprises dominantly flat abyssal plain occurring at water depths around 5,500 km.

2.1.13 Sediments

Terrestrial environments are not a major source of sediment in the area and terrigenous sediments tend to be confined to the inner shelf (generally less than 100 m water depth), particularly in areas adjacent to rivers. Sediments in the area generally become finer with increasing water depth, ranging from sand and gravels on the shelf to mud on the slope and abyssal plain. Joseph Bonaparte Gulf is an exception to this pattern, as sediments with high mud content extend across the inner and mid shelf within the Gulf, graduating to sands and gravels in the Bonaparte Depression.

The distribution and resuspension of sediments on the inner shelf is strongly influenced by the strength of tides across the continental shelf as well as episodic events such as cyclones. Further offshore, on the mid to outer shelf and on the slope itself, sediment movement is primarily influenced by ocean currents and internal tides. Internal tides describe the tidal movement across a slope of water stratified by marked differences in density. Internal tides cause resuspension and net down-slope deposition of sediments on the North West Shelf (DEWHA 2008a).

Surveys conducted over the North West Shelf indicate that similar sediments occur extensively over this geographic region, but with spatial variation in the grain size and origin of the surface sediments.

The ecology of the southwest is also greatly influenced by the lack of river discharge into the Region. The few significant rivers adjacent to the Region flow intermittently and their overall discharge is low. The low discharge of rivers and the generally low rate of biological productivity also results in low turbidity (suspended sediments), making the waters of the Region relatively clear (McLoughlin & Young 1985). Surface sediments in the area are predominantly composed of skeletal remains of marine fauna, with lenses of weathered sands (McLoughlin & Young 1985).

Several geomorphic formations have been associated with Key Ecological Features (DEWHA 2008a) and these are discussed in **Section 10**.

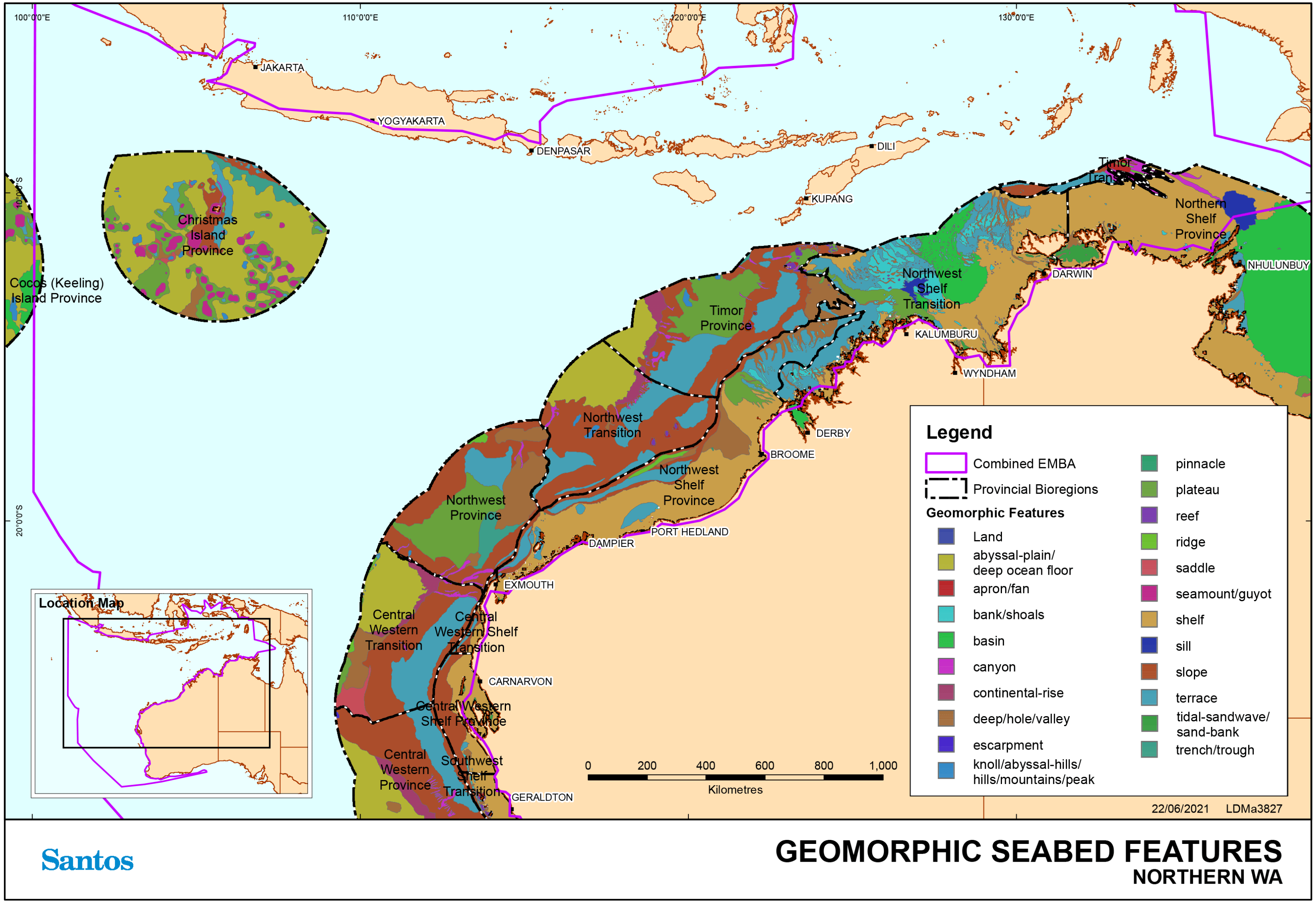


Figure 2-1: Geomorphic/seafloor features of Northern WA

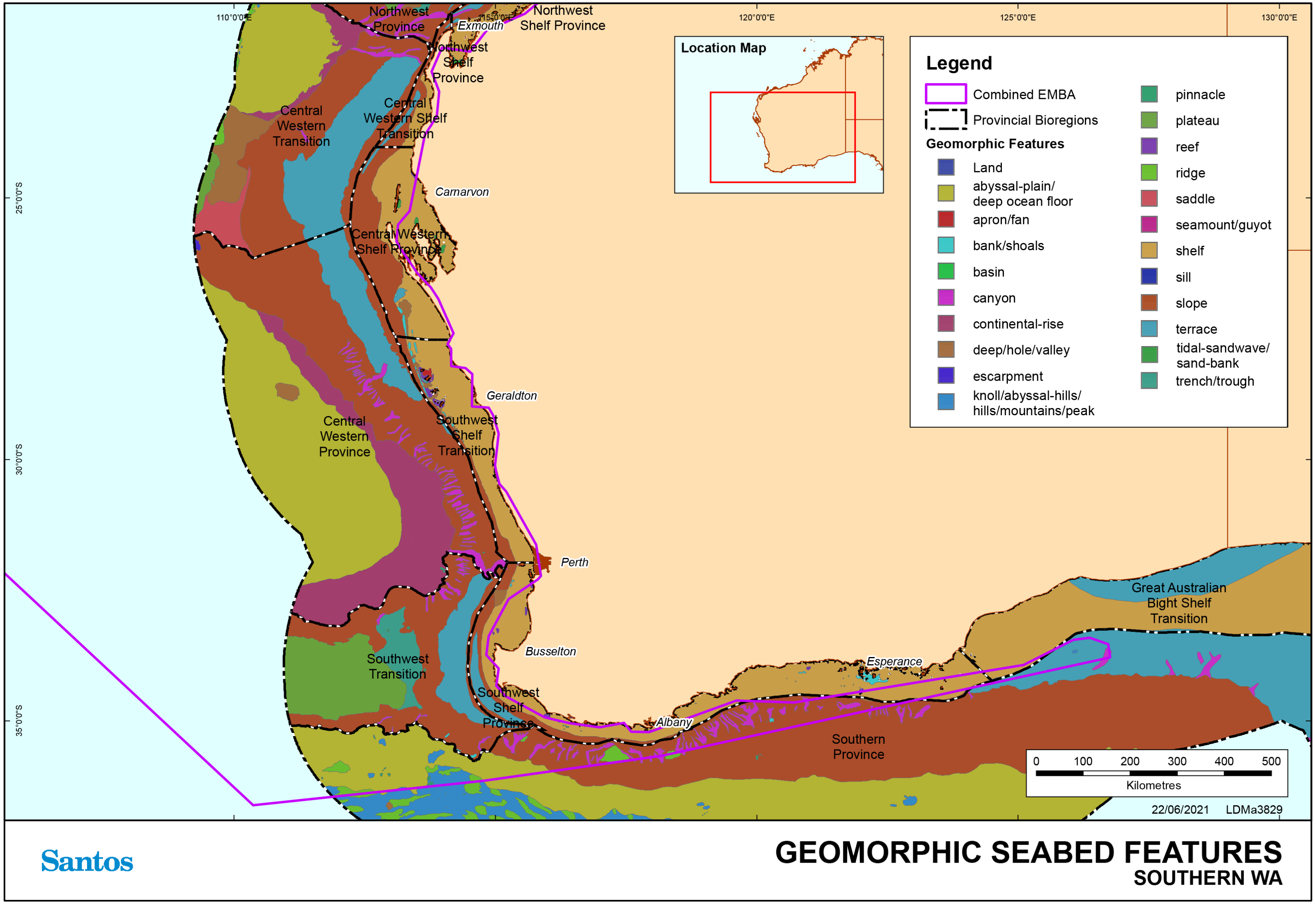


Figure 2-2: Geomorphic/seafloor features of Southern WA

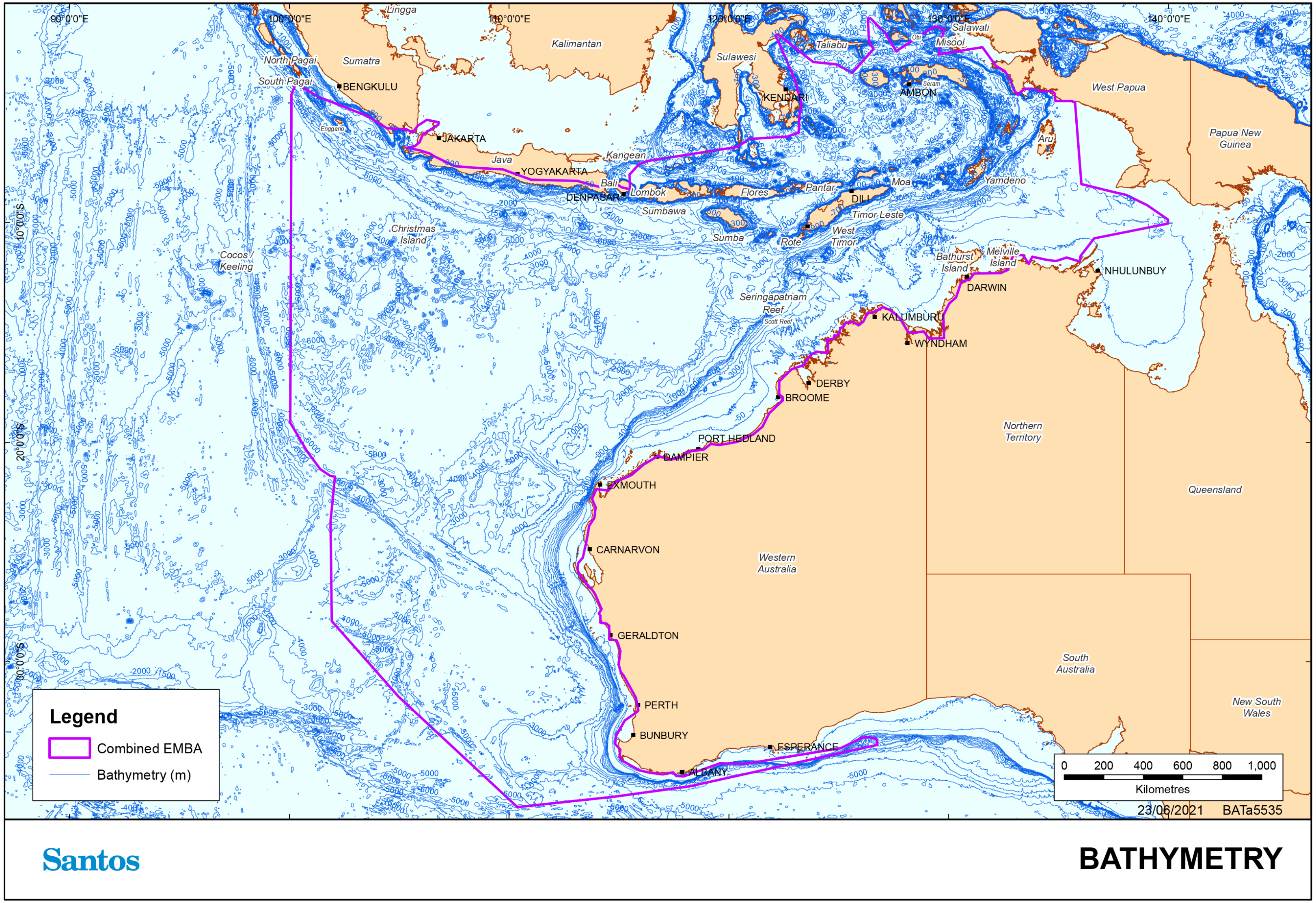


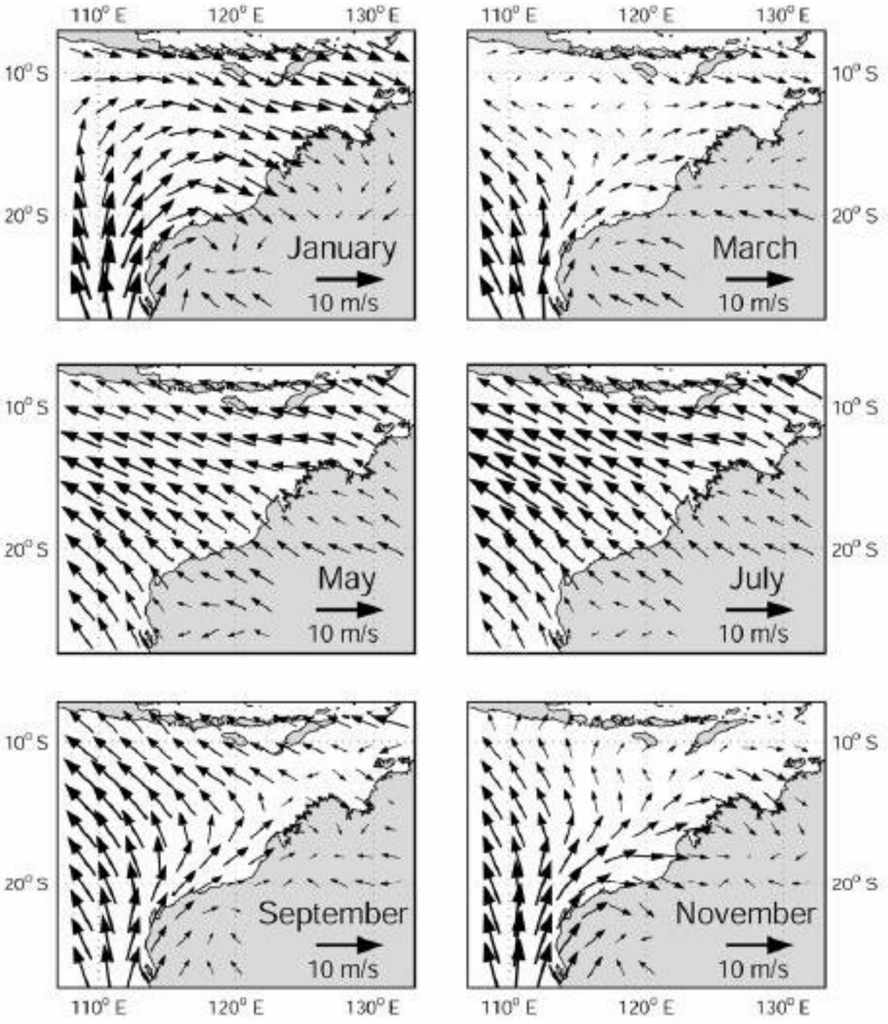
Figure 2-3: Bathymetry of the combined EMBA

2.2 Climate

Waters in northern Western Australia predominantly lie in the arid tropics, experiencing high summer temperatures and periodic tropical cyclones in summer. Rainfall in the region is low, although intense rainfall may occur during the passage of summer tropical cyclones and thunderstorms (Condie *et al.* 2006). Mean air temperatures range from a minimum of 11°C in winter to a maximum of 36°C in summer (Condie *et al.* 2006). Due to the arid climate, daytime visibility in the area is generally greater than 5 nautical miles (SSE 1991).

The summer and winter seasons fall into the periods September–March and May–July, respectively. Winters are characterised by clear skies, fine weather, predominantly strong east to southeast winds and infrequent rain (calculated from NCEP-NCAR dataset measured from 1982 to1999; Condie *et al.* 2006; **Figure 2-4**).

Summer winds are more variable, with strong south-westerlies dominating. Transitional wind periods, during which either pattern may predominate, can be experienced in April–May and September of each year.



Calculated from NCEP-NCAR dataset measured from 1982 to 1999. Source: Condie *et al*. (2006)

Figure 2-4: Seasonally averaged winds at 10 m above mean sea level

Tropical cyclones generate the most significant storm conditions in the area (SSE 1993). These clockwise-spiralling storms have generated wind speeds 50–120 knots (SSE 1991). Tropical cyclones develop in the eastern Indian Ocean, and the Timor and Arafura Seas during the summer months. Three to four cyclones per year are typical, with the official cyclone season being November through to April (Bureau of Meteorology

(BoM) 2013). In Indonesia, the main variable in climate is not temperature or pressure, but rainfall, which varies greatly by month and place, ranging from 997 millimetres (mm) to 4,927 mm.

Waters in the southwest and southern Western Australia experience a Mediterranean style climate that is characterised by cool, wet winters and hot, dry summers. In winter, wind patterns are characterised by a prevailing westerly wind stream. This enables winter cold fronts and strong westerly winds to regularly penetrate the south-west, with cold fronts crossing the coast every week or so. Apart from the passage of storms, typically lasting one day or less, the weather is otherwise mild in winter with winds variable and relatively weak. In summer, cold fronts rarely penetrate into the south of the state with any strength and hot easterly winds prevail.

The Bonaparte Basin and Timor Sea region in the north has a tropical climate. These areas experience a distinct 'wet' season with summer monsoonal conditions from October to March and a distinct 'dry' season with cooler and drier conditions from April to September. The wet season usually comprises south-westerly winds capable of generating thunderstorm activity, high rainfall and cyclones. The dry season usually comprises dry and warm conditions with little rainfall (Fugro, 2015).

2.3 Oceanography

Major drivers of marine ecosystems include ocean currents, tides, waves, temperature and salinity. The dominant offshore sea surface current is the Leeuwin Current (**Figure 2-5**), which carries warm tropical water south along the edge of Western Australia's continental shelf, reaching its peak strength in winter and becoming weaker and more variable in summer (Condie *et al.* 2006). The current is typically located seaward of the shelf break (200 m isobath) and is a narrow, surface current, extending to a depth of 150 m (BHPB 2005, Woodside 2005) and a width of 50–100 km (DEWHA 2008a). The formation of meanders and eddies are also a feature of the Leeuwin Current and a number of eddies occur south of Shark Bay (DEWHA 2008a). The strength of the Leeuwin Current is influenced by seasonal variability in the pressure gradient (DEWHA 2008a). The Holloway Current is the prevailing seasonal current, travelling south-west along the north West Australian coast in winter and north-east in summer (Brewer et al. 2007). It is a relatively narrow boundary current that flows along the north-west shelf at between 100 m and 200 m depth, flowing towards the north-east in summer and the south-west in winter (Fugro, 2015).

The Indonesian Throughflow is the other important current influencing the upper 200 m of the outer North West Shelf (Woodside 2005). This current brings warm and relatively fresh water to the region from the western Pacific via the Indonesian Archipelago (**Figure 2-5**). Modelling undertaken by Woodside and Commonwealth Scientific and Industrial Research Organisation (CSIRO) Marine and Atmospheric Research indicates that significant east–west flows occur across the North West Shelf to the north of the North West Cape, possibly linking water masses in the area (Woodside 2005, Condie *et al.* 2006).

Currents in the coastal zone and over the inner to mid-shelf are largely driven by tides and winds, whereas offshore, over the continental shelf, slope and rise are influenced by large scale regional circulation (DEWHA 2008a). Large-scale currents of the Timor and Arafura seas in the north are dominated by the Indonesian Throughflow. Christmas and Cocos (Keeling) Islands territories are located in the eastern Indian Ocean, in the path of the South Equatorial Current that carries the Indonesian Throughflow waters into the Indian Ocean.

The nearshore Ningaloo Current flows northwards opposite to the Leeuwin Current, along the outside of the Ningaloo Reef and across the inner shelf from September to mid-April (BHPB 2005, Woodside 2005). The nearshore Capes Current, which is to the south of the Ningaloo Current, is a seasonal current that appears strongest between Cape Leeuwin and Cape Naturaliste, in the southwest of Western Australia (Pearce and Pattiaratchi 1999). Strong northwards winds between November and March slow the Leeuwin Current and increase the strength of the Capes Current. Localised upwelling is also known to occur in the area (Pearce and Pattiaratchi 1999).

Tides increase in amplitude from south to north, corresponding with the increasing width of the shelf (Holloway 1983). Tides in the area are generally semi-diurnal (i.e. two high tides and two low tides per day) with a spring/neap cycle. The northern area experiences some of the largest tides in the world. In the Kimberley, the daily tidal range is up to 10 m during spring tides and less than 3 m during some neap tides. Mid-shelf tidal currents are predicted to have average speeds of approximately 0.25 knots during neap tides and up to 0.5 knots during spring tides (NSR 1995, WNI 1995).

The wave climate in the northwest is composed of locally-generated wind waves (seas) and swells that are propagated from distant areas (WNI 1995). In summer the seas typically approach from the west and southwest, while in winter the seas typically approach from the south and east. Mean sea wave heights are typically less than 1 m and peak heights of less than 2 m are experienced in all months of the year (WNI 1995). Cyclones and tropical storms can greatly increase wave heights by up to 8 m in the outer Timor Sea during the cyclone season (Przeslawski et al. 2011).

Indonesian waters, especially the eastern part of the archipelago, play an important role in the global water mass transport system, in which warm water at the surface conveys heat to the deeper cold water in what is known as the great ocean conveyor belt (refer **Figure 2-5**). The eastern archipelago is the only place in the Pacific Ocean that connects with the Indian Ocean at lower latitudes. The water mass transport from the Pacific to the Indian Ocean through various channels in Indonesia is called Arlindo (Arus Lintas Indonesia), also known as the Indonesian Throughflow (ADB 2014). Surface currents in Indonesian waters are more strongly influenced by circulation from the Pacific Ocean than from the Indian Ocean. The currents are also greatly influenced by the winds of the prevailing monsoon.

Average swell heights are low, around 0.4–0.6 m in all months. The greatest exposure to swells is from the west (SSE 1993). Tropical cyclones have generated significant swell heights of up to 5 m in this area, although the predicted frequency of swells exceeding 2 m is less than 5% (WNI 1996). In the open ocean, sustained winds result in wind-forced currents of approximately 3% of the wind speed (Holloway & Nye 1985).

Tides in the South West Capes area are mixed (i.e. diurnal and semi-diurnal) and generally less than one metre, with a typical daily range of about 0.7 m during spring tides and about 0.5 m during neap tides. Tides of this magnitude produce weak currents compared to wind and wave driven flows (Hill & Ryan 2002 cited in Department of Environment and Conservation (DEC) 2013).

Waters on the continental shelf are usually thermally-stratified, with a marked change in water density at approximately 20 m (SSE 1993). Surface temperatures vary annually, being warmest in March (32°C) and coolest in August (19°C). Vertical gradients are related to the seasonality of sea surface temperatures, and are greatest during the warm-water season (SSE 1991). Near-bottom water temperature on the North West Shelf is approximately 23°C, with no discernible seasonal variation.

Salinity is relatively uniform at 34–35 ppt throughout the water column and across the North West Shelf. Due to the low rainfall there is little freshwater run-off from the adjacent mainland (Blaber *et al*. 1985).

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

Santos

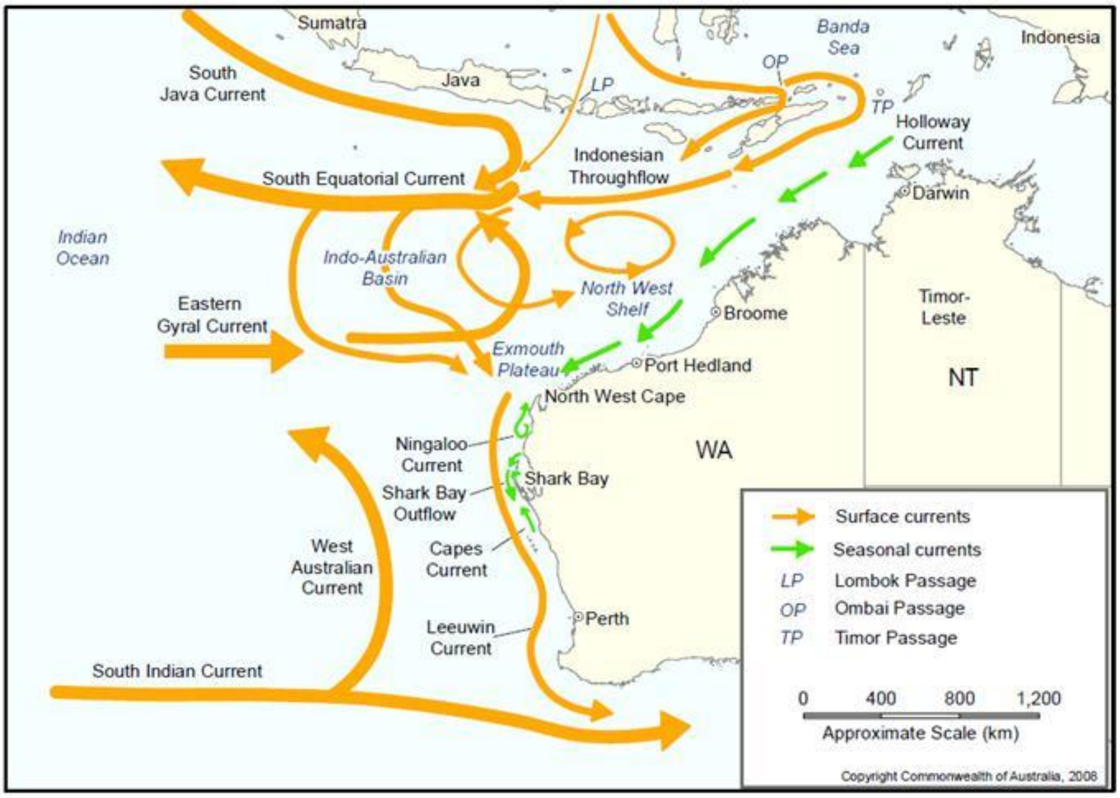


Figure 2-5: Surface currents in the Northern Territory and Western Australia

Source: DEWHA (2008b)

3. Benthic and Pelagic Habitats

Benthic habitats are defined as those subtidal habitats lying below the lowest astronomical tide (LAT). The benthic habitats within waters in the combined EMBA lie at depths ranging from LAT down to more than 6,000 m at Argo and Cuvier abyssal plains (DEWHA 2008a, 2008b, 2008c).

Benthic habitats are partially driven by light availability. Primary producers (photosynthetic corals, seagrasses and macroalgae) are limited to the photic zone, whereas benthic invertebrates including filter feeding communities may be found in deeper waters. The depth of the photic zone varies spatially and temporally and is predominantly dependent on the volumes of suspended material in the water column. The photic zone in the offshore Pilbara is approximately 70 m whereas in oceanic waters in the northwest and coastal waters of the southwest the photic zone may extend to 120 m (DEWHA 2008b). The photic zone in the offshore north extends to 100 m (DEWHA 2008c).

The following section broadly categorises benthic habitats as four biological communities; coral, seagrasses, macroalgae and non-coral benthic invertebrates. These communities are discussed in terms of the 18 IMCRA v. 4.0 bioregions. Some broad scale benthic habitat mapping exists for the Northwest and Central Western Shelf Provinces and this is shown in **Figure 3-1**.

3.1 Coral Reefs

Corals are both primary producers and filter feeders and thus play a role in the provision of food to marine fauna and in nutrient recycling to support ecosystem functioning (Conservation and Land Management (CALM) & Marine Parks and Reserves Authority (MPRA) 2005a).

Corals create settlement substrate and shelter for marine flora and fauna. Studies have shown that declines in the abundance, or even marked changes in species composition of corals, has a marked impact on the biodiversity and productivity of coral reef habitats (Pratchett *et al*. 2008). As part of the reef building process, scleractinian corals are also important for protection of coastlines through accumulation and cementation of sediments and dissipation of wave energy (CALM & MPRA 2005a).

The waters in the combined EMBA contain extensive coral communities. Coral reefs in the area fall into two general groups: the fringing reefs around coastal islands and the mainland shore; and large platform reefs, banks and shelf-edge atolls offshore (Woodside 2011). The distribution of corals in area is governed by the availability of hard substrate for attachment and light availability.

Coral reefs are dynamic environments that regularly undergo cycles of disturbance and recovery. Depending on how frequent and severe the disturbances are, recovery can take a few years or more than a decade. Disturbances can include bleaching, cyclones and disease outbreaks (Australian Institute of Marine Science (AIMS) 2011).

Corals in the northwest and central provinces have experienced bleaching events and subsequent recovery. Bleaching is the process where symbiotic algae are expelled from the coral tissue, often leading to the death of the colony. Causes of bleaching include high temperatures (Scott Reef; 1998), anoxic conditions (Bill’s Bay; 2008) or smothering (Waples & Hollander 2008, Gilmour et al. 2013). Coral susceptibility to bleaching and their ability to recover is an important consideration in the context of potential anthropogenic impacts.

Three bioregions (Northwest Province, Central Western Province and Central Western Transition) lie in deep waters below the photic zone. Two bioregions (Southwest Transition and Southern Province) occur in waters that are too cold to support tropical coral reefs species. Photosynthetic corals are not present in either of these locations and hence these bioregions are not discussed further. The EMBA overlaps the deeper waters of the Cocos (Keeling) Island Province, (not those close to shore) which are greater than 4000m deep and therefore photosynthetic corals are not present.

3.1.1 Southwest Shelf Transition

The coral reefs of the Houtman Abrolhos Islands are the most southern extensive coral community along the west coast. Smaller localised pockets do occur as far south as Rottnest Island and even extend to Cape Naturaliste in the Southwest Shelf Province. The reefs around the Abrolhos Islands comprise 211 known species of corals and all but two of the coral species are tropical (Department of Fisheries (DoF) 2012). The greatest diversity and density of corals is found on the reef slopes, shallow reef perimeters and lagoon patch reefs in the more sheltered northern and eastern sides of each of the three limestone platforms that support the island groups (DoF 2012).

3.1.2 Southwest Shelf Province

The Southwest Shelf Province is a nearshore bioregion that extends from Rottnest Island to Point Dempster, approximately 185 km east of Esperance. Adjacent to Commonwealth waters, the extensive area of granite reef (35 203 km2 of reef habitat) and seagrass habitat of the Recherche Archipelago is noted for its high diversity of warm temperate species including 263 known species of fish, 347 known species of molluscs, 300 known species of sponges, and 242 known species of macro-algae (DEWHA, 2008a).

3.1.3 Great Australian Bight Shelf Transition

Few species of scleractinian and soft coral (Orders Stolinifera, Telestacea and Alcyonacea) occur in southern Australia. Three reef-building species occur in shallow waters and >50 species of non-reef-building (ahermatypic) species occur in waters up to 900 m deep. The distribution patterns of corals in the GAB are largely unknown (McLeay et.al, 2003).

3.1.4 Central Western Shelf Province

The Central Western Shelf Province occurs on the continental shelf between Coral Bay and Busselton and is generally flat with depths ranging from 0–100 m. The province includes Shark Bay and Bernier, Dorre and Dirk Hartog Islands.

Studies at Shark Bay recorded 80 species of coral (Marsh 1990). The study determined that salinity and seasonal temperature gradients restrict the distribution of corals to areas that have normal salinity in the western half of the Bay, a few species occur in the metahaline waters but none in the hyper saline areas (Marsh 1990). The eastern shores of Bernier, Dorre and Dirk Hartog Islands provide the most favourable habitats for coral growth due to shelter, and water with relatively small salinity and temperature fluctuations. Some sections of these islands support prolific coral growth (up to 100% cover) both in the sheltered leeward and exposed areas. This bioregion is a transitional zone between the predominantly tropical flora and fauna of the north and temperate flora and fauna further south (CALM & NPNCA 1996).

3.1.5 Central Western Shelf Transition

A significant proportion of this bioregion is covered by the Ningaloo Reef. The Ningaloo Reef is unique in that it is the largest fringing reef in Australia and is the only large reef found on the western side of a continent in the southern hemisphere.

A 300 km section of the coast, from Red Bluff to North West Cape and extending to Bundegi in Exmouth Gulf, is included in the Ningaloo Marine Park. Ningaloo Reef supports variable lagoonal, intertidal and subtidal coral communities along its length. Ningaloo Reef is characterised by a high diversity of hard corals with at least 217 species representing 54 genera of hermatypic (reef building) corals recorded to date (Veron & Marsh 1988). The most diverse coral communities are found in the shallow relatively clear water, high energy environment of the fringing barrier reef and low energy lagoonal areas to the west of North West Cape (CALM & MPRA 2005a).

Coral diversity reduces with increasing depth, and corals are uncommon at depths greater than 40 m (Waples & Hollander 2008). At depths between 20 and 30 m hard corals have been found to be more dominant in the northern areas of the Ningaloo Marine Park, whereas in southern areas other sessile invertebrates such as sponges, are more prevalent (Waples & Hollander 2008).

3.1.6 Northwest Transition

This bioregion lies mostly over the continental slope and the abyssal plain in deep waters that preclude photosynthetic coral growth (DEWHA 2008a). However, in contrast with the surrounding area, the Rowley Shoals are three distinct reef systems (Mermaid, Clerke and Imperieuse Reefs) approximately 30–40 km apart that rise vertically to the surface from depths of between 500 and 700 m. The marine reef fauna of the Rowley Shoals is considered to be exceptionally rich and diverse, including species typical of the oceanic coral reef communities of the Indo-West Pacific. As many of these species are not found in the inshore tropical waters of northern Australia, such populations are of regional significance (DEWHA 2008a).

A 1993 survey at Mermaid Reef recorded 214 species of scleractinian corals (Done *et al*. 1994). Since 1997, mean coral cover has increased through periods of impact and recovery from cyclones, reaching the highest (71%) on record in 2017 (Gilmour *et al.* 2019). The survey found that coral assemblages of the Rowley Shoals are broadly comparable to those found on the reefs of the outer Great Barrier Reef and in the Coral Sea. While the coral fauna is similar to Scott Reef, it differs considerably from that of north-western Australia (Veron 1986). Veron (1986) notes that the clear water of the Rowley Shoals allows coral communities to exist over a great range of depths, while the strong wave action on the outer coral slopes and the wide tidal range result in distinct patterns of zonation.

3.1.7 Northwest Shelf Province

This province contains numerous small coastal islands in addition to larger archipelago and offshore island groups. Many of these features are surrounded by shallow waters with small barrier and fringing reefs that support coral communities. Key areas recognised for coral communities in this bioregion are discussed below.

The Dampier Archipelago supports coral reefs in shallow waters near islands and submerged pinnacles. The most significant coral reefs have formed along the seaward slopes of Delambre Island, Hamersley Shoal, Sailfish Reef, Kendrew Island and north-west Enderby Island (CALM & MPRA 2005). Field trips in the Dampier Archipelago between 1972 and 1998 recorded 229 species of corals from 57 genera (Griffith 2004). Surveys of the Dampier Port and inner Mermaid Sound recorded approximately 120 coral species from 43 genera (Blakeway & Radford 2005) with coral reefs dominated by acroporids and pocilloporids. The greatest coral cover (up to 70%) was recorded in the eastern half of the archipelago (Wells *et al*. 2003).

The Montebello, Lowendal and Barrow Islands include 315 islands associated with extensive coral reefs, the most significant of which occur in the sheltered waters on the eastern side of the islands. Examples of these significant reefs include Dugong Reef, Batman Reef and reefs along the Lowendal Shelf (DEC & MPRA 2007a). Dominant corals include acroporids and poritids, with greater than 70% cover recorded for some areas (Chevron 2010). Subtidal coral reef communities around the islands are highly diverse, with at least 150 species of hard corals recorded from fringing and patch coral reef areas (DEC & MPRA 2007a).

Coral distribution near the mainland is restricted by lack of light due to natural turbidity. Corals may exist as sparse coral colonies in some locations, rather than extensive coral communities. Within Exmouth Gulf, coral communities are less common but are present on fringing reefs surrounding islands, as solitary corals distributed across areas of hard substrate, or on larger isolated patch reefs.

An epibenthic dredge survey of nearshore areas north of Broome identified 14 species of hard corals from six families (Keesing *et al*. 2011). Limited coral surveys conducted at Broome (15 species) and the Lacepede Islands (ten species) (Veron & Marsh 1988) suggest the species diversity in this locality may be low. However, low species diversity observed during the dredge survey may reflect the limited sampling frequency, limited depth range (11–23 m) or inadequate sampling in habitats considered favourable for the proliferation of hard corals (hard substrate). In contrast, other surveys of nearshore locations in the region have recorded much higher levels of species diversity. Veron and Marsh (1988) stated that 102 species of hard corals have been recorded from the Kimberley coast and nearshore reefs and Cairns (1998) recorded 87 species of azooxanthellate hard coral species from north-western Australian waters.

3.1.8 Northwest Shelf Transition

Coral communities of the Northwest Shelf Transition have historically not been well studied. However, based on the scale of reef development and the diversity of coral species recorded through limited surveys, it is highly likely that further surveys will demonstrate that the Kimberley contains a coral reef province of global significance (Masini *et al*. 2009).

Coral reefs in the province include fringing reefs around coastal islands and some mainland shores. Development of coral communities in inshore areas is limited due to persistent high turbidity. Known examples of coral reefs in the bioregion are given below, however further mapping is required.

Benthic habitat surveys at Adele and Long Islands in 2009 and 2010 revealed extensive development of hard and soft coral communities (Richards *et al*. 2013). Scleractinian coral communities at Adele Island were diverse, supporting 176 species in intertidal and subtidal areas up to 14 m depth. At Long Island approximately 200 species of scleractinian corals were recorded in intertidal and subtidal areas. These surveys also identified two significant and unique habitats; a zone of mixed corallith and rhodolith habitat at Adele Island and an Organ Pipe Coral habitat zone with unusually high benthic cover at Long Island (Richards *et al*. 2013).

Studies by DBCA and the LNG industry indicate that fringing and emergent coral reefs are well developed in the Heyward island group, around islands in the Bonaparte Archipelago, and off mainland shores of Cape Voltaire and Cape Bougainville. Surveys by INPEX of Maret, Bethier and Montalivet islands, which were largely restricted to the intertidal zone, have recorded 280 species of coral from at least 55 genera, making the Kimberley Bioregion the most coral-diverse area in WA (INPEX 2008).

Montgomery Reef has been identified as a key feature in the area. Montgomery Reef is a huge submerged rock platform covering approximately 400 km^2. Corals occur in the subtidal area around Montgomery Reef, and in the many rock pools on the platform where there is shaded from the sun by algae or rock ledges (DEWHA 2008a). A survey of benthic habitats at Montgomery Reef was conducted in 2009 by AIMS but a literature search found no published results from this survey (AIMS 2014).

Browse Island is surrounded by a minor fringing coral reef. Assemblages at Browse Island are characteristic of coral platform reefs throughout the Indo-West Pacific region, particularly Cartier Island. Coral diversity was greatest on the reef faces and shallow lagoons but these areas were of very limited extent (URS 2010a).

Hard corals have been recorded at Echuca Shoals but the community was low in both species richness and abundance (URS 2010a). The presence of occasional large outcrops suggests that larger coral structures have occurred previously and may still occur elsewhere on the shoal (RPS Environmental 2008).

3.1.9 Timor Province

Although water depths in this province are generally deep (200 m to almost 6,000 m) there are several reefs and islands that are regarded as biodiversity hotspots (DEWHA 2008a).

Ashmore Reef, Cartier Island, Hibernia, Scott and Seringapatam Reefs are areas of enhanced local biological productivity, within an area of relatively unproductive waters. Ashmore Reef National Nature Reserve supports one of the greatest number of coral species of any reef off the West Australian coast, with 255 species of reef-building corals in 56 genera (Veron 1993). Taxonomic revisions and additional surveys have resulted in a net increase in species numbers to 275 (Griffith 1997, Ceccarelli *et al*. 2011). Species are typical of the Indo-pacific region and none are unique or considered endemic. However, 41 species (15% of the total hard coral species at the site) are listed as vulnerable on the IUCN Red List (IUCN 2019). In 1998, hard coral covered an area of around 717 ha at Ashmore Reef. The majority of hard corals occur in the deep lagoon (265 ha) and shallow reef top (315 ha) with small areas in the shallow lagoons, and reef edge/slope habitats (Skewes *et al*. 1999a). The soft, non-reef building corals are less well studied at Ashmore Reef than the hard corals (Hale & Butcher 2013). In 1986, 39 soft coral taxa were recorded within the Ashmore Reef, including the vulnerable blue coral (*Heliopora coerulea*) which was moderately common on the reef flats (Marsh 1993). In 1998, the total cover of soft coral at Ashmore Reef was 323 ha and *Sarcophyton* spp. was the dominant taxa covering around 19 ha in total (Skewes *et al*. 1999b, Hale & Butcher 2013).

The species composition of all the hard coral reefs in the bioregion is very similar and reflects strong links with Indo-West Pacific fauna, largely as a result of the dispersal of coral spawn via regional currents. The reefs and islands in this bioregion are thought to be important biological stepping-stones between centres of biodiversity in the Indo–Pacific and reef ecosystems further south (DEWHA 2008a).

Seringapatam Reef is a regionally important scleractinian coral reef as it has a high biodiversity, which is comparable to Ningaloo Reef. Results from the Western Australian Museum (WAM) survey in 2006 noted 159 species of scleractinian corals with a hard coral cover of approximately 16% (WAM 2009). The dominant benthic habitats of the reef were observed to include hard and soft corals (Heyward et al. 2013 cited in ConocoPhillips 2018).

Scott Reef consists of two reefs, North Scott Reef and South Scott Reef, which are separated by a deep (400–700 m) channel. North Scott Reef is an annular reef which encloses a lagoon that is connected to the ocean. South Scott Reef is a crescent-shaped reef which forms an arc and partially encloses another lagoon. Light penetration at Scott reef is high due to low turbidity. Light penetration depths to the deeper part of South Reef Lagoon are in excess of 50m with corals able to survive at depths of up to 70 m (Woodside Energy Limited *et al.* 2010).

Hibernia Reef consists of an approximately oval-shaped reef, with large areas of the reef becoming exposed at low tide. Hibernia Reef is also characterised by a deep central lagoon and drying sand flats.

There are a number of shoals and banks in the NMR and NWMR. Relatively few studies have been undertaken of these features with the majority of the understanding derived from the Big Bank Shoals study (Heyward *et al*. 1997), PTTEP surveys initiated in response to the Montara incident (Heyward *et al*. 2010; Heyward *et al.* 2011) and ConocoPhillips baseline surveys undertaken to support the Barossa Area Development (Heyward *et al.* 2017). The PTTEP surveys completed at Ashmore, Cartier and Seringapatam Reefs were undertaken during a coral bleaching disturbance likely to be attributed to regional thermal stress indicated by both *in situ* and satellite based data for the region. The condition of the reefs communities was consistent with previous surveys within the area and did not indicate any disturbance from the Montara incident (Heyward *et al*. 2010; Heyward *et al.* 2012).

In general, the submerged features are characterised by abrupt bathymetry, rising steeply from the surrounding outer continental shelf at depths of 100 m–200 m. The shoals and banks tend to flatten at depths of 40-50 m, with horizontal plateau areas of several square kilometres generally present at 20-30 m depths (Heyward *et al*. 2010). The shoals and banks support a diverse and varied range of benthic communities, including algae, reef-building soft corals, hard corals and filter-feeders (Heyward *et al.* 1997, Heyward *et al.* 2012). The plateau areas were dominated by benthic primary producer habitat, with interspersed areas of sand and rubble patches (Heyward *et al*. 2012).

3.1.10 Timor Transition

Due to the deep, offshore nature of the Timor Transition (up to 300 m with no coastal areas), there are no corals expected within this area (DEWHA 2008c). However, there is evidence of relic reef next to drainage channels of the outer slope of the Timor Transition. This is thought to be associated with local upwellings of cooler nutrient rich water from the Timor Sea (DEWHA 2008c).

3.1.11 Northern Shelf Province

The Northern Shelf Province contains submerged patch or barrier reefs in areas with approximately 30-50 m depth of water, these mainly occur around the margin of the Gulf of Carpentaria (which lies outside the combined EMBA) (DEWHA 2008c). The majority of the province is relatively featureless with sandy and muddy sediments and this is expected to be the case for the portion of the combined EMBA that overlaps the Northern Shelf Province.

3.1.12 Christmas Island Province

The subsurface marine habitat immediately surrounding Christmas Island consists of a relatively narrow and shallow coral reef shelf about 20 to 100 metres wide in approximately six to 20 metres of water depth. There are caves in some of the island's rocky sea cliffs that adjoin the coral reef shelves. Coral reef shelves also contain areas of sand and rubble.

The shallow coral reef shelves drop off steeply to the island's mid and deep-water marine habitats which include outer reef seaward slopes, vertical walls and oceanic waters. The marine boundary of the Christmas Island National Park extends 50 metres seaward from the low water mark, which means that the park has no true deep-water habitats but some outer reef slopes and vertical walls fall within the park's waters (DNP, 2012).

3.1.13 International Waters

Important areas outside of the IMCRA bioregions include:

Indonesia (west)

Indonesia has an estimated 75,000 km^2 coral reef ecosystem distributed throughout the archipelago (Tomascik et al. 1997 cited in Hutumo & Moosa 2005). Fringing reefs are the most common reef types with scleractinian corals as being the most dominant and important group. 452 species of hermatypic scleractinian coral were collected from Indonesian waters by Tomascik et al. (1997 cited in Hutumo & Moosa 2005), a study presented by Suharsono (2004 cited in Hutumo & Moosa 2005), indicated that 590 species of scleractinian corals exist in Indonesian waters. *Acropora, Montipora* and *Porites* are the most important reef building corals in Indonesia.

The Lesser Sunda Ecoregion encompasses the chain of islands and surrounding waters from Bali, Indonesia to Timor-Leste. This region contains suitable habitat for corals on shallow water substrates formed by limestone and lava flows and is thought to contain more than 500 species of scleractinian reef-building corals (DeVantier *et al.* 2008). Coral species composition is influenced by regional and local scale seasonal upwellings that typically occur from April to May each year on the southern side of the islands. The ecoregion is considered important for coral endemism, particularly the areas of Bali-Lombok, Komodo, and East Flores. Fringing coral reefs tend to be less developed on the southern, more exposed shorelines (Wilson *et al.* 2011).

The world heritage sites of Siberut and Ujung Kulon are also recognised for their extensive coral ecosystems, as well as marine national parks in the waters and islands surrounding Indonesia, such as Laut Sawu, Teluk Cenderawasih, Bunaken, Kapulauan Wakatobi, Togian Islands, Karimunjawa, the islands of Kepulauan Seribu, the table reefs of Taka Bonerate and the Savu Sea National Marine Conservation Area (refer to **Section 9.8**).

Majority of these sites form parts of the marine area known as the Coral Triangle, named for its staggering number of corals and associated marine life, situated in the waters of Indonesia, Malaysia, the Philippines, Papua New Guinea, Timor Leste and Solomon Islands (ADB, 2014).

Timor-Leste

See **Section 3.1.8** for a description of habitat typical of shoals and banks in the Timor Sea.

3.2 Seagrasses

Seagrasses are biologically important for four reasons:

1. As sources of primary production;
2. As habitat for juvenile and adult fauna such as invertebrates and fish;
3. As a food resource; and
4. For their ability to attenuate water movement and trap sediment (Masini *et al*. 2009).

Twenty-five species of seagrass have been recorded in WA, the highest diversity in the world, and over 30 species of seagrasses have been recorded as occurring within Australian waters (Masini *et al*. 2009). Waters extending from Busselton to the NT border support predominantly tropical species although temperate species are also found, particularly between Busselton and Exmouth (Walker 1987). One species, *Cymodocea angustata*, is endemic to WA (Department of Parks and Wildlife (DPAW) 2013). Other seagrass meadows of note include those around Tiwi Islands which provide significant habitat to a number of species. Seagrass habitats also occur within shallower waters near islands and have potential to occur closer to the Indonesian and Timor-Leste coastlines.

The main seagrasses of the region are small, ephemeral species that grow on soft sediments and have a seed bank in the surficial sediments that allows them to recover quickly from disturbance (Walker 1989). Small, ephemeral species of seagrass tend to form mixed associations with macroalgae (CALM & MPRA 2005, DEC & MPRA 2007a, BHPBIO 2011) and usually covers less than 5% of the substrate (BHPBIO 2011, van Keulen & Langdon 2011).

Areas occupied by seagrass vary markedly both seasonally and interannually and it is not clear why some areas of suitable substrate will support seagrass in one year but not the next. It appears that recruitment to what may otherwise be suitable substrate is haphazard, lending weight to the descriptions of these seagrass communities as ephemeral (CALM & MPRA 2005, DEC & MPRA 2007a).

Four bioregions (Northwest Province, Central Western Province, Central Western Transition and Timor Transition) lie entirely in deep waters below the photic zone. Two bioregions (Southwest Transition and Southern Province) occur in waters that are too cold to support seagrasses. The EMBA overlaps the deeper waters of the Cocos (Keeling) Island Province, (not those close to shore) which are greater than 4000m deep and therefore seagrasses are not present.

Seagrasses are not present hence these bioregions are not discussed further.

3.2.1 Southwest Shelf Province

Geographe Bay is a large relatively sheltered area with that supports extensive beds of tropical and temperate seagrass that have a high diversity of species and endemism (DEWHA 2008a). They are thought to account for about 80% of benthic primary production in the area. These seagrass beds provide important nursery habitat for many shelf species that use the shallow seagrass habitat as nursery grounds for several years before moving out over the shelf to their adult feeding grounds along the shelf break.

The Geographe Bay seagrass meadows are among the most extensive temperate seagrass communities on the west coast (MPRSWG 1994 cited in DEC 2013), and include 10 species from five genera (*Amphibolis, Posidonia, Halophila, Heterozostera* and *Thalassodendron*). Geographe Bay is dominated by stands of the narrowleaf tape-weed (*Posidonia sinuosa*) that covers approximately 70% of Geographe Bay. It has smaller areas of *Posidonia angustifolia*, *Amphibolis griffithii*, *A. antarctica* and minor species, which have irregular distributions both spatially and temporally (Lord 1995 cited in DEC 2013). *Thalassodendron pachyrhizum*, *Posidonia* spp. and *Amphibolis* spp. are also found in depths of between 27 and 45 m (Walker *et al*. 1994 cited in DEC 2013).

3.2.2 Southwest Shelf Transition

Species diversity of seagrasses in this bioregion is the highest in the world, with 14 species occurring (DEWHA 2008a). In total, 10 seagrass species have been recorded at the Abrolhos ranging from small, delicate species to larger, more robust types that grow in large meadows (DoF 2012). Small paddle-weeds grow in protected lagoon areas or deep waters between the islands, such as Goss Passage and the larger species may be found growing on reef as well as in sandy areas (DoF 2012). *Thalassodendron pachyrhizum*, which is encountered growing on the exposed reef crest area, has been recorded at a number of the island groups. There are also two species of wire-weed (*Amphibolis* species), endemic to southern Australia, found at the Abrolhos (DoF 2012). The most abundant seagrass is *Amphibolis antarctica*, while *Amphibolis griffithii* appears to be restricted to bays such as Turtle Bay in the Wallabi Group.

The larger ribbon-weeds (*Posidonia* species) grow in sheltered bays and lagoons where the sand cover is deeper and more stable (e.g. Turtle Bay, the Gap, East Wallabi Island, the lagoon on the west side of West Wallabi Islands and around North Island) (DoF 2012).

Nine species of seagrass are found in the Perth region, including at Rottnest Island where *Amphibolis* thrives in clear waters overlying limestone rock (Amalfi 2006). Seagrasses are a major component of the ecosystem on the Rottnest Shelf, thriving in waters ranging in depth from intertidal to 45m (Amalfi 2006). All of the seagrass species identified with the exception of *Syringodium isoetifolium* and *H. ovalis* are endemic to temperate areas of southern Australia (Amalfi 2006). At Rocky Bay, on the north side of the island where it is protected from big swells and strong south to south-westerly winds, a mix of dense seagrass meadow consisting of *Amphibolis* and *Posidonia* thrive. The meadows around Rottnest Island serve as nurseries for juveniles of many fish species, and are home to species such as the cobbler and long-headed flathead (Amalfi 2006).

3.2.3 Great Australian Bight Shelf Transition

The Australian coastline has the highest number of seagrass species of any continent. There are approximately 30 species of seagrasses in Australia belonging to 11 genera. Approximately one third (18 species) of all species known worldwide are endemic in Australia. Of these, 16 species are restricted to temperate waters.

Southern temperate waters have two endemic genera, *Heterozostera* and *Amphibolis*. Many endemic species belong to the genera *Posidonia*. The distribution and abundance of seagrasses is a function of topography and environment. A distinction exists between subtropical and warm temperate types. In southern Australia, species with warm water affinities (*Posidonia, Amphibolis*) decline in number from west to east as water temperatures decrease.

In South Australia, seagrasses cover approximately 9620 km2 and represent one of the largest seagrass ecosystems in the world. Seagrass distribution in the GAB is patchy and limited by exposure to swell. Most seagrass is found in sheltered bays or in the lee of reefs and islands in the eastern GAB. These areas contain nearly 10% of the seagrass meadows found in South Australia. Posidonia species dominate, especially *P. angustifolia, P. coriacea* at the base of cliffs and *P. australis* and *P. angustifolia* in the sheltered lee of fringing reefs. *Amphibolis antarctica* and *Heterozostera tasmanica* are present but less common in sheltered bays of the region (McLeay et al., 2003).

3.2.4 Central Western Shelf Province

Shark Bay contains the largest reported seagrass meadows in the world (approximately 4,000 km^2), as well as some of the most species-rich seagrass assemblages (Walker *et al.* 1989). Twelve species of seagrass are found in the Bay with the dominant species being *Amphibolis antarctica*. Seagrass is a fundamental component of biological processes in Shark Bay; it has modified the physical, chemical and biological characteristics of the Bay and provides food, habitat and nursery grounds for many species (CALM & National Parks and Nature Conservation Authority (NPNCA) 1996).

An inshore survey of benthic habitats near Busselton recorded dense coverage of *Amphibolis* spp. on limestone pavement. *Halophila* spp., *Heterozostera* spp. and *Syringodium isoetifolium* were recorded on sandy substrates (DoF 2007).

3.2.5 Central Western Shelf Transition

Nine species of seagrasses have been found throughout Ningaloo Reef (van Keulen & Langdon 2011). Some delineation of temperate and tropical species exists; however, several species were found throughout the Ningaloo Reef. Halophila ovalis was the most commonly found seagrass at Ningaloo and was generally found growing in sandy patches between coral bomboras. *Amphibolis antarctica* is a large meadow forming species that has been found growing in large clumps in Bateman Bay, north of Coral Bay (van Keulen & Langdon 2011).

3.2.6 Northwest Transition

The Rowley Shoals provide the only suitable shallow substrate for seagrasses in this predominantly deep bioregion. Sparse seagrass is found within subtidal coral reef communities of the Rowley Shoals but is not a major habitat type. Two species of seagrass, *Thalassia hemprichii* and *Halophila ovalis*, have been recorded at Mermaid Reef (Huisman *et al*. 2009). Earlier studies at Mermaid and Imperieuse Reef recorded the above two species and a third species; *Thalassodendron ciliatum* (Walker & Prince 1987).

3.2.7 Northwest Shelf Province

In the Northwest Shelf Province, seagrasses are present but sparsely distributed to depths of approximately 30 m (LEC & Astron 1993, URS 2009, CALM 2005a). The abundance and distribution of tropical (and subtropical) seagrass species can vary greatly due to seasonal changes in water quality (turbidity, light penetration) and conditions (wave action, temperature), with biomass tending to peak in summer (Lanyon & March 1995).

Studies between Quondong and Coulomb Points north of Broome identified seagrass communities of *Halophila* spp. patchily distributed across large areas, from the lower intertidal and out to a depth of approximately 20 m (DEC 2008, Fry *et al*. 2008). Similarly, *Halophila decipiens* was the only seagrass collected from epibenthic dredge studies at five localities near Broome from Gourdon Bay to Packer Island (Keesing *et al.* 2011).

Roebuck Bay is located south of Broome and includes large areas of intertidal mudflats. Extensive seagrass meadows occur in the northern regions of Roebuck Bay and are dominated by *Halophila ovalis* and *Halodule uninervis*. *Halophila minor* and *Halodule pinifolia* have also been reported at this location (Prince 1986, Walker & Prince 1987, Seagrass-Watch 2019).

In the Dampier Archipelago seagrass occurs in the larger bays and sheltered flats of the area (CALM & MPRA 2005). Six species of seagrass, including three Halophila species, have been recorded on the subtidal soft sediment habitats (CALM & MPRA 2005). Seagrasses do not form extensive meadows within the proposed reserves, but rather form interspersed seagrass/macroalgal beds. The largest areas of seagrass are found between Keast and Legendre islands, and between West Intercourse Island and Cape Preston (CALM & MPRA 2005).

Surveys near Onslow found that *Halophila* spp. were the most widespread of the seagrasses in that region. Seagrasses were found to be generally sparsely distributed (<10% cover), occurring in small patches within larger areas of suitable substrate. Small areas of higher (>50%) seagrass cover occurred in shallow clear water areas but were not common (URS 2009, URS 2010b, Chevron 2010).

Similarly, in the Montebello/Barrow Islands Marine Conservation Reserves, seagrasses appear not to form extensive meadows but are sparsely interspersed between macroalgae. Seven seagrass species have been recorded in the Reserves (DEC & MPRA 2007a) with *Halophila* spp. the most common seagrass species on shallow soft substrates and sand veneers. Distributions of these species extend from the intertidal zone to approximately 15m water depth (DEC & MPRA 2007a). Surveys to the northwest and southeast of Barrow Island from 2002 to 2004 did not identify any significant seagrass meadows but confirmed the presence of sparse coverage of *Halophila* and *Halodule* spp. in shallow areas east of Barrow Island (RPS BBG 2005).

A significant meadow of large seagrasses at Mary Anne Reef east of Onslow was identified almost 30 years ago and its presence today is unconfirmed. The meadow was several hundred hectares of *Cymodocea angustata* at 30–50% cover, occurring primarily at a depth of 2–3 m (Walker & Prince 1987).

3.2.8 Northwest Shelf Transition

Extensive and diverse intertidal seagrass meadows are known from islands in the southern Kimberley, particularly in the Sunday Island One Arm Point area (Walker 1995, Walker & Prince 1987). Ten species of seagrasses have been recorded at One Arm Point, with the majority of meadows low to moderate in abundance and dominated by *Thalassia hemprichii* with *Halophila ovalis*, *Halodule uninervis* and *Enhalus acoroides* (Seagrass-Watch 2019).

While some seagrasses have been collected from intertidal sites in the central and north Kimberley (Walker *et al*. 1996, Walker 1997), these areas were not found to be species rich and did not support extensive seagrass meadows like those found in the southern Kimberley.

Subtidal seagrass meadows in the Northwest Shelf Transition are not well mapped, although dugongs are known to feed on seagrass communities in coastal waters of the Joseph Bonaparte Gulf (DEWHA 2008a).

3.2.9 Timor Province

Seagrass has been reported on the reef flats of offshore reefs of this bioregion (Whiting 1999, Hale & Butcher 2013). Five species of seagrass were reported at Ashmore Reef with *Thalassia hemprichii* being the dominant species (Pike & Leach 1997, Skewes *et al*. 1999b, Brown & Skewes 2005). The total area of seagrass at Ashmore Reef in 1999 was estimated to be 470 ha (Skewes *et al*. 1999b). However, much of this was very sparse cover and there were only 220 ha of seagrass with a greater than 10% cover (Brown & Skewes 2005). Seagrass grew in a sparse, patchy distribution across the sand flats, but had a higher coverage on the reef flat area, where it extended to within 100 m of the reef crest. The area of greatest cover and diversity was in the west and south-west areas of the reef on the inner reef flat (Brown & Skewes 2005). These seagrass meadows support a small but significant population of dugongs estimated at around 100 individuals comprising all age classes from calves to adults (Hale & Butcher 2005).

Similarly, Scott Reef supports five species of seagrass (URS 2006), with *Thalassia hemprichii* most abundant (Skewes *et al*. 1999a, URS 2006). The area of seagrass at Scott Reef is significantly less than that recorded for Ashmore Reef (approximately 100 ha) (Woodside 2011). The highly energetic environment and significant tidal exposure of Scott Reef restricts the area of habitats potentially suitable for seagrass establishment to a small proportion of the total area, resulting in low abundance (Skewes *et al*. 1999a, URS 2006).

Seringapatam Reef was found to have a seagrass cover of 2 ha out of 5,519 ha (0.04%) composed of *Thalassia hemprichii* and *Halophila ovalis* in approximately equal quantities (Skewes *et al*. 1999a). This finding contrasts with a more recent survey where only one species of seagrass (*Halophila decipiens*) was recorded at Seringapatam (Huisman *et al*. 2009).

Skewes *et al*. (1999a) did not observe any seagrass communities at Hibernia Reef.

3.2.10 Northern Shelf Province

Coastlines adjacent to the Northern Shelf Province contain seagrasses providing habitat to a number of marine species, particularly juvenile tiger prawns, which make up approximately 50% of the total prawn catch in the province. However, majority of these seagrass habitats exist within the Gulf of Carpentaria, which lies outside the combined EMBA.

3.2.11 Christmas Island Province

The subsurface marine habitat immediately surrounding Christmas Island consists of a relatively narrow and shallow coral reef shelf about 20 to 100 metres wide in approximately six to 20 metres of water depth. The sandy areas and some lagoons are also known to support seagrass habitat (DNP 2012).

3.2.12 International Waters

Important areas outside of the IMCRA bioregions include:

Indonesia (west)

Within Indonesian waters, the lower intertidal and upper subtidal zones are considered important areas for the growth of seagrass (Hutumo and Moosa 2005). Pioneering vegetation in the intertidal zone is dominated by *Halophila ovalis* and *Halodule pinifolia* while *Thalassodendron ciliatum* dominate the lower subtidal zones. Wide areas of the Indonesian coastal waters are covered by dense beds of seagrass.

Seagrass habitats are widely distributed across the Lesser Sunda Ecoregion. Preliminary data from the United Nations Environment Program's (UNEP) World Conservation Monitoring Centre (WCMC) has identified the following areas as potential areas of importance for seagrass, many of which are outside the combined EMBA (DeVantier *et al.* 2008):

+ North-west Bali;
+ South-west and west Lombok;
+ North-east Sumbawa;
+ Komodo Islands;
+ Savu; and
+ South coast of Timor-Leste.

The Kepulauan Seribu National Park, Laut Sawu Marine National Park, Bunaken National Park, Karimunjawa Marine National Park and Savu Sea National Marine Conservation Area are also known for their rich diversity of seagrasses (refer to **Section 9.8**).

3.3 Macroalgae

Macroalgae are important contributors to primary production and nutrient cycling in the region, providing food and habitat for vertebrate and invertebrate fauna. Macroalgae are also recognised for their role in spatial subsidies; the movement of nutrients or energy between neighbouring habitats. Spatial subsidies involving macroalgae include the movement of wrack from macroalgal beds to bare substrates and shorelines (Orr 2004).

Macroalgae are primarily associated with hard substrates. They occur in moderate to high cover on exposed hard substrates, but typically have lower cover on hard substrates that are covered with a veneer of sediment (SKM 2009, BHPBIO 2011). Macroalgae exhibit very high seasonal and interannual variation in biomass (Heyward *et al*. 2006) and distribution, abundance and biodiversity (Rio Tinto 2009, BHPBIO 2011). The distribution of hard substrates therefore indicates areas that may support macroalgal communities, although abundance and diversity may fluctuate annually.

Macroalgae are susceptible to disturbance from factors such as sedimentation, scouring and turbidity but the marked seasonality in biomass, abundance, diversity and distribution suggests macroalgae are likely to be resilient to acute, short-term disturbance acting at local scales. Macroalgae may be more susceptible to impacts acting over longer time scales (years) and at certain times of the year, where recruitment at a regional scale could be affected. Indirect impacts affecting the numbers, distribution and community structure of herbivorous fish can also be expected to have impacts (either positive or negative) on macroalgal habitats (Vergès *et al*. 2011).

Three bioregions (Northwest Province, Central Western Province and Central Western Transition) lie entirely in deep waters below the photic zone. Two bioregions (Southwest Transition and Southern Province) occur in colder waters. The EMBA overlaps the deeper waters of the Cocos (Keeling) Island Province, (not those close to shore) which are greater than 4000m deep and therefore macroalgae are not present.

Macroalgae are not present hence these bioregions are not discussed.

3.3.1 Southwest Shelf Province

Species diversity of macroalgae is very high. The south coast of the bioregion is characterised by a relatively higher diversity of temperate macro-algal species compared with the Southwest Shelf Transition. These colonise the exposed rocky shorelines and rocky reefs (DEWHA 2008a).

3.3.2 Southwest Shelf Transition

The Houtman Abrolhos have known species of benthic algae with macroalgae communities considered important in supporting a diversity of marine life.

More than 340 species of macroalgae (including 54 species of green algae, 71 species of brown algae, and 222 species of red algae) have been recorded from rock platforms around Rottnest Island (Amalfi 2006).

3.3.3 Great Australian Bight Shelf Transition

Seaweed diversity and endemism in temperate waters of Australia is among the highest in the world, perhaps due to the length of the southerly-facing rocky coastline and the long period of geological isolation. The number of species found in southern Australia is 50-80% greater than other temperate regions of the world. A small number of tropical species and isolated species from tropical genera also occur in the GAB.

Oceanic waters of South Australia support one of the world's most diverse seaweed assemblages, with >1200 species recorded. Many species of macroalgae found in South Australian waters extend into the cool temperate waters of Victoria and Tasmania and warmer waters of Western Australia. However, South Australia has the highest concentration of species. The waters of the GAB are clear and allow chlorophyllus plants to live at depths of up to 70 m.

Among the green algae (Chlorophyta), few microscopic forms have been studied; however, a few southern Australian species are recognised in the genera *Ulva* (2) and *Bryopsis* (6). Coenocytic green algae are well represented, including *Codium* (15 species) and *Caulerpa* (19 species). Brown algae (*Phaeophyta*) and red algae (*Rhodophyta*) are particularly diverse. Approximately 43% of the genera (658) and 20% of the species

(~4000) of red algae that occur worldwide are found in southern Australia. Over 75% of red algae, 57% of brown algae, and 30% of green algae are endemic to southern Australia (Womersley 1990). Womersley (1984, 1987, 1994, 1996, 1998 and 2003) documents the macroalgae of southern Australia. (McLeay et al., 2003).

3.3.4 Central Western Shelf Province

Although seagrasses are the most visually dominant organisms found in Shark Bay (Walker *et al*. 1989) macroalgae are also a significant component within the system, with 161 taxa of benthic macroalgae reported from the location (Kendrick *et al*. 1990). The seagrass meadows host a large number of epiphytic algal species (Harlin *et al*. 1985, Kendrick *et al*. 1990), which numerically dominate the algal flora of the area. Eighty algal species were epiphytic on the seagrass *Amphibolis antarctica*, and of these, over half have been reported both as epiphytes and benthic algae. Benthic macroalgae can be found growing on occasional subtidal rock (limestone–sandstone) platforms and extensive sand flats that occur throughout Shark Bay, and as drift within seagrass meadows (Kendrick *et al*. 1990).

The benthic algae of Shark Bay are not predominantly temperate as is the case with the seagrasses (Walker *et al*. 1989) and seagrass epiphytes (Kendrick *et al*. 1990). The majority of taxa are either of tropical or cosmopolitan distribution. Their local distribution within Shark Bay is correlated with salinity, with benthic algal species richness lower in areas of high salinity (Kendrick *et al*. 1990).

Limestone platforms occur along the bioregion’s coastline and high energy environments are likely to be dominated by large brown algae including *Ecklonia radiata* and *Sargassum* spp. with articulated coralline algae making up the understorey. More diverse algae assemblages may be observed in sheltered locations such as potholes and ledges (DoF 2007).

3.3.5 Central Western Shelf Transition

Macroalgal beds along the Ningaloo coastline are generally found on the shallow limestone lagoonal platforms and occupy about 2,200 ha of the Ningaloo Marine Park and Muiron Islands Marine Management Area (CALM & MPRA 2005a). Macroalgal communities within the area have been broadly described (Bancroft & Davidson 2000). The dominant genera are the brown algae *Sargassum*, *Padina*, *Dictyota* and *Hydroclathrus* spp. (McCook et al. 1995).

3.3.6 Northwest Transition

Although macroalgae is present at the Rowley Shoals, it is not recognised as a key habitat component in the Mermaid Reef Marine National Nature Reserve Plan of Management (EA 2000) or the Rowley Shoals Marine Park Management Plan (DEC & MPRA 2007b).

There is nothing to suggest that the algal flora of the Rowley Shoals is unique within the Indo-Pacific (Huisman *et al*. 2009). A study of macroalgae at 16 locations at Mermaid Reef recorded over 100 species (Huisman *et al*. 2009). The algal flora recorded at the Rowley Shoals represents a small portion of the highly diverse Indo-Pacific flora. The majority of species that were recorded at Mermaid Reef had been previously recorded from mainland north-western Australia or from Indonesia (Huisman *et al*. 2009).

3.3.7 Northwest Shelf Province

Macroalgae are diverse and widespread throughout the Northwest Shelf Province. They are restricted to depths where sufficient light penetrates to the substrate and therefore tend to be most common in shallow subtidal waters down to approximately 20 m depth.

In the nearshore regions of the Pilbara, macroalgae are often a dominant component of the mosaic of benthic organisms found on hard substrates in shallow water. In these shallow waters, regular disturbance to reef habitats from seasonal changes in sedimentation/ erosion patterns and the less frequent impacts of cyclones and storms through sedimentation and scouring may substantially alter the distribution and composition of the benthic communities associated with reefs, including macroalgal habitats (BHPBIO 2011).

Macroalgae dominate shallow (<10 m) submerged limestone reefs and also grow on stable rubble and boulder surfaces in the Dampier Archipelago (CALM & MPRA 2005). Huisman and Borowitzka (2003) reported approximately 200 species of macroalgae from the Dampier Archipelago. Low relief limestone reefs that are dominated by macroalgae, account for 17% (approximately 35,460 ha) of the marine habitats within the proposed Marine Management Area (CALM 2005a).

Epibenthic dredge surveys along the coastline north of Broome identified 43 species of algae from 22 families (Keesing *et al*. 2011). The lower species diversity collected by this study is attributed to the method of collection and limited depth range (11–23 m) (Keesing *et al*. 2011).

Macroalgae occur around the numerous small offshore islands within this bioregion (including Thevenard Island, Airlie Island and Serrurier Island) associated with limestone pavement and protected areas of soft sediments. Dominant species are consistent with those described for the Dampier Archipelago (Woodside 2011).

In the shallow offshore waters of the Pilbara region, macroalgae are the dominant benthic habitat on hard substrates in both the Montebello and Barrow Islands Marine Parks and are the main primary producers (DEC & MPRA 2007a, Chevron 2010). Shallow water habitats outside these marine parks are also likely to support substantial areas of macroalgal habitat wherever conditions are suitable.

Macroalgae occupy approximately 40% of the benthic habitat area in the Montebello/ Lowendal/ Barrow Island region (CALM 2005b). At least 132 macroalgal taxa occur around Barrow Island, with most thought to be widely distributed in the tropical Indo-Pacific region (Chevron 2005).

Macroalgae monitoring around the Lowendal and Montebello Islands since 1996 (The Ecology Lab 1997, IRCE 2002 2003 2004 2006 2007, URS 2009) has found macroalgal cover and biomass to be naturally spatially and temporally variable. *Sargassum* spp. represented 70% of the macroalgal assemblage in 2009, compared to 96% in 2002 (URS 2009). Sargassum spp. cover as a percentage of total macroalgae cover was significantly lower in 2009 than in previous years, primarily due to an increase in filamentous algae at a number of sites (URS 2009).

3.3.8 Northwest Shelf Transition

There is a lack of information regarding the marine benthic flora of north-west Western Australia and no comprehensive marine flora list exists for the region (Huisman 2004). However, about 70 algae species were collected during a survey of intertidal reefs on the central Kimberley coast in 1997 (Walker 1997).

Tropical macroalgae species are typically associated with areas of hard substrate and various types of macroalgae occur on rock platforms intermingled with coral and sponge. Abundance and biomass typically exhibit strong seasonal trends (Heyward *et al*. 2006).

The diversity and abundance of algae in the Kimberley is probably linked to the region’s extreme tidal exposure and highly turbid waters, reducing light penetration and resulting in deposition of fine sediments (Walker 1997). However, the role of algae appears crucial to the growth of reefs in the highly turbid waters of the Kimberley coast and islands (Brooke 1997). *Sargassum* spp. and coralline algae may be dominant (DPAW 2013).

It is also considered that in offshore parts of the Northwest Shelf Transition, there are high levels of primary production, including macroalgae. This is due to light penetration through relatively clear, shallow waters (DEWHA, 2008a). In particular, carbonate banks and reefs in the Northwest Shelf Transition are considered to support macroalgae, therefore macroalgae would be expected to be present within the Carbonate Bank and Terrace System of the Van Diemen Rise key ecological feature, located within the Northwest Shelf Transition.

3.3.9 Timor Province

Macroalgae at Ashmore Reef are estimated to cover over 2,000 ha, mostly on the reef slope and crest areas (Hale & Butcher 2013). The algal community is dominated by turf and coralline algae, with fleshy macroalgae comprising typically less than 10% of total algal cover (Skewes *et al*. 1999b).

Surveys at Scott and Seringapatam Reefs recorded over 100 species of marine algae (Huisman *et al*. 2009). The marine algal community was similar between reefs and also similar to the Rowley Shoals. Algae found at these offshore atolls forms a small subset of the Indo-Pacific algal flora, with virtually all of the species identified thus far having been previously collected from north-western Australia or from localities further north. Although further research is necessary, at present there is nothing to suggest that the macroalgae communities of these offshore atolls are unique within the Indo-Pacific (Huisman *et al*. 2009).

3.3.10 Timor Transition

There is a lack of published information regarding macroalage within the Timor Transition. However, the presence of the Shelf Break and Slope of the Arafura Shelf key ecological feature indicates that macroalgae may be present in association with this seabed feature. Upwelling associated with the topography of the shelf break lifts nutrient rich deep ocean water onto the edge of the shelf and into the euphotic zone, leading to enhanced biological productivity (DSEWPAC, 2012).

3.3.11 Northern Shelf Province

Macroalgae is sparse in the Northern Shelf Province (DEWHA, 2008c). However, around reef areas, there have been observations of phytoplankton blooms, thought to occur at localised micro-upwellings of nutrients potentially driven by wind and tidal eddies (DEWHA, 2008c).

3.3.12 Christmas Island Province

Coral reefs are 'turfed' with fine hair-like algae which are grazed by many animals. Some red algae form hard pink crusts which cement sand and dead coral together (DNP, 2012).

3.3.13 International Waters

No information on macroalgae in international waters has been identified other than for Timor-Leste waters.

See **Section 3.1.8** for a description of habitat typical of shoals and banks in the Timor Sea.

3.4 Non-Coral Benthic Invertebrates

The offshore marine environment from Busselton to the Northern Territory is overwhelmingly dominated by soft sediment seabeds; sandy and muddy substrates, occasionally interspersed with hard substrates covered with sand veneers, and rarely, exposed hard substrate. In shallow waters, non-coral benthic invertebrates may form part of the mosaic of benthic organisms found on hard substrates, alongside macrophytes and coral colonies. As light reduces with water depth, non-coral benthic invertebrates are the dominant community, albeit at low densities.

Non coral benthic invertebrates feed by filtering small particles from seawater, typically by passing the water over a specialised filtering structure. Examples of filter feeders are sponges, soft and whip corals and sea squirts.

3.4.1 Southwest Transition

There is little available information on benthic biological communities of this bioregion however deep sea crabs, such as the champagne crab and crystal crab are known to inhabit the seafloor of the slope (DEWHA 2008b).

3.4.2 Southwest Shelf Province

East of Albany, the dominant lobster species changes from the western rock lobster to the southern rock lobster. In this bioregion there is a notable increase in the ratio of benthic fish to crustaceans. Crustaceans appear to be less important in structuring shallow benthic communities here than in bioregions to the north and to the south-east of the Murray River mouth, around the Bonney Upwelling and Tasmania (DEWHA 2008b).

3.4.3 Southwest Shelf Transition

The inner shelf of the bioregion, extending between 0-50 m deep, includes distinct ridges of limestone reef with extensive beds of macro-algae (principally *Ecklonia* spp.). These inshore lagoons are inhabited by a diverse range of coralline algae, sponges, molluscs and crustaceans. On the outer shelf and shelf break filter feeding sponges and bryozoans dominate the hard bottom. The reefs around the Houtman Abrolhos islands support 492 known species of molluscs, 110 known species of sponges, 172 known species of echinoderms and 234 known species of benthic algae (DEWHA 2008b). Western rock lobster, the dominant large benthic invertebrate in this bioregion, is considered to be an important part of the food web of the inner shelf.

3.4.4 Southern Province

There is little information available on the benthic biological communities within the bioregion, however it is described as a unique region of deep-sea habitats that includes the Diamantina Fracture Zone Key Ecological Feature. The Diamantina Fracture Zone is described as structurally complex deep water environment of seamounts and numerous closely spaced troughs and ridges, which represents a unique region of deep-sea habitats including 26 endemic species of demersal fish (DSEWPaC) 2012b).

3.4.5 Great Australian Bight Shelf Transition

The invertebrate fauna of the GAB also displays a high degree of endemism (85-95%, Shepherd 1991). South Australia's benthic invertebrate assemblages also include tropical species. Fossils of benthic foraminiferans, nektonic nautiloids and planktonic protists suggest that tropical species have been transported into South Australia by the Leeuwin Current since the Eocene.

Early research in the GAB included an expedition on Australia's first fisheries research vessel, the Southern Endeavour that reported the presence of hydroids, molluscs and sponges. Many of South Australia's invertebrate species are included in the South Australian Handbook Series Marine Invertebrates of Southern Australia. Part I, includes the Porifera, Cnidaria, Platyhelminths, Annelida, Sipuncula, Echiura, Bryozoa and Echinodermata (Shepherd and Thomas 1982); Part II deals solely with the Mollusca (Shepherd and Thomas 1989); and Part III includes the Nemertea, Entoprocta, Phoronida, Brachiopoda, Hemichordata, Pycnogonids and Tunicates (Shepherd and Davies 1997). The most notable group not covered by these books is the Crustacea. Edgar (2000) describes 1200 species of invertebrates, fish, algae and sea grasses that occur in the intertidal zone to 30 m depth between Sydney and Perth (McLeay et al., 2003).

3.4.6 Central Western Province

The understanding of marine life in this bioregion is mostly confined to the demersal fish on the continental slope. The exception to this is the Perth Canyon which, although poorly understood, is known to have unique seafloor features with ecological properties of regional significance.

3.4.7 Central Western Shelf Province

The Central Western Shelf Province occurs on the continental shelf in water depths from 0 to 100 m. Biological communities of the shelf are likely to include a sparse invertebrate assemblage of sea cucumbers, urchins, crabs and polychaetes on sand substrates. Hard substrates are likely to contain sessile invertebrates such as sponges and gorgonians. The biological communities of this bioregion share many similarities with the adjoining temperate region (DEWHA 2008a).

Stromatolites occur in Shark Bay. Although they are a microbial colony (prokaryote), and not an invertebrate (eukaryote), they are described here as a unique benthic biological community. Stromatolites are rock-like structures built by cyanobacteria. Shark Bay's stromatolites are 2,000 to 3,000 years old and are similar to life forms found on Earth up to 3.5 billion years ago. Until about 500 million years ago, stromatolites were the only macroscopic evidence of life on the planet; hence they provide a unique insight into early life forms and evolution. The stromatolites are located in the hypersaline environment of Hamelin Pool and are one of the reasons for the area's World Heritage Listing (DPAW 2009).

3.4.8 Central Western Transition

The Central Western Transition extends from the shelf break to the continental slope with some parts of the bioregion occurring on the abyssal plain. Water depths range from 80 m to almost 6,000 m. Sediments are dominated by muds and sands that decrease in grain size with increasing depth. The present level of understanding of the marine environment in this bioregion is generally poor. The harder substrate of the slope in waters of 200–2,000 m deep is likely to support populations of epibenthic fauna including bryozoans and sponges. These support larger infauna and benthic animals such as crabs, cephalopods, echinoderms and other filter feeding epibenthic organisms. In the deeper waters of the abyss, the benthic communities are likely to be sparse (DEWHA 2008a).

3.4.9 Central Western Shelf Transition

The Central Western Shelf Transition is located entirely on the continental shelf and is comprised mainly of sandy sediments in depths between 0 and 80 m (DEWHA 2008a).

Some sponge species and filter-feeding communities found in deeper waters offshore from the Ningaloo Reef appear to be significantly different to those of the Dampier Archipelago and Abrolhos Islands, indicating that the Commonwealth waters have some areas of potentially high and unique sponge biodiversity (Rees *et al*. 2004).

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3.4.10 Northwest Province

The Northwest Province is located entirely on the continental slope in water depths of predominantly between 1,000–3,000 m and is comprised of muddy sediments. Despite the present poor knowledge of the benthic communities on the Exmouth Plateau, information on sediments in the bioregion indicates that benthic communities are likely to include filter feeders and epifauna. Soft-bottom environments are likely to support patchy distributions of mobile epibenthos, such as sea cucumbers, ophiuroids, echinoderms, polychaetes and sea pens.

3.4.11 Northwest Transition

The Northwest Transition is located from the shelf break (200 m water depth) over the continental slope to depths of more than 1,000 m at the Argo Abyssal Plain. Benthic habitat mapping surveys and epibenthic sampling conducted by CSIRO at the continental slope (approximately 400 m water depth) showed that all survey sites predominantly comprised soft muddy sediment, which was often riffled. Gravel, boulders and small outcrops were occasionally recorded. Epifaunal abundance was similar all sites, with epifauna limited to sparsely distributed isolated individuals. Epifauna included isolated scattered sessile crinoids, anemones, glass sponges and seapens. Occasional non-sessile fauna included urchins, prawns and other decapods, holothurians and sea stars. Modelling indicated a 1 km long beam trawl across the continental shelf (approximately 400 m water depth) would be expected to yield sparse (<20 individuals) and low diversity (<10 species) of epibenthic fauna (≥1 cm body size) (Williams *et al*. 2010). Deeper on the continental slope at approximately 700 m and approximately 1,000 m, habitats were similar to those observed at 400 m (Williams *et al*. 2010).

Although soft sediment habitat may appear monotonous and featureless, there is likely to be some marked differences in terms of ecological functioning and faunal composition between shelf and deep-sea areas, with the 200 m isobath widely believed to represent a key boundary (Wilson 2013, Brewer *et al*. 2007, Gage & Tyler 1992). Beyond the 200 m isobath, deep-sea benthic communities rely exclusively on the settling of organic detritus from the overlying water column as a food source. The spatial and temporal distribution of benthic fauna depends on factors such as sediment characteristics, depth and season (Wilson 2013).

Due to contrasting depths, the Rowley Shoals supports a diverse marine invertebrate community including a number of endemic species. Invertebrate species (excluding corals) at the Rowley Shoals include sponges, cnidarians (jellyfish, anemones), worms, bryozoans (sea mosses), crustaceans (crabs, lobsters, etc.), molluscs (cuttlefish, baler shells, giant clams, etc.), echinoderms (starfish, sea urchins) and sea squirts (DEC & MPRA 2007b).

3.4.12 Northwest Shelf Province

This bioregion is located primarily on the continental shelf in water depths from 0 to 200 m (DEWHA 2008a). The sandy substrates on the shelf within this bioregion are thought to support low density benthic communities of bryozoans, molluscs and echinoids (DEWHA 2008a). Sponge communities are also sparsely distributed on the shelf, but are found only in areas of hard substrate. The region between Dampier and Port Hedland has been described as a hotspot for sponge biodiversity (Hooper & Ekins 2004).

Epibenthic dredge surveys in nearshore areas around Broome covered 1,350 m^2 of seabed in depths between 11 and 23 m. The survey recorded 357 taxa comprising 52 sponges, 30 ascidians, 10 hydroids, 52 cnidarians (not including scleractinian corals), 69 crustaceans, 73 molluscs and 71 echinoderms. The most important species on soft bottom habitats in terms of biomass was the heart urchin *(Breynia desorii)*, whilst sponges were the dominant fauna by biomass on hard bottom habitats. The biomass of other filter feeders, especially ascidians, soft corals, gorgonians was also high, indicating the importance of these groups in characterising hard bottom habitats.

In 2007, CSIRO conducted extensive benthic habitat mapping surveys and epibenthic fauna (living on the surface and ≥1 cm body size) sampling in deep waters (100–1,000 m) spanning thirteen sites between Barrow Island and Ashmore Reef running along the continental shelf and across the continental slope of the North West Shelf (Williams *et al*. 2010). At the continental shelf margin (approximately 100 m water depth) Williams *et al*. (2010) reported that similar benthic habitats occurred at each survey site across the breadth of the North West Shelf. Benthic habitats at this depth comprised a mix of riffled muddy sand (sometimes as a veneer over rocky subcrops) together with gravel to pebble-sized rubble, cobbles, boulders and some rock outcrops. Typical epifauna found at these depths included scattered isolated hydroids, sea fans and soft corals and often small sponges. Other fauna observed at some of the sites included scattered isolated sea whips, crinoids, sea pens, urchins and anemones. Epibenthic fauna along the continental shelf margin were quantified as sparse and low diversity (Williams *et al*. 2010). Modelling indicated that a trawl sample of 1 km length would generally be expected to yield approximately 80 individuals represented by 15 species (Williams *et al*. 2010) in 100 m depth waters.

At the shelf edge (approximately 200 m water depth), two sites were surveyed. Both sites were similar to the continental shelf margin, except the northern site mainly comprised coarse material. Epifauna observed at the northern site was similar at 200 m as at 100 m. At the southern site, epifauna included sparse and scattered individual soft corals, anemones, glass sponges and stalked crinoids (Williams *et al.* 2010). Modelling indicated epibenthic fauna were sparse and had low diversity, numbering approximately 20–40 individuals in a 1 km long trawl sample represented by approximately 5–10 species (Williams *et al*. 2010).

Baseline studies undertaken in nearshore areas of the Pilbara (SKM 2009, Rio Tinto 2009, BHPBIO 2011) and offshore areas around Barrow Island (Chevron 2010) have shown that filter feeder communities are a dominant component of benthic habitats in depths >10 m where reduced light appears to inhibit extensive development of hard corals and macroalgae. The pavement habitats between Barrow Island and the mainland are covered by a sediment veneer that appears to periodically move, exposing areas of pavement reef. Sessile benthic organisms that require hard substrates for attachment, such as gorgonians, are frequently seen emerging through a shallow veneer of sand. This type of substrate (sediment veneer) with sparse filter feeder communities is common throughout this area (SKM 2009, Rio Tinto 2009, BHPBIO 2011).

3.4.13 Northwest Shelf Transition

The Northwest Shelf Transition is located on the continental shelf with a small area extending onto the continental slope, with water depths ranging from 0–330 m. Nearshore areas may support significant filter feeding communities but these have not yet been described (Masini *et al*. 2009).

Pipeline route surveys north of the Kimberley in water depths from 10–250 m recorded a seabed largely devoid of hard substrate, with only sparse epibenthic fauna noted on the predominantly sandy substrate. Occasional epibenthic fauna (featherstars, gorgonians, bryozoans, sea urchins, hydroids and sponges) were recorded in areas where rocky substrate or outcrops were present (URS 2010a).

In contrast, benthic surveys at Echuca Shoals identified broad areas of hard substrate with substantial epibenthic fauna. The shallow shoal areas were dominated by a flat ‘reef’ platform with crinoids, sea whips, soft corals and low densities of hard corals. With increasing depth (25–80 m) soft corals and sponges became increasingly dominant. At greater depths (80–100 m) the density of epibenthic fauna decreased substantially with sea whips and sea fans became dominant (URS 2010a).

3.4.14 Timor Province

The Timor Province is located on the continental slope and abyssal plain and water depths range from 200 m to almost 6,000 m. Benthic studies in this bioregion are scarce, however data from the North West Slope Trawl Fishery suggests that muddy sediments in the Timor Province support significant populations of crustaceans (Brewer *et al*. 2007). Additionally, research into the demersal fish communities of the continental slope has identified the Timor Province as an important bioregion. This is due to the presence of a number of endemic fish species, and two distinct demersal community types associated with the upper slope (water depths of 225–500 m) and mid-slope (water depths of 750–1,000 m) (Last *et al*. 2005). The current understanding of the relationship between demersal fish communities and benthic environments on the continental slope is rudimentary (DEWHA 2008a).

Over 130 species of sponges have been recorded at the Ashmore Reef National Nature Reserve (Russell & Hanley 1993).

Studies of Seringapatam Reef have observed the dominant benthic habitats to include filter feeders, such as sponges, gorgonians, hydroids and seapens (Heyward et al. 2013 cited in ConocoPhillips 2018).

3.4.15 Timor Transition

Carbonate banks and reefs of the Timor Transition have been found to support non-coral communities and benthic invertebrate communities associated with hard substrates (DEWHA, 2008c). Of particular note is the Shelf Break and Slope of the Arafura Shelf key ecological feature which is located within the Timor Transition. This key ecological feature has been recognised for the invertebrates that is hosts, which are thought to be the basis for the offshore food webs in the area (DEWHA, 2008c). Furthermore, the Tributary Canyons of the Arafura Depression key ecological feature is also in the Timor Transition and surveys of this key ecological feature identified around 245 macroscopic species of invertebrates (Wilson, 2005).

3.4.16 Northern Shelf Province

Studies of taxa within the Northern Shelf Province found 684 taxa of infaunal benthic invertebrates in waters deeper than 20 m. However, the Gulf of Carpentaria Basin contains the most significant non-coral benthic habitats within the Northern Shelf Province, which is outside the boundary of the combined EMBA (DEWHA, 2008c).

3.4.17 Christmas Island Province

Three major molluscs grow on Christmas Island’s reefs: bivalves, gastropods and cephalopods. Echinoderms include sea stars, brittle stars, feather stars, sea urchins and sea cucumbers (DNP, 2012). The deeper waters connecting Christmas Island to the Cocos (Keeling) Island Province are described below (**Section 3.4.18**).

3.4.18 Cocos (Keeling) Island Province

The hard substrates that occur on seamounts within the province are likely to provide surfaces and topographical structure for recruitment and growth of passive,sessile, epi-benthic suspension feeders (Genin et al., 1986) such as deep sea corals, sponges,crinoids, ascidians and bryozoans. Most of the seamounts within the subregion are relatively deep (>2000 m) and the deeper seamounts (>3000 m) are a unique feature of this subregion. Little is known about the communities that live on the tops and slopes of these seamounts. However, it seems likely that their unique position in the water column, and geographically, will support unique benthic and demersal communities (Brewer *et al*., 2009).

3.4.19 International Waters

No information on non-coral benthic invertebrates in international waters has been identified other than for Timor-Leste waters.

See **Section 3.1.8** for a description of habitat typical of shoals and banks in the Timor Sea.

3.5 Plankton

Plankton abundance and distribution is patchy, dynamic and strongly linked to localised and seasonal productivity (Evans *et al.* 2016). Fluctuations in abundance and distribution occur both vertically and horizontally in response to tidal cycles, seasonal variation (light, water temperature and chemistry, currents and nutrients) and cyclonic events. As a key indicator for ecosystem health and change, Plankton distribution and abundance has been measured for over a century in Australia (Richardson *et al.* 2015). The compilation of this data has been made publicly available through the Australian Ocean Data Network (Australian Ocean Data Network 2017) and has been used in the Australia State of the Environment 2016 report (Jackson *et al.*

2017) to nationally assess marine ecosystem health. According to their findings, warming ocean temperatures has extended the distribution of tropical phytoplankton species (which have a lower productivity), further south resulting in a decline in primary productivity in oceanic waters north of 35°C, especially the North West Shelf (Evans *et al.* 2016). Trends of primary productivity across Australia are however variable with the South West of Australia experiencing an increase in productivity and northern Australia experiencing no change between 2002-2016 (Evans *et al.* 2016).

Within the combined EMBA, peak primary productivity varies on a local and regional scale. For example, peak phytoplankton biomass in waters surrounding Broome has been observed in May with a high variability recorded in August, whereas recorded phytoplankton biomass in waters surrounding Geographe Bay has been found to peak during winter and is localised close to the coast (Bloundeau-Patissier *et al.* 2011). In general, these peaks are linked to mass coral spawning events, peaks in zooplankton and fish larvae abundance and periodic upwelling. Regional upwelling is most common close to the coast and where surface waters diverge. Despite the suppression of major upwelling along the WA coast by the Leeuwin Current, known key upwelling regions include the Ningaloo region (Hanson & McKinnon 2009) and Cape Mentelle (Pattiaratchi 2007). It is also expected that a high abundance of plankton will occur within areas of localised upwelling in the combined EMBA where the seabed disrupts the current flow.

In waters surrounding Indonesia, seasonal peaks in phytoplankton biomass is linked to monsoon related changes in wind. When the winds reverse direction (offshore vs. onshore), nutrient concentrations decrease/increase because of the suppression/enhancement of upwelling (National Aeronautics and Space Administration (NASA) 2017). Annual variability of phytoplankton productivity in waters surrounding Indonesia is heavily influenced by the El Niño-Southern Oscillation climate pattern (NASA 2017). For example, phytoplankton productivity around Indonesia increases during El Niño events.

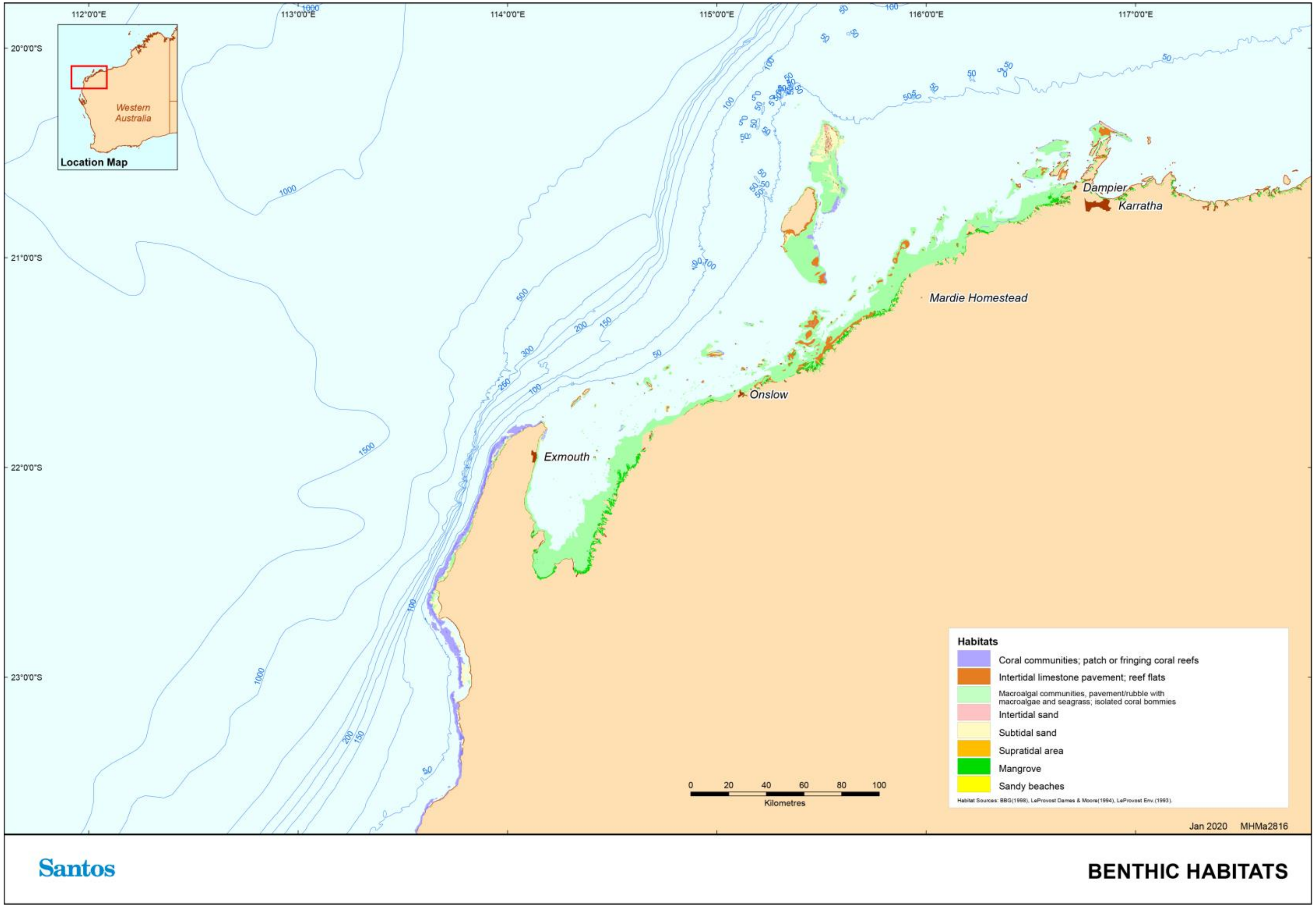

Figure 3-1: Benthic habitats from Coral Bay to Dampier

4. Shoreline Habitats

Shoreline habitats are defined as those habitats that are adjacent to the water along the mainland and of islands that occur above the LAT and most often in the intertidal zone.

The following section broadly categorises shoreline habitats as the following biological communities; mangroves, intertidal mud/sand banks, beaches, and rocky shores. These communities are discussed in **Sections 4.1- 4.5**, in terms of the 18 IMCRA v. 4.0 bioregions where relevant and where information is available.

Figure 3-1 broadly illustrate these habitats within the Northwest Shelf Province and Central Western Shelf Transition. Noting that shoreline habitats of the Cocos (Keeling) Islands are not described as the combined EMBA is restricted to the outermost deep waters of the bioregion.

4.1 Mangroves

Mangroves commonly occur in sheltered coastal areas in tropical and sub-tropical latitudes (Kathiresan and Bingham 2001). Up to eight species of mangroves are found further north in the Central Western Shelf Transition region, but at most locations the dominant mangrove (in terms of area of intertidal zone occupied) is *Avicennia marina*, with the stilt rooted mangrove *Rhizophora stylosa* often occurring as thin zones of dense thickets within the broad zone of *A. marina*. Mangroves are found wherever suitable conditions are present including wave dominated settings of deltas, beach/dune coasts, limestone barrier islands and ria/archipelago shores (Semeniuk 1993). Mangrove plants have evolved to adapt to fluctuating salinity, tidal inundation and fine, anaerobic, hydrogen sulfide rich sediment (Duke *et al.* 1998).

Mangroves are important primary producers and have a number of ecological and economic values. For example, they play a key role in reducing coastal erosion by stabilising sediment with their complex root systems (Kathiresan and Bingham 2001). They are also recognised for their capacity to help protect coastal areas from the damaging effects of erosion during storms and storm surge. Mangroves are also important in the filtration of run-off from the land which helps maintain water clarity for coral reefs which are often found offshore in tropical locations (National Oceanic and Atmospheric Administration (NOAA) 2010). The intricate matrix of fine roots within the soil also binds sediments together.

Mangroves play an important role in connecting the terrestrial and marine environments (Alongi 2009). Numerous studies (e.g. Nagelkerken *et al.* 2000, Alongi 2002, Alongi 2009, Kathiresan and Bingham 2001) have shown mangroves to be highly productive and an important breeding and nursery areas for juvenile fish and crustaceans, including commercially important species (Kenyon *et al*. 2004). They also provide habitat for many juvenile reef fish species.

Mangroves also play an important ecosystem role in nutrient cycling and carbon fixing (NOAA 2010). The trees absorb carbon dioxide from the atmosphere and the organic matter such as fallen leaves forms nutrient rich sediments creating a peat layer that stores organic carbon (Alongi 2009, Ayukai 1998).

The muddy sediments that occur in mangrove forests are home to a variety of epibenthic, infaunal and meiofaunal invertebrates (Kathiresan and Bingham 2001). Crustaceans known to inhabit the mud in mangrove systems include fiddler crabs, mud crabs, shrimps and barnacles. Within the water channels of the estuary, various finfish are found from the smaller fish such as gobies and mudskippers (which are restricted to life in the mangroves) through to larger fish such as barramundi (*Lates calcarifer*) and the mangrove jack (*Lutjanus argentimaculatus).* Mangroves and their associated invertebrate-rich mudflats are also an important habitat for migratory shorebirds from the northern hemisphere, as well as some avifauna that are restricted to mangroves as their sole habitat (Garnet and Crowley 2000).

The two key State regulatory documents relevant to the protection and management of mangroves in WA are:

- EPA (2001) Guidance Statement for Protection of Tropical Arid Zone Mangroves along the Pilbara Coastline. Guidance Statement No. 1; and
- EPA (2016) Technical Guidance – Protection of Benthic Communities and Habitats.

4.1.1 Great Australian Bight Shelf Transition

Mangrove forests occur at sheltered sites on the South Australian coast and cover an area of approximately 230 km2. Mangroves are poorly represented in the Great Australian Bight as they show preference for low energy, muddy shorelines, particularly in the tropics. Of the 69 species in the world only one occurs in the eastern part of the GAB, the grey mangrove, Av*icennia marina*. It forms coastal woodlands up to 5m tall with the most significant stands in the GAB occurring near Ceduna in the east (McLeay, 2003).

4.1.2 Central Western Shelf Province

Shark Bay (in the Central Western Shelf Province) supports the southern-most area of substantial mangrove habitat in Western Australia (Rule *et al*. 2012). The mangroves of Shark Bay comprise only one species, the white mangrove *Avicennia marina*, and these trees occur around the coastline in widely dispersed and often isolated stands of varying size.

4.1.3 Central Western Shelf Transition

The regional mangroves from Exmouth to Broome (within the Central Western Shelf Transition and southern part of the Northwest Shelf Province) represent Australia's only 'tropical-arid' mangroves. The most significant stand of mangroves in the Central Western Shelf Transition is Mangrove Bay on the western side of the Cape Range Peninsula in the Ningaloo Marine Park. This small area of mangrove (37 ha) represents the largest area of mangrove habitat within the Ningaloo Marine Park and is considered extremely important from a biodiversity conservation perspective (CALM 2005).

4.1.4 Northwest Shelf Province

In the Pilbara region, the coast is a complex of deltas, limestone barrier islands and lagoons, with a variable suite of substrates. As a result, mangroves in this region form relatively diverse fringing stands, albeit often stunted in stature but at times quite extensive in area. The mangroves along the Pilbara coastline are the largest single unit of relatively undisturbed tropical arid zone habitats in the world. The area has nine mangrove taxa and a total of 632 km^2 mangroves (MangroveWatch 2014). As with most arid zone mangroves, Pilbara mangroves are characterised by open woodlands and shrublands that are of relatively lower productivity than the mangrove communities of the wet tropics because of the extreme water and salinity stresses that affect the intertidal zone in the Pilbara (EPA 2001). Significant stands of mangroves in the Pilbara include:

+ Exmouth Gulf: mangrove assemblages within the Bay of Rest on the western shore of the Gulf and the extensive mangrove system on the eastern shore of the Gulf that extends as a series of tidal flats and creek channels from Giralia Bay to Yanrey Flats (Astron 2014). These areas of mangrove are also designated as 'regionally significant' by the EPA (2001). The importance of these mangroves to the Exmouth Prawn Fishery is discussed in Kangas et al. (2006);
+ Mainland coast and nearshore islands: mangrove assemblages at Ashburton River Delta, Coolgra Point, Robe River Delta, Yardie Landing, Yammadery Island and the Mangrove Islands are all designated as 'regionally significant' by the WA EPA (2001) and the EPA will give these mangrove formations the highest degree of protection with respect to geographical distribution, biodiversity, productivity and ecological function; and
+ Montebello, Barrow and Lowendal Islands: mangrove assemblages all lay within designated reserves. The mangrove communities of the Montebello Islands are considered globally unique as they occur in lagoons of offshore islands (DEC 2007). Mangrove stands identified on Varanus Island occur on the west coast in discrete patches within the tidal and supratidal zones, at South Mangrove Beach and a small embayment (Astron 2016). Mangrove stands on Varanus Island have been identified as healthy, with similar stands also identified as present on Bridled Island to the north of Varanus Island (Astron 2016).

The mangroves of the Kimberley are particularly diverse and relatively untouched. They occupy a variety of coastal settings including rocky shores, beaches and tidal flats (Cresswell and Semeniuk 2011). They belong to the Indo-Malaysian group of Old World Mangroves centred in the Indian-Pacific area (Cresswell and

Semeniuk 2011). Of the eighteen species of mangrove plants known to Australia all are represented in the Kimberley including *Avicennia marina, Aegialitis annulata, Aegiceras corniculatum, Rhizophora stylosa, Ceriops tagal, Osbornia octodonta, Bruguiera exaristata, Camptostemon schultzii, Excoecaria agallocha, Sonneratia alba,* and *Xylocarpus australasicus* (Pendretti and Paling, 2001; Waples, 2007). Of these, ten occur only in the Kimberley (Waples 2007). *Rhizophora stylosa* and *Avicennia marina* are the most common mangrove species along the WA Coast.

Mangroves line much of the coastal area within the western Kimberley (and within the proposed Horizontal Falls Marine Park area). They are known to line the shore in the upper reaches of Talbot Bay and to fringe many of the islands of the Buccaneer Archipelago. There are large stands in the southern section of Dugong Bay. Kingfisher Islands has been noted to exhibit extensive mangroves where 10 species of mangrove have been recorded (Wilson 2013). Mangroves line the shores of the southern coast of Collier Bay and large tracts are found in Walcott Inlet and Secure Bay (Duke *et al.* 2010). The mangroves on the eastern side of the inlet extend about 30 km inland (Gueho 2007, Pendretti and Paling 2001, Zell 2007). Further along the coast mangroves have been identified lining much of the shores of Doubtful Bay. Mangroves are also known to line the shores of the Sale River and have been identified in George Water. For detailed maps of mangrove distribution refer to Pendretti and Paling (2001).

4.1.5 Northwest Shelf Transition

Mangroves are also a prominent feature of the North Kimberley. Fringing mangroves have developed around the edge of Prince Frederick Harbour and to the east of Cape Voltaire extending along the shores of Walmesly Bay and Port Warrender (Zell 2007). This region is humid and *Xylocarpus granatum* is localised here (Cresswell and Semeniuk 2011). The rocky coastline between Cape Pond and Cape Voltaire does not lend itself to mangrove development; instead coastal woodland grows on the shores above high water mark. Mangroves are interspersed with rocky outcrops and beaches around much of the Admiralty Gulf, Vansittart Bay and Napier Broome Bay (with extensive stands around the Drysdale estuary). Cape Londonderry marks the westerly limit of *Scyphiphora hydrophylacea* (Duke *et al.* 2010).

Between Cape Londonderry and Cape Dussejour mangrove communities are sparse, and limited to a few small stands in the bays as this part of the coastline is dominated by high relief rocky shores which are exposed to the prevailing easterly winds (Wilson 1994). Extensive mangroves do however line the shores of the islands and rivers in the Cambridge Gulf, where 12 mangrove species have been recorded (Wilson 2013). The mangroves of the Ord River are notable in terms of their structural complexity and diversity. Fourteen species of mangrove have been recorded in the boundaries (Pedretti and Paling 2001). The mangroves of the Cambridge Gulf are important for saltwater crocodiles and mangrove bird communities. A unique type of flycatcher which is an intermediate between *Microcea flavigater* and *Microeca tormenti* has been identified in the mangroves of the Cambridge Gulf (Johnstone 1984). Additionally, the area is important for maintaining stocks of the commercially exploited species of the Red-Legged Banana Prawns (*Penaeus indicus)* (Kenyon *et al.* 2004).

Further north, mangroves also occur at the Tiwi Islands. Mangrove communities in the Tiwi Islands are predominantly within tidal creeks and are not expected along the shoreline. The Northern Territory mainland coastline, however, has a number of estuaries and rivers that drain into the surrounding hinterland during the wet season, this includes Darwin Harbour that contains approximately 260 km^2 of mangroves (INPEX, 2010).

4.1.6 Timor Province

Details on habitats in the Timor Province is provided in **Section 12.3.12**.

4.1.7 Northern Shelf Province

Coastlines within the Northern Shelf Province are described as being dominated by mangroves, which provide significant habitat for commercial and non-commercial fish species. In particular, banana prawns tend to favour mangrove areas with the highest catch of banana prawns being recorded in areas with the highest concentration of mangroves (DEWHA, 2008).

4.1.8 Christmas Island Province

There are no coastal mangroves, but a stand of normally estuarine *Bruguiera gymnorhiza* and *B. sexangula* occurs at Hosnie's Spring (registered as a Ramsar Wetlands site of international importance) about 50 metres above sea level. Two other mangrove species occur on the east coast. *Heritiera littoralis* occurs on the inland terrace above Greta Beach (outside the park) and further south towards Dolly Beach, as well as a discrete stand on the terrace above Dean's Point. *Cynometra ramiflora* occurs in two small stands south of Ross Hill (DNP, 2012).

4.1.9 International Waters

Subawa's south coast in Indonesia is thought to contain the most significant stand of mangroves in the Lesser Sunda Ecoregion (DeVantier 2008). Other significant stands have been mapped at the following locations (DeVantier 2008):

+ North-west and south east Bali;
+ North coast of Nusa Lembongan;
+ North-east and east Sumba;
+ South-west, north-west, north and east Flores and Maumere;
+ Komodo Island, and nearby islands; and
+ South west, south, central and north Timor-Leste.

Several Indonesian National Parks, including Laut Sawu Marine National Park, Karimunjawa National Park, Kepulauan Seribu National Park, Teluk Cenderawasih National Park, Kapulauan Wakatobi National Park, Meru Betiri National Park, Togian Islands National Park, Bali Barat National Park, Savu Sea National Marine Conservation Area and the World Heritage sites of Komodo National Park, Siberut and Ujung Kulon contain mangrove forest (refer to **Section 9.8**).

4.2 Intertidal Mud/Sand Flats

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

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

4.2.1 Central Western Shelf Province

Shark Bay in the Central Western Shelf Province has a protected intertidal ecological community 'Subtropical and Temperate Coastal Saltmarsh', as listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It is the northerly limit for this community and there is a transition zone for many saltmarsh species (CALM 1996). The EPBC 'Listed Advice' (DSEWPaC 2013a) reports that sediments associated with these communities generally consist of poorly-sorted anoxic sandy silts and clays, and may have salinity levels that are much higher than seawater due to evaporation. The drainage characteristics of coastal soils, along with tidal patterns and elevation, can strongly influence the distribution of flora and fauna within the Coastal Saltmarsh ecological community (DSEWPaC 2013a).

4.2.2 Northwest Shelf Province

Within Northwest Shelf Province both Roebuck Bay and Eighty Mile beach are areas with significant intertidal mudflats that are used by birds in spring and summer including species listed as threatened under the *Biodiversity Conservation Act 2016* (BC Act) or EPBC Act, or listed on the IUCN Red List of Threatened Species (IUCN 2019). Intertidal mudflats are also an important feature of the Kimberley coast forming in many bays and inlets of the region (Waples 2007). The sediments that dominate these flats are generally of terrigenous origin (Wilson 2013).

The mudflats of the Kimberley coast have been shown to be important for migratory birds of the East Asian-Australasian Flyway, which is estimated to support more than five million migratory shorebirds (Barter 2002, Bennelongia Pty Ltd 2010, Wade and Hickey 2008). The migratory birds visit the mudflats of the Kimberley coast to feed on benthic organisms prior to embarking on a 10,000–15,000 km migration to their breeding grounds in the Artic (Wade and Hickey 2008).

4.2.3 Northwest Shelf Transition

Extensive mud flats are located in Collier Bay, where the highest tidal range in Australia is found. (Wilson 2013, Zell 2007). A study by (Duke *et al*. 2010, Masini *et al*. 2009) also identified fringing mudflats around Walcott Inlet, and Doubtful Bay. The tidal mudflats of Walcott Inlet are up to 5 km wide and support a rich intertidal invertebrate community (Gibson and Wellbelove 2010). These invertebrate communities in turn also support large numbers of waterbirds (Wilson 1994).

Extensive intertidal mudflats occur in Prince Frederick Harbour and are generally backed by mangroves. The mudskipper is known to feed on these mudflats at low tide. Intertidal flats are also a feature of the estuary of the Mitchell River. The mudflats of Port Warrender are known to support 20 shorebird species and tern species and it is likely the other mudflats in the region also support high numbers of birds. The ecological significance of the wetlands of the Mitchell River has been recognised in *A Directory of Important Wetlands in Australia*. Mud and sand flats are also known to surround much of Deep Bay and Napier Broome Bay.

Intertidal sand and mudflats are a common feature of the East Kimberley. Large sand bars are present on the river mouths of the King George River, Berkeley River and Lyne River and intertidal mudflats are extensive along the edges of the Cambridge Gulf. The estuary is wide and very shallow in some sections, and the silt and clay is continually picked up and redeposited by strong tidal currents (Robson *et al.* 2008). The tidal flats of the Ord River in the Cambridge Gulf have been listed as a wetland of international importance for the conservation of waterbirds under the Ramsar convention. The area supports a variety of fauna including shorebirds and mudskippers. Tidal mudflats are also extensive along the coast between the Cambridge Gulf and the WA-NT Border.

Further north, the Tiwi islands have also been identified as containing tidal flats, whilst the extent of these are not well documented they are thought to be closely related to the mangrove habitats at the Tiwi Islands (ConocoPhillips, 2020).

4.2.4 Timor Province

Details on habitats in the Timor Province is provided in **Section 12.3.12**.

4.2.5 Northern Shelf Province

The subtidal and intertidal communities in Darwin Harbour and around the NT coastline, within the Northern Shelf Province are characterised as including a variety of shoreline habitats, including intertidal mud flats (URS 2010). The Tiwi Islands are also partially located within the Northern Shelf Province and are identified as supporting a number of shoreline habitats including sand and mud flats.

4.2.6 International Waters

Although no specific areas of intertidal mud or sand flats have been identified for international waters, the southern coasts of the islands that make up the Lesser Sunda Ecoregion of Indonesia and Timor-Leste do contain numerous estuarine habitats. These estuaries are likely to contain intertidal and tidal sand and mud flats that support a range of benthic invertebrate species that in turn attract other species such as birds and fish. Such estuaries in the Lesser Sunda Ecoregion are typically mangrove lined. Within the Lesser Sunda Ecoregion, the following areas are recognised as containing estuarine habitat (Wilson et al. 2011):

+ Lombok;
+ Sumba;
+ Central south and central north coasts of Sumbawa;
+ North-east coast of Flores; and
+ South-west coast of Timor-Leste.

The Irebere Estuary, located on the south-eastern coast, Tilomar located on the southern coast and Nino Konis Santana located on the eastern coast of Timor-Leste has been recognised as an Important Bird Area (Birdlife International 2018).

Several National Parks in the Ecoregion also contain estuarine habitats (likely to include intertidal sand and mud flats), including Karimunjawa National Park (refer to **Section 9.8**).

4.3 Intertidal Platforms

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

4.3.1 Southwest Shelf Province and Southwest Shelf Transition

Intertidal platforms within the Northwest and Southwest bioregions support a mosaic of fauna and flora that typically exhibits strong variability in percent cover, community composition, abundance and diversity both between and within reefs at varying spatial and temporal scales (SKM 2009, 2011). Reef platforms typically exhibit zonation of fauna and flora from upper to lower levels on the intertidal zone, with increasing diversity, abundance and biomass lower in the intertidal (Morton and Britton in Jones 2004, SKM 2009, 2010, 2011, Hanley and Morrison 2012).

On the south coast of the Southwest Shelf Province, the coastal geomorphology changes from the predominant limestone reefs to eroded Precambrian rocks. Intertidal platforms are also common along the Southwest Shelf Transition. Shark Bay in the Central Western Shelf Province has a high diversity of intertidal marine habitats as a result of the diversity of benthic substrate, salinity and the broad geographical features which influence depth, water movement and turbidity (CALM 1996, DSEWPaC 2013b). This includes extensive, limestone platforms (as well as sand flats, mud flats, salt marsh and mangroves and beaches (CALM 1996).

4.3.2 Great Australian Bight Transition

The coastline is subject to moderate to high wave energy and high swells (2-4 m). This region features limestone cliffs interspersed by rocky headlands, narrow intertidal rock platforms, reefs and beaches backed by dune barriers.

The Eyre Region is subject to moderate to high wave energy and features a rocky coast with numerous headlands, sheltered bays, cliffs, shore platforms, beaches backed by dune barriers, offshore islands, seamounts and lagoon deposits in sheltered areas (McLeay, 2003).

4.3.3 Central Western Shelf Province and Transition

Limestone pavements extend out from the beach into subtidal zones, e.g. along the Ningaloo Coast and North West Cape; and higher relief platforms (>0.5 m off high water mark) are also present at a number of headlands along the North West Cape.

4.3.4 Northwest Shelf Province and Northwest Shelf Transition

Large tidal regimes are likely to be the defining environmental factor influencing the distribution of intertidal flora and fauna in the Northwest Shelf Province and Northwest Shelf Transition. The intertidal area of the Kimberley has an extreme tidal range (hypertidal) which creates unique environmental conditions and habitats not seen else anywhere else in the world. As a remote area many of the habitats are untouched and they are recognised as having significant conservation value (DPaW 2013). DPaW (2013) reports that as a result of the monsoonal influxes of freshwater and land-derived nutrients distinctive tropical marine ecosystems have occurred.

4.3.5 Christmas Island Province

Rocky shore platforms occur at many locations around the island, more extensively on the western coastline between North West Point and Egeria Point. There are also tidal rock pools which are maintained by wave splash and tidal surge (DNP, 2012).

4.3.6 International Waters

While no significant areas of intertidal platforms have been identified in international waters, the high energy southern coastlines of the islands of the Lesser Sunda Ecoregion of Indonesia (and also including Timor-Leste) are likely to have areas of exposed pavements consisting of limestone and remnant lava flows (Wilson *et al*. 2011).

4.4 Sandy Beaches

Sandy beaches are those areas within the intertidal zone where unconsolidated sediment has been deposited (and eroded) by wave and tidal action. Sandy beaches can vary from low to high energy zones; the energy experienced influences the beach profile due to varying rates of erosion and accretion. Sandy beaches are found across the combined EMBA and vary in length, width and gradient. They are interspersed among areas of hard substrate (e.g. sandstone) that form intertidal platforms and rocky outcrops. There is a wide range of variation in sediment type, composition, and grain size along the combined EMBA.

Sandy beaches provide habitat to a variety of burrowing invertebrates and subsequently provide foraging grounds for shorebirds (Garnet and Crowley 2000). The number of species and densities of benthic macroinvertebrates that occur in the sand are typically inversely correlated with sediment grain-size and exposure to wave action, and positively correlated with sedimentary organic content and the amount of detached and attached macrophytes (Wildsmith *et al.* 2005). However, the distributions of these faunas among habitats will also reflect differences in the suite of environmental variables that characterize those habitats (Wildsmith *et al.* 2005).

Sandy habitats are important for both resident and migratory seabirds and shorebirds (refer **Section 8**). While sand flats and beaches generally support fewer species and numbers of birds than mudflats of similar size; some species such as the beach thick knee (*Esacus giganteus*) a crab eater, are commonly associated with sandy beaches (Garnet and Crowley 2000). Sandy beaches can also provide an important habitat for turtle nesting and breeding (see marine turtles **Section 6.1**).

4.4.1 Southwest Shelf Province

The hooded plover (*Thinornis rubricollis*) is a shorebird found on several beaches within the South West capes. Hooded plovers live on sandy surf beaches and prefer beaches backed by dunes rather than cliffs (DEC 2013). In addition to this, beaches in the South West province provide a variety of socio-economic values including tourism, commercial and recreational fishing, and support other recreational activities.

4.4.2 Southwest Shelf Transition

Sandy beaches throughout the Abrolhos host breeding populations of the Australian sea lion. The Abrolhos represent the northernmost breeding population of Australian sea lions. The current population at the Abrolhos is estimated to be approximately 90 individuals (DoF 2012).

In addition to this, beaches in the South West province provide a variety of socio-economic values including tourism, commercial and recreational fishing, and support of other recreational activities.

4.4.3 Central Western Shelf Province

Sandy beaches are found along the coastline at Shark bay within the marine park which is further described in **Section 12.3.2**.

4.4.4 Northwest Shelf Province

Eighty Mile Beach Marine Park is one of the Australia's largest uninterrupted sandy beaches (stretching 220 km) and is an important feeding grounds for small wading birds that migrate to the area each summer, travelling from countries thousands of kilometres away (DEC 2012a). It is also a listed Ramsar wetland (see **Section 9** on Protected Areas).

4.4.5 Northwest Shelf Transition

Sand habitat within the Camden Marine Park is mainly associated with shorelines and inlets on both mainland and island shores. Some beach deposits on islands in the Kimberley are composed of skeletal carbonate sand, while they may also consist of sediments from inland areas carried to the sea by rivers and gullies (DPaW 2013). The sediment coarseness of the sand may vary, and may also be littered with dead shell, rock and/or coral material. Sea cucumbers that ingest sand and filter out microscopic food are often common in this habitat DPaW 2013).

Significant sandy beaches occur on the Tiwi Islands, specifically the west coast of Bathurst Island and the north coast of Melville Island. These beaches are important areas for marine turtles with nesting dominated by flatback and olive ridley turtles (peak nesting in March to May) (Chatto and Baker, 2008).

Generally, in this region, sand habitat is adjacent to either dense mangrove stands or rocky cliffs (DPaW 2013). Beaches can be highly influenced by tide and weather conditions. Those that overlie rock are likely to shift and be ephemeral in nature.

4.4.6 Timor Province

Details on habitats in the Timor Province is provided in **Section 12.3.12**.

4.4.7 Christmas Island Province

These are formed of sand and of coral and shell rubble, often with limestone outcrops. Dolly and West White Beaches are the two largest beaches in the island, while Dolly and Greta Beaches hold sufficient sand to provide habitat for hermit and ghost crabs and to enable green turtles to dig nests (DNP, 2012).

4.4.8 International Waters

The southern coastlines of the islands of the Lesser Sunda Ecoregion of Indonesia and Timor-Leste are known to contain sandy beaches consisting of soft black sand, formed by volcanic activity. Within this region, a number of National Parks are considered important sites for turtle nesting beaches, including the Meru Betiri National Park (refer to **Section 9.8**).

The World Heritage site of Ujung Kulon is also a known site of sandy beaches, as well as the marine national parks of Kepulauan Seribu and Taka Bonerate which are also known as important turtle nesting sites (See **Section 9.8**).

4.5 Rocky Shorelines

Rocky shorelines are found across the combined EMBA and are often indicative of high energy areas (wave action) where sand deposition is limited or restricted (perhaps seasonally or during a cyclone). They are formed from limestone pavement extending out from the beach into subtidal zones, for example along the Ningaloo Coast and North West Cape; higher relief platforms (>0.5 m off high water mark) are also present at a number of headlands along the North West Cape. This habitat is also widespread heading south towards Perth.

Rocky shores can include pebble/ cobble, boulders, and rocky limestone cliffs (often at the landward edge of reef platforms). Rocky outcrops typically consist of hard bedrock, but some of the coastline has characteristic limestone karsted cliffs with an undercut notch. Rocky shorelines can vary from habitats where there is bedrock protruding from soft sediments to cliff like structures that form headlands. Rocky shorelines are an important foraging area for seabirds and habitat for invertebrates found in the intertidal splash zone (Morton and Britton cited in Jones 2004). For example, oyster catchers and ruddy turnstones feed along beaches and rocky shorelines (see seabirds in **Section 8.2.2**).

4.5.1 International Waters

The Lesser Sunda Ecoregion contains numerous rocky shores, particularly on the exposed southern coastlines of the islands that make up the ecoregion. Areas of rocky shores include the following (DeVantier 2008):

+ The Bukit Peninsula and Nusa Penida areas of Bali;
+ South Lombok;
+ South-east Sumbawa;
+ Nusa Tengara;
+ Sumba; and
+ Timor-Leste, including Roti Island, Fatu and Atapupu.

The World Heritage site of Ujung Kulon is also known for its coastline of rocky outcrops, among other ecosystems (see **Section 9.8**).

4.6 International Shorelines

The EMBA extends to the Indonesian, West-Timor and Timor-Leste coastline. The coastlines of these countries support a range of habitats and communities, including sand and gravel beaches, rocky shores and cliffs, intertidal mudflats, mangroves, seagrass and coral reefs (Tomascik et al. 1997; Asian Development Bank 2014). The coastal waters provide habitat for a number of protected species, including humphead wrasses, marine turtles, giant clams, some mollusc species, crustaceans, cetaceans (dolphins and whales) and dugongs, and commercially important species of fish, shrimps, and shellfish (Asian Development Bank, 2014). Nearshore waters also support significant capture fisheries (commercial and subsistence) that contribute to the nation’s economy and employment (Asian Development Bank 2014).

5. Fish and Sharks

Fish distributions in the combined EMBA are discussed with respect to the IMCRA Provincial Bioregions which were defined using CSIRO's 1996 regionalisation of demersal fish on the continental shelf to the shelf break, and their 2005 regionalisation of demersal fish on the continental slope to approximately 1,200 m depth (DEH 2006). The EPBC species listed as threatened and migratory found in the combined EMBA, according to the Protected Matters search (**Appendix A**), are shown in **Table 5-1** along with their WA and NT conservation listings (as applicable) and discussed in **Section 5.2** below.

The following WA conservation codes apply to WA conservation significant fauna:

- Threatened species (listed under the *Biodiversity Conservation Act 2016* (WA) (BC Act)):
  - Critically endangered
  - Endangered
  - Vulnerable
- Specially protected species (listed under BC Act):
  - Migratory
  - Species of special conservation interest (conservation dependant fauna)
  - Other specially protected species
- Priority species (non-statutory state based administrative process):
  - Priority 1, 2 and 3: poorly-known species – possible threatened species that do not meet survey criteria or are otherwise data deficient. Ranked in order of priority. In urgent need of further survey.
  - Priority 4: species that are adequately known, are either: rare but not threatened; meet criteria for near threatened; or delisted as threatened species within last five years for reasons other than taxonomy. Requiring regular monitoring.

The following NT conservation codes apply to NT conservation significant fauna:

- Threatened wildlife (listed under the Territory Parks and Wildlife Conservation Act 1976 (TPWC Act))
  - Extinct in the wild
  - Critically endangered
  - Endangered
  - Vulnerable
- Protected wildlife (listed under the Territory Parks and Wildlife Conservation Act 1976)
  - Wildlife in a Territory park, reserve, sanctuary, wilderness zone or area of essential habitat
  - Any vertebrate that is indigenous to Australia

A detailed account of commercial and recreational fisheries that operate in the region is provided in in the Commercial Fisheries **Section 14.7** and detailed in *The State of the Fisheries Report* 2018/2019 (Gaughan *et al.*, 2020).

Table 5-1: EPBC listed fish and shark species in the combined EMBA

Species	Conservation Status				Likelihood of occurrence in EMBA	BIA in EMBA
	EPBC Act 1999	BC Act 2016[1]	Other WA Conservation Code	*TPWC Act 1976*		
Blind gudgeon (*Milyeringa veritas)*	Vulnerable	Vulnerable	-	-	Species or species habitat known to occur within area.	None - No BIA defined
Balstons pygmy perch (*Nannatherina balstoni*)	Vulnerable	Vulnerable	-	-	Species or species habitat likely to occur within area.	None - No BIA defined
Blind cave eel (*Ophisternon candidum)*	Vulnerable	Vulnerable	-	-	Species or species habitat known to occur within area.	None - No BIA defined
Black-stripe minnow (*Galaxiella nigrostriatal*)	Endangered	Endangered	-	-	Species or species habitat known to occur within area.	None - No BIA defined
Grey nurse shark (*Carcharias taurus*)	Vulnerable	Vulnerable	-	Listed nationally	Species or species habitat known to occur within area.	None - BIA not found in EMBA
Great white shark (*Carcharodon carcharias*)	Vulnerable & Migratory	Vulnerable	-	-	Foraging, feeding or related behaviour known to occur within area.	Yes – Refer to **Table 5-3**
Whale shark (*Rhincodon typus*)	Vulnerable & Migratory	Specially protected (species otherwise in need of special protection)	-	Listed nationally	Foraging, feeding or related behaviour known to occur within area.	Yes – Refer to **Table 5-3**
Northern river shark (*Glyphis garricki)*	Endangered	-	Priority 1	Endangered	Breeding likely to occur within the area.	None - BIA not found in EMBA
Speartooth shark *(Glyphis glyphis)*	Critically Endangered	-	-	Vulnerable	Species or species habitat known to occur within area.	None - BIA not found in EMBA
Dwarf sawfish (*Pristis clavata)*	Vulnerable & Migratory	-	Priority 1	Vulnerable	Breeding known to occur within area.	Yes – Refer to **Table 5-3**

[1] The Wildlife Conservation (Specially Protected Fauna) Notice 2018 has been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of threatened, extinct and specially protected species under Part 2 of the BC Act.

Species	Conservation Status				Likelihood of occurrence in EMBA	BIA in EMBA
	EPBC Act 1999	BC Act 2016[1]	Other WA Conservation Code	*TPWC Act 1976*		
Freshwater sawfish (*Pristis pristis)*	Vulnerable & Migratory	-	Priority 3	Vulnerable	Species or species habitat known to occur within area.	Yes – Refer to **Table 5-3**
Narrow sawfish (*Anoxypristis cuspidate)*	Migratory	-	-	-	Species or species habitat known to occur within area.	None - No BIA defined
Green sawfish (*Pristis zijsron)*	Vulnerable & Migratory	Vulnerable	-	Vulnerable	Breeding known to occur within area.	Yes – Refer to **Table 5-3**
Oceanic whitetip shark (*Carcharhinus longimanus*)	Migratory	-	-	-	Species or species habitat likely to occur within area.	None - BIA not found in EMBA
Shortfin mako *(Isurus oxyrinchus)*	Migratory	-	-	-	Species or species habitat likely to occur within area .	None - No BIA defined
Longfin mako *(Isurus paucus)*	Migratory	-	-	-	Species or species habitat likely to occur within area.	None - No BIA defined
Reef manta ray *(Manta alfredi)*	Migratory	-	-	-	Species or species habitat known to occur within area.	None - No BIA defined
Giant manta ray *(Manta birostris)*	Migratory	-	-	-	Species or species habitat known to occur within area.	None - No BIA defined
Porbeagle *(Lamna nasus)*	Migratory	-	-	-	Species or species habitat may occur within area.	None - No BIA defined

In addition a review of conservation dependent species[2] identified five species of fish / sharks that may occur in the combined EMBA:

- Orange roughy (Hoplostethus atlanticus);
- Southern blue fin tuna (*Thunnus maccoyii*);
- Southern dogfish (Centrophorus zeehaani);
- School shark (*Galeorhinus galeus*); and
- Scalloped hammerhead (*Sphyrna lewini*).

[2] Conservation dependent species are listed species under the EPBC Act and are considered as part of the Commonwealth marine area.

5.1 Regional Surveys

Within the combined EMBA a number of important geographical areas for fish exist, including Ningaloo Marine Park, Montebello/Barrow Island Marine Park, Abrolhos Marine Park and the Rowley Shoals.

5.1.1 Southwest Shelf Province

At least 150 species have been identified within the capes region as being reef-associated (Hutchins 1994 cited in DEC 2013). Of these, 77% are warm temperate species, 18% are subtropical species and 5% are tropical (DEC 2013).

The most abundant finfish species across the region identified during surveys were the Maori wrasse (*Opthalmolepis lineolatus*), red banded wrasse (*Pseudolabrus biserialis*), McCulloch scalyfin (*Parma mccullochi*), and western king wrasse (*Coris auricularis*). The yellow headed hulafish (*Trachinops noarlungae*), black headed puller (*Chromis klunzingeri*), rough bullseye and common bullseye (*Pempheris multiradiata* and *P. klunzingeri*) were also common at Eagle Bay and Geographe Bay (Westera *et al.* 2007 cited in DEC 2013).

5.1.2 Southwest Shelf Transition

A total of 389 finfish species have been recorded at the Abrolhos (DoF 2012). The Abrolhos and their surrounding coral and limestone reef systems consist of a combination of abundant temperate macroalgae with coral reefs, supporting substantial populations of large species such as baldchin groper and coral trout. Some of the species occurring in the Abrolhos are dependent on larvae carried southward by the Leeuwin Current from areas further north, such as Shark Bay or Ningaloo Reef. Similarly, populations of some of the species occurring at Rottnest Island are dependent on larvae generated from breeding populations at the Abrolhos (DoF 2012).

More than 20 species of sharks have been identified at the Abrolhos (DoF 2012). These sharks include:

+ Port Jackson sharks (Heterodontus portusjacksoni);
+ Tiger shark (Galeocerdo cuvier);
+ Whaler sharks (Carcharhinus brachyurus); and
+ Wobbegongs (Orectolobus maculatus).

Abrolhos waters are considered to be an important food source for sharks, due to the resident fish populations. Various species of rays have been recorded at the Abrolhos. These include the manta ray and the white spotted eagle ray (DoF 2012).

5.1.3 Southern Province

The demersal fish assemblages inhabiting the shelf break and slope resemble those found on the Southeast Marine Region's continental slope more than those of the Central Western Province. The canyons south of Kangaroo Island and adjacent shelf break appear to be important areas for biological productivity and for spawning and aggregation for a range of marine species, particularly during winter. The Albany Group of submarine canyons south of Albany and Esperance are also considered important for biological productivity that attracts feeding aggregations (DEWHA 2008b).

Scientists have described 463 species of fish on the slope of this bioregion, of which 26 are endemic. Only one extensive study of slope fish communities, undertaken during the late 1980s, has been conducted in this bioregion. There is a lower proportion of bottom-feeding demersal fish in this bioregion compared with the west coast, which appears to relate to greater availability of food such as meso-pelagic fish like myctophids (lantern fish) in the water column. Commercial fish landings taken from the shelf break and down the upper and mid-slope include orange roughy, blue grenadier, Bight redfish, school shark, gummy shark, angel shark, gemfish, deep water flatheads, leatherjackets, latchets, stingrays and stingarees (DEWHA 2008b).

Fisheries scientists and some fishers speculate that species such as blue grenadier and western gemfish may have spawning aggregations amongst the submarine canyons and other prominent geological features rising from the seafloor on the slope adjacent to Esperance and Hopetoun. The Diamantina Fracture Zone represents a unique but virtually unknown region of deep-sea habitat and experts speculate it is highly likely that marine communities in this area comprise unique species with high biodiversity. The physical complexity of numerous troughs and ridges and complex water circulation that occurs in this area support these assertions. A number of KEFs are defined which support enhanced productivity and aggregations of marine life (Section 10) (DEWHA 2008b).

5.1.4 Great Australian Bight Shelf Transition

Of the 600 species of fish occurring in southern Australia, 370 are recorded from South Australian waters (Scott et al. 1980). Species restricted to South Australia that occur in the GAB include the coastal stingaree (*Urolophus orarius*) and the crested threefin (*Norfolkia cristata*.

In South Australia, 77 species of fish are utilised commercially. The main fishes targeted by commercial fishers in the GAB are southern bluefin tuna (*Thunnus maccoyii)*, sardine (*Sardinops sagax*), school shark (*Galeorhinus galeus*), gummy shark (*Mustelus antarcticus*), bronzewhaler shark (*Carcharhinus brachyurus*), snapper *(Pagrus auratus*), King George whiting (*Sillaginodes punctata*) and deepwater species such as deepwater flathead (*Neoplatycephalus conatus*), bight redfish (*Centroberyx gerrardi*), deep sea trevalla (*Hyperoglyphe antarctica*) and orange roughy (*Hoplostethus atlanticus*). Surveys conducted by the CSIRO in the GAB between 1965 and 1989 collected information on species composition, sizes, and distribution patterns of fishes. Surveys were conducted by trolling (1979, 1981) and demersal (1978-81), pelagic (1979) and mid-water trawling (1978, 1980-81). CSIRO also have data from Russian surveys conducted in the GAB in 1965-1974.

Recreational fishers in the GAB target Australian salmon (*Arripis truttacea*), mulloway (*Argyrosomus japonicus*), snapper (*Pagrus auratus*), King George whiting (*Sillaginodes punctata*), Australian herring (*Arripis georgiana*) and yellowtail kingfish (*Seriola lalandi*) (Mcleay et al., 2003; DEWHA, 2008b).

5.1.5 Central Western Shelf Province

The Central Western Shelf Province is located near Shark Bay and is the northern limit of a transition region between temperate and tropical marine fauna. Of the 323 fish species recorded from Shark Bay, 83% are tropical species with 11% warm temperate and 6% cool temperate species (CALM 1996).

5.1.6 Central Western Shelf Transition

Ningaloo is the largest fringing coral reef in Australia, forming a discontinuous barrier that encloses a lagoon that provides habitat for many fish species. Gaps that regularly intercept the main reef line provide channels for water exchange with deeper, cooler waters (CALM 2005). Ningaloo Reef is a well known biodiversity hotspot, supported by the direct link between the reef and the ancient reef systems found closer to the equator by the Leeuwin Current (Kemps 2010). Approximately 500 species of fish have been reported to inhabit the reef (Kemps 2010). The Piercam project from inception in 2005 to 2013, identified 165 fish species from 50 families at the Point Murat Navy Pier alone, located within the Ningaloo Marine Park (Whisson & Hoschke 2013).

Seasonal aggregations of whale sharks occur at Ningaloo each year (CALM 2005). There is limited data available on species diversity and distribution of sharks in the Ningaloo area as chondrichthyan biodiversity for the area has not been specifically recorded. Despite this, it is possible that the Ningaloo Reef Marine Park contains the largest and most diverse collection of sharks on the Australian coastline (Stevens *et al.* 2009). It was estimated in 2009 by Last and Stevens (cited in Stevens *et al.* 2009), that there are likely to be 118 species of chondrichthyan fishes occurring in the park. Of these species, 59 are shark species predicted to be found at depths of less than 200 m (Stevens *et al.* 2009).

The lagoon at Ningaloo Reef appears to provide a juvenile habitat and nursery area for shark species such as the grey nurse shark (*C. taurus*), black-tipped reef shark (*Carcharhinus melanopterus*) and other reef sharks (Carcharhinidiae) (Stevens *et al.* 2009). A study conducted on the distribution and abundance of elasmobranches in the Ningaloo Marine Park, in 2009, tracked the movements of six key shark species. Species such as *Galeocerdo cuvier* (tiger shark) and *Sphyrna mokarran* (great hammerhead) were found to remain for brief time periods in the park, in contrast to other species found to re-visit the Ningaloo area (Stevens *et al.* 2009). Several species of sharks within Ningaloo have been identified as key indicator species for the health of the system (Stevens *et al.* 2009).

Barrow Island includes Biggada Reef, an ecologically significant fringing reef, and the Montebello Islands comprise over 100 islands, the majority of which are rocky outcrops; providing fish habitat (DEC 2007a). Within the Barrow/Montebello region, at least 380 fish species have been recorded (de Lestang & Jankowski 2017). Most species exhibit wide distributions, with local species composition closely resembling that of the Dampier Archipelgao. Coral habitats support the most diverse fish community in this region, comprising, among others, many species of damselfish (Pomacentridae), parrotfish (Scaridae), snappers (Lutijanidae) and groupers (Serranidae) (de Lestang & Jankowski 2017). The region's macroalgal habitats are considered important nursery areas for a diverse range of fish species, such as emperor (Lethrinidae), threadfin bream (Nemipteridae), tuskfish (Labridae) and trevally (Carangidae) (de Lestang & Jankowski 2017).

Ramsar wetlands within the area (e.g. Eighty Mile Beach and Ashmore Reef National Nature Reserve) can also provide important habitat for fish (see **Section 9.1.3**).

5.1.7 Central Western Transition

The biological communities of the Central Western Transition are thought to be distinctive owing to the proximity of deep oceans areas to the continental slope and shelf, resulting in close interaction between pelagic species of the Cuvier Abyssal Plain and those of the slope and shelf (DEWHA 2008a).

The present level of understanding of the marine environment in this bioregion is generally poor. The diversity of fish and cephalopod species changes with depth, generally decreasing species numbers with increasing depth. The demersal slope fish bioregionalisation identified some endemism in communities in this bioregion (Last *et al*. 2005), however, it is lower than other areas of the North-west Marine Region (DEWHA 2008a).

Bentho-pelagic fish, such as deep-water snappers (e.g. *Paracaesio* spp, and *Eletis* spp.), hatchetfish (*Argyropelecus* spp.), dragonfish (*Melacosteus* spp.), viperfish (*Chauliodus* spp.) and a number of eels species migrate between the benthic and pelagic systems, forming an important link between these systems (DEWHA 2008a).

Transient fish species through the Central Western Transition bioregion include southern bluefin tuna (migrating to and from spawning grounds), broadbill swordfish (*Xiphius gladius*), bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*) and striped marlin (*Tetrapturus audax*). Pelagic sharks also range across the bioregion following schools of pelagic fish (DEWHA 2008a).

5.1.8 Central Western Province

The Perth Canyon appears to be an important ecological feature attracting krill and fish aggregations that in turn attract larger species such as predatory fish and pygmy blue whales (DSEWPaC 2012). Demersal slope fish assemblages in this bioregion are characterised by high species diversity. Scientists have described 480 species of demersal fish that inhabit the slope of this bioregion and 31 of these are considered endemic to the bioregion. Demersal fish on the slope in this bioregion in particular have high species diversity compared with other more intensively sampled oceanic regions of the world. Below 400 m water depth demersal fish communities are characterised by a diverse assemblage where relatively small, benthic species (grenadiers, dogfish and cucumber fish) dominate.

5.1.9 Northwest Transition

The Northwest Transition bioregion may support sparse populations of bentho-pelagic fish and cephalopods in low densities. Pelagic fish species likely to be present include grenadiers and hatchetfish (*Argyropelecus* spp.) as well as transient populations of highly mobile pelagic fish. Adult and juvenile southern bluefin tuna are through to migrate through this bioregion on their way to and from spawning grounds in the north-eastern Indian Ocean (DEWHA 2008a).

The slope habitat of this bioregion is associated with important populations of demersal fish species and supports the second richest demersal fish assemblage nationally (Last *et al*. 2005). Over 508 fish species have been identified on the slope in this area and 64 of these species are endemic. The high diversity and endemism of the demersal fish fauna indicates important interactions between physical processes and trophic structures in this bioregion. For more information on the slope habitat for fish and sharks, refer to **Section 10.1.19**.

The Rowley Shoals within the Northwest Transition comprise three oceanic reef systems approximately 30–40 km apart, namely Mermaid Reef, Clerke Reef and Imperieuse Reef. The Shoals are thought to provide a source of invertebrate and fish recruits for reefs further south and as such are regionally significant (DEC 2007b).

5.1.10 Northwest Shelf Province and Northwest Province

The demersal zone of the North West Shelf (which includes the Northwest Province and Northwest Shelf Province) hosts a diverse assemblage of fish of tropical Indo-west Pacific affinity, with up to 1,400 species known to occur, with a great proportion of these occurring in shallow coastal waters (Allen *et al*. 1988). Last *et al*. (2005) and Fox and Beckley (2005) described the North-west Province as being characterised by a high level of endemism and species diversity. Certain areas of increased biological activity (e.g. Glomar Shoals) attract demersal fish species such as Rankin cod, red emperor, crimson snapper and spangled emperor that are exploited by commercial trawl and trap fisheries (Sainsbury *et al*. 1992, Fletcher and Santoro 2013).

The shallow waters (<30 m) of the Dampier Archipelago, in the Northwest Shelf Province, support a characteristic and rich fish fauna of 650 species from a variety of habitats including coral and rocky reefs, mangroves, sand and silty bottoms and sponge gardens (Hutchins 2003 & 2004). The majority of these species are found over hard substrate, but significant numbers are also found from soft bottom and mangrove areas. The outer islands of the Archipelago are inhabited predominantly by coral reef fishes whereas inner areas close to the mainland are occupied by mangrove and silty-bottom dwellers. The inter-island passages have a relatively rich soft bottom fauna. EPBC Act protected fish species within the Dampier Archipelago include the dwarf sawfish (*Pristis clavata*), freshwater sawfish (*Pristis pristis*) and narrow sawfish (*Anoxypristis cuspidate*).

The fish fauna of the archipelago is less diverse than the islands of the West Pilbara to the south, but are closely related to the fauna at the offshore Montebello Islands (Hutchins 2004). The fish fauna of Barrow/ Lowendal/ Montebello Islands are widespread throughout the Indo-west Pacific region.

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

Pelagic fish in the Northwest and Northwest Shelf Province include tuna, mackerel, herring, pilchard and sardine, and game fish such as marlin and sailfish (BBG 1994, Brewer *et al*. 2007), some of which are targeted by both commercial and recreational fishers. In particular, adult and juvenile southern bluefin tuna are thought to migrate through the North West Shelf on their way to and from spawning grounds in the north-eastern Indian Ocean. However, the timing of these migrations and the use of regional currents to assist their migration is still unclear. The oceanic waters of the North West Shelf are also believed to provide important spawning and nursery grounds for a number of large pelagic fish species. **Table 5-2** provides a summary of the key fish species and likely timing of their spawning in the region (DoF correspondence).

5.1.11 Northwest Shelf Transition

Creek systems, mangroves and rivers, and ocean beaches within this region provide habitat for a variety of species including barramundi, tropical emperors, mangrove jack, trevallies, sooty grunter, threadfin and cods (Fletcher and Santoro 2013). The offshore atolls and the continental shelf waters in the Northwest Shelf Transition are also geographically important for fish species. They support species of recreational and commercial interest, including saddle-tail snapper and red emperor, cods, coral and coronation trout, sharks, trevally, tuskfish, tunas, mackerels and billfish (Gaughan et al. 2019).

The Rowley Shoals within the Northwest Shelf Transition comprise three oceanic reef systems approximately 30–40 km apart, namely Mermaid Reef, Clerke Reef and Imperieuse Reef. The Shoals are thought to provide a source of invertebrate and fish recruits for reefs further south and as such are regionally significant (DEC

2007b). See **Section 11** on State Marine Parks and Nature Reserves for further details on important geographical areas for fish.

Table 5-2: Spawning and aggregation times of key commercially caught fish species within the North West Shelf

Species		Month											
Species Common Name	**Species Latin Name**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Blacktip shark	*Carcharhinus tilstoni* and *C. limbatus*												
Goldband snapper	*Pristipomoides multidens*												
Rankin cod	*Epinephelus multinotatus*												
Red emperor	*Lutjanus sebae*												
Sandbar shark	*Carcharhinus plumbeus*												
Spanish mackerel	*Scomberomorus commerson*												
Pink snapper	*Pagrus auratus*												
Baldchin groper	*Choerodon rubescens*												
Crystal (snow) crab	*Chaceon spp.*												
King George whiting	*Sillaginodes punctate*												
Spangled emperor	*Lethrinus nebulosus*												
Pearl oyster	*Pinctada maxima*												
Blue-spotted emperor	*Charaxes cithaeron*												
Dusky whaler	*Carcharhinus obscurus*	May occur throughout the year											
Whiskery shark	*Furgaleus macki*												
Gummy shark	*Mustelus antarcticus*	Peak pupping periods unknown											
Fish	other species	Timing of spawning activity varies between species											

5.1.12 Timor Province

The diversity of demersal fish assemblages on the continental slope in the Timor Province (as well as the Northwest Transition and the Northwest Province) is high compared to elsewhere along the Australian continental slope (DSEWPaC 2012). Elements of the Timor Province are not well known, due to limited survey data in the northern limits of the region. The province is geographically extensive and includes 418 fish species, 64 of which are endemic to the region (Last *et al.* 2009). Key indicator species include *Bembrops nelsoni*, *Bythaelurus* sp., *Halicmetus* sp., *Malthopsis* spp, *Neobythites australiensis*, *Nobythites bimaculatus*, *Neobythites macrops*, *Neobythites soelae*, *Parapterygotrigla* sp., *Physiculus roseus* (Last *et al.* 2005).

Scott and Seringapatam Reefs are regionally important for the diversity of their fauna, including 558 fish species (Department of the Environment (DoE) 2014). Scott Reef has enormous habitat diversity and is considered a hot spot for fish, with five endemic species (DoE 2014). Scott Reef has biogeographic significance due to the presence of species which are at or close to the limits of their geographic ranges, including fish known previously only from Indonesian waters such as cardinalfish, azure damselfish (*Chrysoptera hemicyanea*), comb-tooth blenny (*Escnius schroederi*) and several Gobiids (DoE 2014).

The diversity of fish at Ashmore Reef is also higher than other comparable reefs in the bioregion with over 760 species recorded (Russell *et al.* 2005, Kospartov *et al.* 2006. The majority of fish species are shallow water, benthic taxa that typically inhabit depths down to 100 m and are widely distributed throughout the Indo-West Pacific (Russell *et al.* 2005). The most species rich groups are gobies (Gobiidae), damselfishes (Pomacentridae), wrasses (Labridae), cardinal fishes (Apogonidae), moray eels (Muraenidae), butterflyfishes (Chaetodontidae), and rockcods and groupers (Serranidae) (Allen 1989, Russell *et al*. 2005).

5.1.13 Timor Transition

Records show that the Timor Transition hosts at least 284 demersal fish species (DEWHA, 2008c). The Timor Transition is also known to have a number of pelagic species that are prominent in the open water environment, including some which also have pelagic larval stages in the area (DEWHA, 2008c). The North Marine Bioregional Plan Profile specifically describes pelagic species found within the trough of the Timor Transition including snaggle-teeth fish, hatchet fish and lantern fish (DEWHA, 2008c). The soft-edge/slope of the Timor Transition is also known to support whale sharks and threadfin fish species, with the canyons and channels having distance genetic stocks of red snapper (DEWHA, 2008c).

5.1.14 Northern Shelf Province

Records of the fish species in the Northern Shelf Province show that the majority of available information shows an abundance of fish species in the Gulf of Carpentaria, which is outside the combined EMBA. However, other fish species, including sharks and sawfish are known to occur within the estuarine waters and coastal waters of the Northern Shelf Province (DEWHA, 2008c).

Within the combined EMBA, the Arafura Shelf supports a number of submerged reefs that are used for breeding and aggregation of a number of fish species including mackerel, mangrove jack and snapper (DEWHA, 2008c). Sea snakes and shark species have also been observed in the reef areas (DEWHA, 2008c). Furthermore, the Canyons of the Arafura Depression key ecological feature, which is also within the combined EMBA, is specifically identified as attracting aggregations of predatory fish, whale sharks and sawfish (DEWHA, 2008c).

5.1.15 Christmas Island Province

The Christmas Island Province is in deep, offshore waters (2,200 m – 6,000 m depth range). The island's predominantly intact fringing reefs and adjacent waters support a number of marine and coastal ecosystems and species, including over 600 fish species, with most being typical of the Indian Ocean region. These waters provide habitat for pelagic finfish species including tuna (*Thunnus* sp.) and wahoo (*Acanthocybium solandri*), and some demersal species such as ruby snapper (*Etelis carbunculus)*. The island has more than 50 reef fish species that are not found anywhere else in Australia (although some species may also occur at the neighbouring Cocos Islands) (DNP, 2014).

5.1.16 Cocos (Keeling) Islands Province

The bulk of fish species are widespread or Indo-west Pacific in origin, which points to the significance of the Indonesian Throughflow current in delivering larval recruits to the island. About two thirds of fish species are shared with Christmas Island. A range of pipefish (syngnathidae) have been sighted in with eight identified at the Cocos (Keeling) Islands. This list is biased towards the shallow habitats where data has been collected by divers. There are likely to be more species occurring in these territories than recorded (e.g. in deeper water, on seamounts, slopes etc) (Brewer et al 2009).The province has an intermediate level of primary productivity due to the distance from upwelling events such as those associated with the Java coast. However, the shallower seamounts would be likely to have some significant upwelling or associated with them, which in turn will produce increased productivity and populations of pelagic fish such as bigeye (*Thunnus obesus*) and yellowfin tuna (*T. albacares*).

5.2 Fish Species

Four species of fish listed as Threatened under the EPBC Act (**Table 5-1**) were identified in the Protected Matters search (**Appendix A**):

- Balston's pygmy perch (*Nannatherina balstoni*);
- Black-stripe minnow (*Galaxiella nigrostriata*);
- Blind gudgeon (*Milyeringa veritas*); and
- Blind cave eel (Ophisternon candidum).

In addition the Barrow cave gudgeon *(Milyeringa justitia*) has been identified as relevant threatened species under the BC Act. This species is not listed under the EPBC Act.

5.2.1 Blind Gudgeon, Balston's Pygmy Perch and Blind Cave Eel

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

The Balston's pygmy perch distribution ranges from Moore River (75 km north of Perth) at the northern extent to Two Peoples Bay near Albany. This freshwater species is typically associated with shallow waters near riparian vegetation and is considered to have low salinity tolerance, making it unlikely to occur in estuarine conditions (DoEE, 2016).

5.2.2 Syngnathids

The EPBC Protected Matters search also identified 72 'listed marine species of fish which are largely from the family Syngnathidae (**Appendix A**). Syngnathids are a group of bony fishes that include seahorses, pipefishes, pipehorses and sea dragons, although taxonomic uncertainty still surrounds a number of these (DEWHA 2012a). Knowledge about the distribution, abundance and ecology of syngnathids is limited, although no species is currently listed as threatened or migratory.

5.3 Sharks, Rays and Sawfishes

The diversity of marine environments in the waters within the NWMR has led to a rich fauna of cartilaginous fish (sharks and rays). Of the approximately 500 shark species found worldwide, 19% (94) are found in the region (DEWHA 2008a). The EPBC Act Protected Matters search (**Appendix A**) identified five species of shark and three species of sawfishes listed as threatened within the search area between south west WA and northern NT (**Table 5-1**), including:

- Grey nurse shark (*Carcharias taurus*);
- Great white shark (*Carcharodon carcharias*);
- Northern river shark (*Glyphis garricki*);
- Whale shark (*Rhincodon typus*);
- Speartooth shark (Glyphis glyphis);
- Dwarf sawfish (*Pristis clavata*);
- Freshwater sawfish (*Pristis pristis*); and
- Green sawfish (*Pristis zijsron*).

In addition, the oceanic whitetip shark (*Carcharhinus longimanus*), the narrow sawfish (*Anoxypristis cuspidate*), two species of ray, the reef manta ray (*Manta alfredi*) and giant manta ray (*Manta birostris*), the porbeagle (*Lamna nasus*) and the longfin (*Isurus paucus*) and shortfin (*Isurus oxyrinchus*) mako sharks are listed as migratory within the search area (**Table 5-1).**

The Biologically Important Areas (BIAs) for relevant species detailed above are illustrated in **Figure 5-1**, **Figure 5-2** and **Figure 5-3**.

5.3.1 Grey Nurse Shark

The grey nurse shark (*Carcharias taurus*) is listed as vulnerable under the EPBC Act and the BC Act, and may be found within the combined 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 is predominantly found around the southwest coast of WA, but has been recorded on the North West Shelf (DEWHA 2012b, Pogonoski *et al*. 2002). It is believed that the east and west coast populations do not interact and ongoing research will probably confirm that the populations are genetically different (Last and 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).

No grey nurse shark BIAs were identified in the combined EMBA.

5.3.2 Great White Shark

The great white shark (*Carcharodon carcharias*) is listed as vulnerable and migratory under the EPBC Act and is listed as vulnerable under the BC Act. In Australia, great white sharks have been recorded from central Queensland around the south coast to northwest WA but may occur further north on both coasts (Last and Stevens 2009). There are no known aggregation sites for white sharks in the North-west marine region, but the species has been recorded in North West Shelf waters during humpback migrations (DEWHA 2012b). They are widely but not evenly distributed in Australian waters and are considered uncommon to rare compared to most other large sharks (CITES 2004).

Study into great white shark populations is difficult (Cailliet 1996) given the uncertainty about their movements, emigration, immigration and difficulty in estimating the rates of natural or fishing mortality.

Great white sharks can be found from close inshore around rocky reefs, surf beaches and shallow coastal bays to outer continental shelf and slope areas (Pogonoski *et al*. 2002). They also make open ocean excursions and can cross ocean basins (for instance from South Africa to the western coast of Australia and from the eastern coast of Australia to New Zealand). Great white sharks are often found in regions with high prey density, such as pinniped colonies (DEWHA 2009). The relevant great white shark BIAs in the combined EMBA are detailed in **Table 5-3** and is shown on **Figure 5-1** (DoEE 2019b).

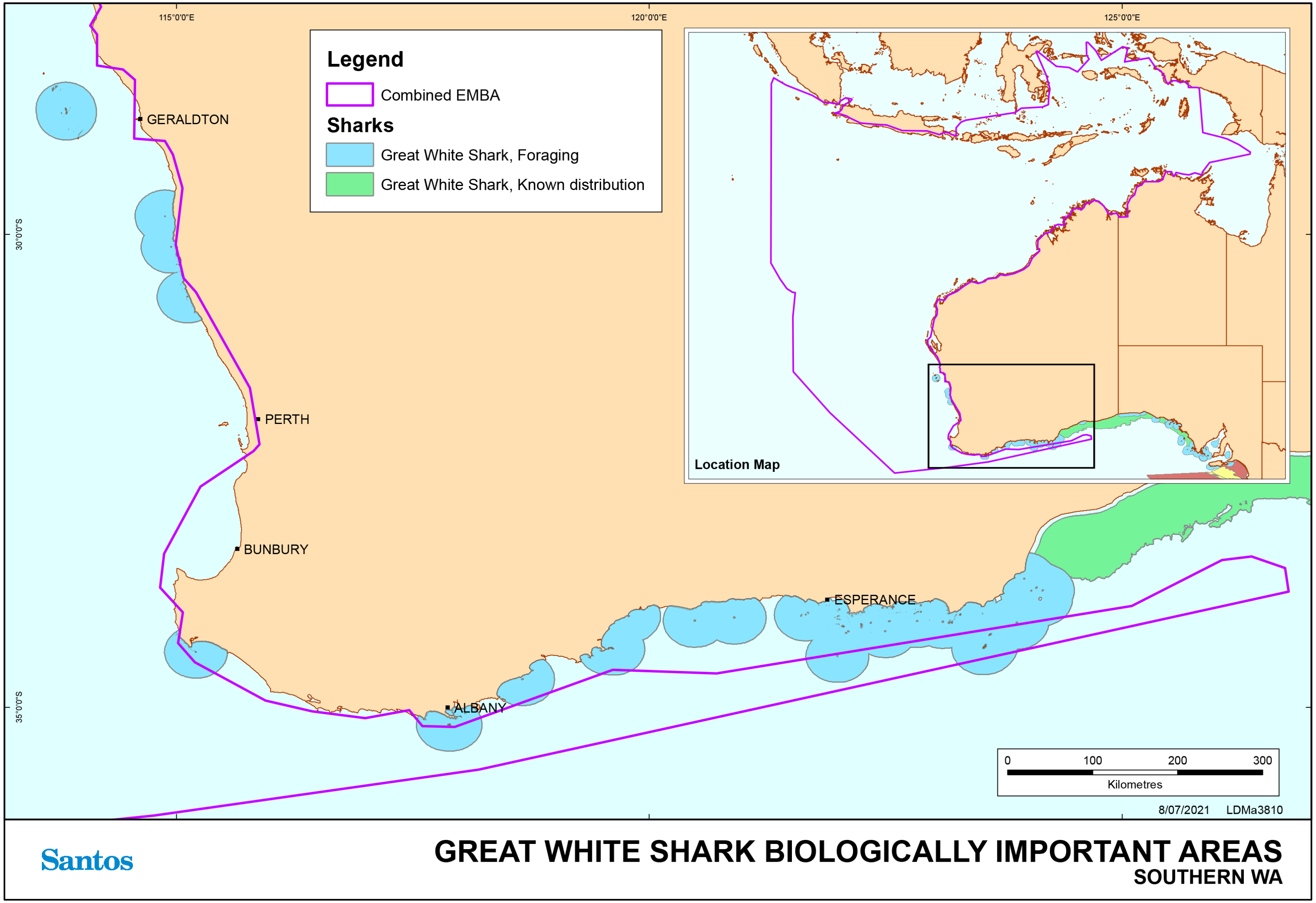

Figure 5-1: Biologically important area – great white shark

5.3.3 Northern River Shark

The northern river shark (*Glyphis garricki*) is listed as endangered under the EPBC Act and is one of the rarest species of shark in the world. Adults only recorded in marine habitats, whereas neonates, juveniles and subadults recorded in freshwater, estuarine and marine environments. It is also listed as a Priority 1 conservation species in WA and as Endangered under the NT *Territory Parks and Wildlife Conservation Act 1976*.

The associated recovery plan (Sawfish and River Sharks Multispecies Recovery Plan, Commonwealth of Australia 2015) identifies adults and juveniles are being known in WA marine waters north of Derby. Pupping and juvenile sharks are identified as known to occur in Cambridge Gulf and pupping is also identified as likely to occur in King Sound. 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.

5.3.4 Whale Shark

The whale shark (*Rhincodon typus*) is listed as vulnerable and migratory under the EPBC Act and is also listed as a specially protected species under the BC Act as a species of special conservation interest (conservation dependent fauna). The species is also classified as vulnerable on the World Conservation Union's Red List of Threatened Species (Norman 2005) and are protected under the WA *Conservation and Land Management Act 1984, NT Territory Parks and Wildlife Conservation Act 1976* and WA *Fish Resources Management Act 1994*.

The whale shark is the largest of all fish (>18 m; Borrell *et al*. 2011; Chen *et al*. 1997, Compagno 2001) and is a migratory species with worldwide geographical ranges between 30º N and 35º S (Last and Stevens 2009). There is a general lack of knowledge on many aspects of whale shark biology, including definitive migration patterns. The species is oceanic but often forms aggregations in coastal waters at sites throughout the tropics. Typically, these aggregations are seasonal and often coincide with specific productivity events that are a focus of feeding for the animals. For example, whale sharks aggregate to feed on dense swarms of copepods in Baja California (Clark and Nelson 1997), fish spawn off Belize (Heyman *et al*. 2001) and red crab larvae at Christmas Island (Meekan *et al*. 2009).

One of the best known aggregation sites for whale sharks occurs along the central and NW coast of Western Australia from March to July and is focused at Ningaloo Reef, within the Exmouth region. The small size and general absence of female whale sharks from Ningaloo Reef suggests that the region may be important for feeding rather than breeding (Norman and Stevens 2007). The timing of this aggregation coincides with a pulse in seasonal productivity that results in large abundances of tropical krill on which these filter feeding sharks feed (Meekan *et al*. 2006, Jarman and Wilson 2004). At Ningaloo Reef, whale sharks are often found swimming close to the reef front, within a few kilometres of the shore and in water of less than 50 m deep. A tourist industry based on snorkelling with the sharks in this area has developed over the last 15 years and is now estimated to be worth over $4 million annually to the local economy of the Ningaloo region.

Estimates of the size of the population participating in the Ningaloo aggregation are between 300 and 500 individuals (Meekan *et al*. 2006), but research indicates that the Ningaloo population of whale sharks is declining (Bradshaw *et al*. 2007).

Whale sharks are known to be highly migratory with migrations of 13,000 km being recorded (Eckert and Stewart 2001). Research on the migration patterns of whale sharks in the western Indian Ocean, and isolated and infrequent observations of individuals, indicate that a small number of the Western Australian population migrate through the North West Shelf. Wilson *et al*. (2006) tagged 19 whale sharks in 2003 and 2004, with long term movements patterns successfully recorded from six individuals. All travelled northeast into the Indian Ocean after departing Ningaloo Reef, with one tracked to Ashmore Reef and another to Scott Reef. Whale sharks are occasionally observed from Santos'' offshore oil and gas facilities on the North West Shelf (Harriet Alpha and Stag platforms). In general, migration along the northern WA coastline broadly follows the 200 m isobath and typically occurs between July and November (DoE 2015). Whale sharks are well known to occur in the Christmas Island territory. There is evidence that the Christmas Island territory is on the migration route for many individuals, but they are rarely sighted within the Cocos (Keeling) Islands territory.

A biologically important area for whale sharks is located in northern WA, offshore of the Pilbara and Kimberley coastline, and broadly follows the 200 m isobath. The relevant whale shark BIAs in the combined EMBA are detailed in **Table 5-3** and is shown on **Figure 5-2**.

DBCA has a wildlife management program to manage whale shark interactions in reserves - *Whale shark management with particular reference to Ningaloo Marine Park, Wildlife Management Program no. 57 (2013).*

5.3.5 Speartooth Shark

The speartooth shark (*Glyphis glyphis)* is a medium sized shark found in tidal rivers and estuaries within the Northern Territory and Queensland (DAWE, n.d). It is listed as critically endangered under the EPBC Act and Vulnerable under the NT *Territory Parks and Wildlife Conservation Act 1976.*

There are three distinct geographical locations where the speartooth shark is known to occur with only one of these areas within the combined EMBA, the Van Diemen Gulf.

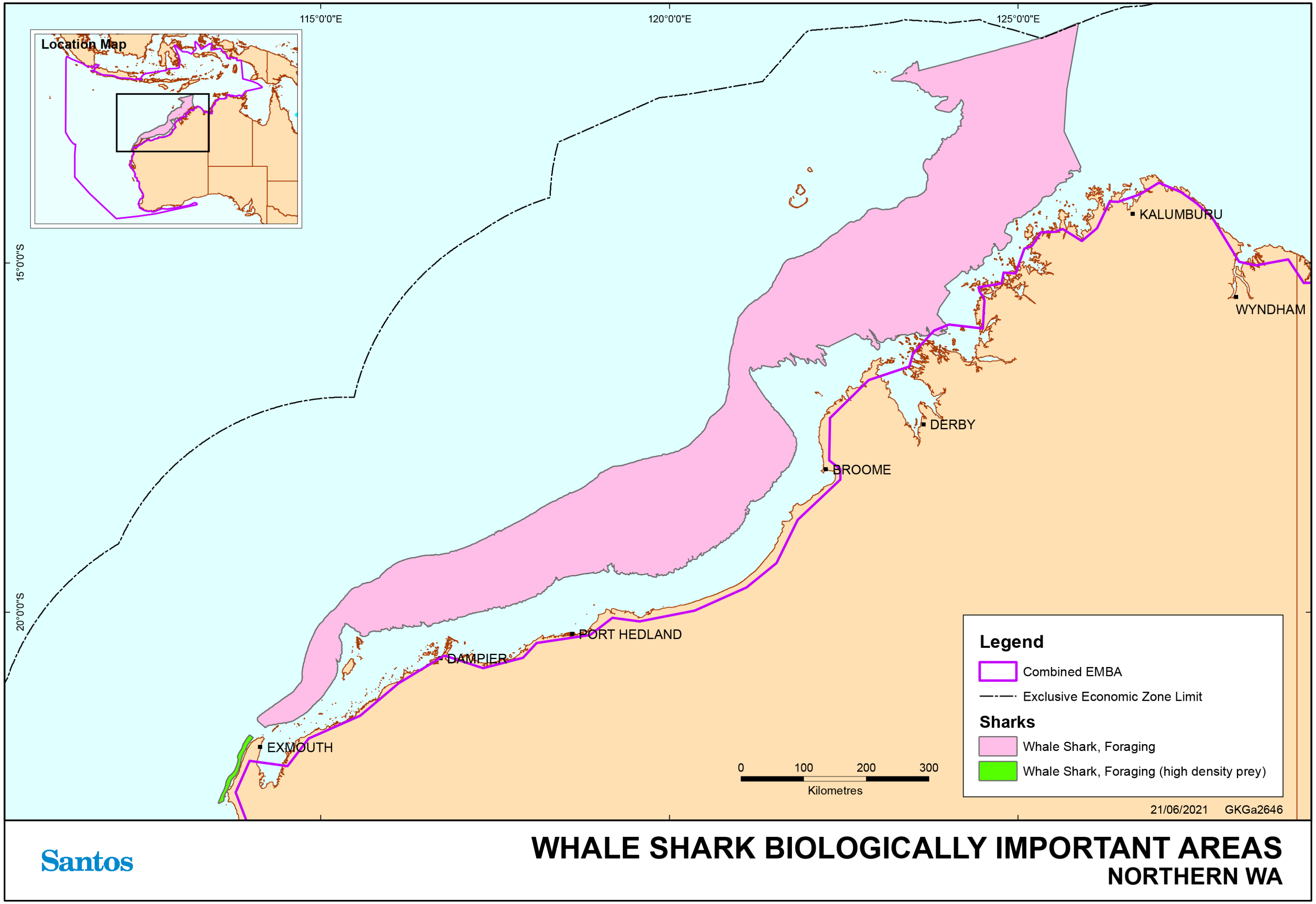

Figure 5-2: Biologically important area – whale shark

5.3.6 Dwarf Sawfish

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 and as Vulnerable in the NT. 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 and the NT 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 Plan (Commonwealth of Australia, 2015). 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.

The relevant sawfish BIAs in the combined EMBA are detailed in **Table 5-3** and are shown on **Figure 5-3**.

5.3.7 Freshwater and Green Sawfish

The freshwater sawfish (*Pristis pristis) (*also previously listed as the Largetooth sawfish*)* and green sawfish (*Pristis zijsron)* are listed as vulnerable under the EPBC Act. The freshwater sawfish is listed as a Priority 3 conservation species in WA, while the green sawfish is listed as Vulnerable under the BC Act and both species are listed as Vulnerable in the NT under the *Territory Parks and Wildlife Conservation Act 1976.*

The freshwater species are wider-ranging than the dwarf sawfish and are also found in the Indo-west Pacific (DoE 2014c, DoE 2014d). Important areas for sawfishes include King Sound, and the Fitzroy, Durack, Robinson and Ord rivers for the freshwater sawfish; and Cape Keraudren for the green sawfish (Stevens *et al*. 2008, Thorburn *et al*. 2007, 2008).

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

The green sawfish has predominantly been recorded in inshore coastal areas, including estuaries and river mouths with a soft substrate, although there have been records of sawfish offshore in depths up to 70 m (Stevens *et al*. 2005). This species does not occupy freshwater habitats (DoE 2014d).

Short-term tracking has shown that green sawfish appear to have limited movements that are tidally influenced, and they are likely to occupy a restricted range of only a few square kilometres within the coastal fringe, with a strong association with mangroves and adjacent mudflats (Stevens et al. 2008). Sawfishes feed close to the benthos on a variety of teleost fishes and benthic invertebrates, including cephalopods, crustaceans and molluscs (Compagno & Last 1999, Last & Stevens 2009, Pogonoski *et al*. 2002, Thorburn *et al*. 2007, 2008).

Baseline surveys undertaken for Chevron's Wheatstone project identified green sawfish habitat and nursery area for juveniles within the north-eastern lagoon of the Ashburton Delta and in Hooley Creek near Onslow. Distribution of sawfish in these creeks is spatially and seasonally variable due to changing tidal and environmental conditions. However, they typically return to inshore waters to breed and pup during the wet season (i.e. January) (Chevron 2011).

The relevant sawfish BIAs in the combined EMBA are detailed in **Table 5-3** and are shown on **Figure 5-3**.

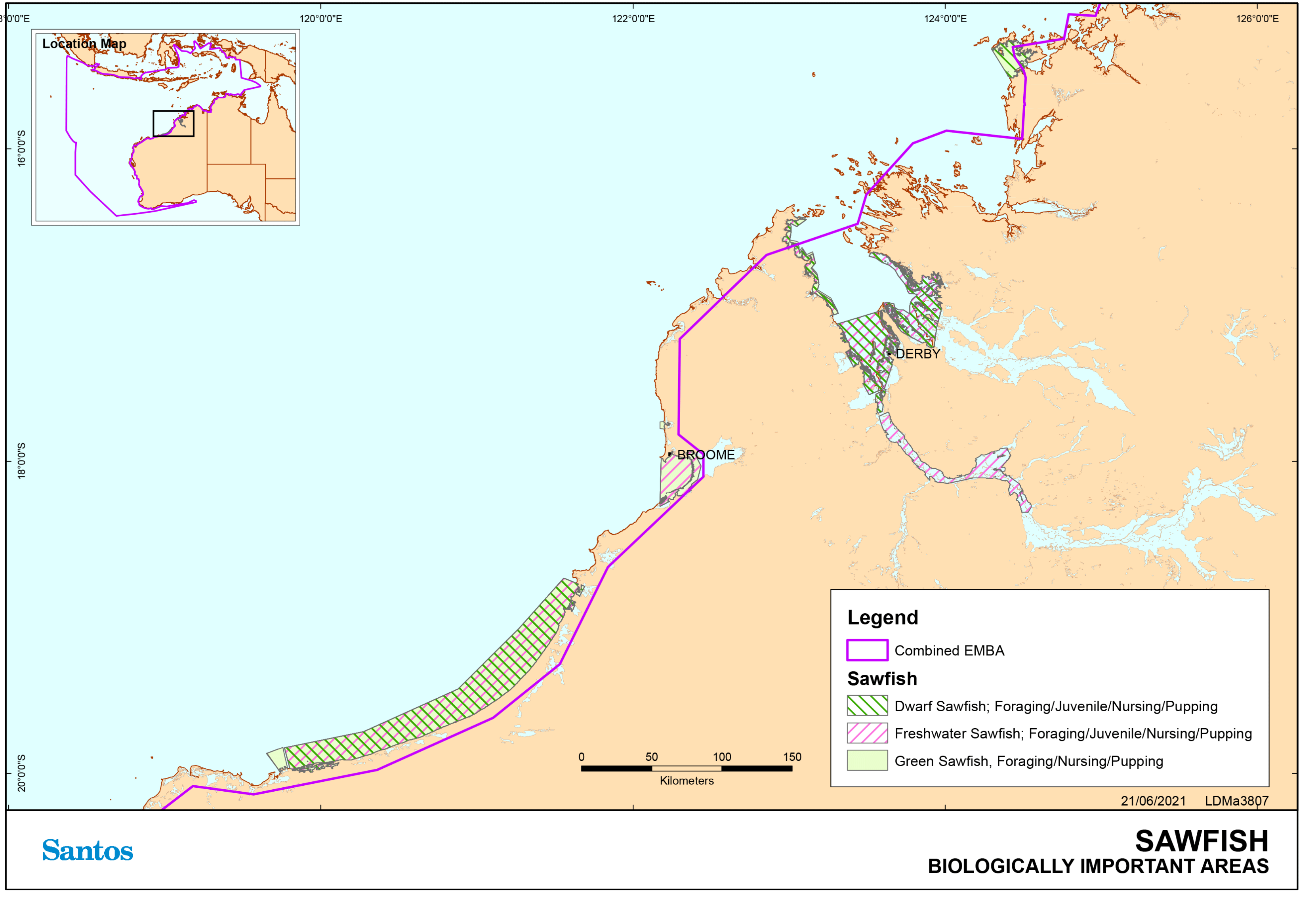

Figure 5-3: Biologically important areas – sawfish

5.3.8 Narrow Sawfish

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

5.3.9 Giant Manta Ray / Reef Manta Ray

The giant manta ray appears to be a seasonal visitor to coastal or offshore sites. Giant manta rays are often seen aggregating in large numbers to feed, mate, or clean. Sightings of these giant rays are often seasonal or sporadic but in a few locations their presence is a more common occurrence. This species is not regularly encountered in large numbers and, unlike some other rays do not often appear in large schools (>30 individuals) when feeding. Overall, they are encountered with far less frequency than the smaller manta species, despite having a larger distribution across the globe (IUCN 2019).

The giant manta ray (*Mobula birostris*) occurs in tropical, sub-tropical and temperate waters of the Atlantic, Pacific and Indian Oceans. They are commonly sighted along productive coastlines with regular upwelling, oceanic island groups and particularly offshore pinnacles and seamounts. 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 (IUCN 2019).

The reef manta ray (*Mobula birostris*) has a circumtropical and sub-tropical distribution, existing in the Pacific, Atlantic and Indian Oceans. Within this broad range, however, actual populations appear to be sparsely distributed and highly fragmented. This is likely due to the specific resource and habitat needs of this species.

Overall population size is unknown, but subpopulations appear, in most cases, to be small (about 100–2,000 individuals). A proportion of the individuals in some populations undertake significant coastal migrations (IUCN 2019). Since the species is migratory it is possible that individuals may be encountered in the operational area, however, given that they generally do not aggregate in large groups, high numbers are not expected to be encountered during the activities.

5.3.10 Oceanic Whitetip Shark

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

5.3.11 Shortfin Mako and Longfin Mako Sharks

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

5.3.12 Porbeagle (Mackerel Shark)

The porbeagle (mackerel shark) (*Lamna nasus*) is listed as migratory under the EPBC Act. The porbeagle is wide-ranging, typically occurring in oceanic waters off the continental shelf, although they occasionally enter coastal waters (Francis *et al*. 2002 cited in DoE 2014e). The porbeagle is known to undertake seasonal migrations, although the timing and details of these migratory movements are not well understood (Saunders *et al.* 2011 cited in DoE 2014e).

5.4 Biologically Important Areas / Critical Habitat – Fish

BIAs 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**.** BIAs are identified by DAWE, however, they have no legal status, but are designed to assist decision making under the EPBC Act. They are not designed to identify protected areas, but may inform such processes. **Table 5-3** below provides an overview of BIAs in the combined EMBA for fish.

The DAWE may make recovery plans for threatened fauna listed under the EPBC Act. The EPBC Act requires that 'habitat critical to the survival of the listed threatened species' is identified in recovery plans, and summary of relevant recovery plans is listed in **Section 13.2**. BIAs may overlap these sites, but may be identified for other purposes. DAWE state that the criteria used to identify 'habitat critical to the survival of the species' are more complex than those used to identify BIA. Specifically, the Sawfish and River Sharks Multispecies Recovery Plan (DoEE 2015) cites that *"all areas where aggregations of individuals have been recorded displaying biologically important behaviour such as breeding, foraging, resting or migrating, are considered critical to the survival of the species unless population survey data suggests otherwise"*.

In addition, both the EPBC Act and WA BC Act and associated regulations (2018) provide for the listing of critical habitat - habitat 'critical to the survival of the threatened species'. To date no critical habitat in WA has been listed under either Act. No provision is made under the Territory Parks and Wildlife Conservation Act 1976 for listing critical habitat.

Table 5-3: Biologically important areas – fish

Species	Scientific name	Aggregation area and use	Specific geographic locations for species
Great white shark	*Carcharodon carcharias*	Foraging – associated with pinniped colonies in the mid-west and south west and waters off Bremer Bay	Waters off pinniped colonies throughout the South-west Marine Region Waters off Bremer Bay
Whale shark	*Rhincodon typus*	Foraging (high density prey) – Ningaloo Reef Foraging – Wider Ningaloo Region	Ningaloo Marine Park and adjacent Commonwealth waters Northward from Ningaloo along 200 m isobath
Dwarf sawfish	*Pristis clavata*	Foraging – Eighty Mile Beach, King Sound, Camden Sound Nursing - Eighty Mile Beach, King Sound, Fitzroy River and May Robinson River Pupping – Eighty Mile Beach, King Sound, Fitzroy River and May Robinson River	Eighty Mile Beach Camden Sound - eastern shore Fitzroy River Mouth, May and Robinson River - tidal tributaries King Sound (inshore waters)

Species	Scientific name	Aggregation area and use	Specific geographic locations for species
		Juvenile – King Sound, Fitzroy River and May Robinson River	
Freshwater sawfish	*Pristis pristis*	Nursing – King Sound Foraging – King Sound, Roebuck Bay, Eighty Mile Beach Pupping – Roebuck Bay, Eighty Mile Beach Juvenile – Roebuck Bay	Eighty Mile Beach King Sound - tidal tributaries Roebuck Bay
Green sawfish	*Pristis zijsron*	Pupping – Cape Keraudren, Eighty Mile Beach, Roebuck Bay, Willie Creek, Cape Leveque Foraging - Cape Keraudren, Roebuck Bay, Cape Leveque, Camden Sound Nursing - Cape Keraudren, Eighty Mile Beach, Ashburton River and Hooley Creek near Onslow	Eighty Mile Beach Camden Sound Cape Keraudren Cape Leveque Roebuck Bay Willie Creek Ashburton River Hooley Creek

6. Marine Reptiles

Thirty-four species of listed marine reptiles under the Commonwealth EPBC Act are known to occur in Australian waters in the combined EMBA, according to the Protected Matters search (**Appendix A**). An examination of the species profile and threats database (DoEE 2019) showed that some listed reptile species are not expected to occur in significant numbers in the marine and coastal environments in the combined EMBA due to their terrestrial distributions. Hence, these species are not discussed further.

Of the remaining reptile species identified in the Protected Matters search (**Appendix A**), eight are listed as threatened and seven are listed as migratory. These species are show in **Table 6-1** along with their WA and NT conservation listings (as applicable)[3]. BIAs within the combined EMBA area discussed in **Table 6-3**.

Table 6-1: EPBC listed marine reptile species in the combined EMBA

Species	Conservation Status				Likelihood of occurrence in EMBA	BIA in EMBA
	EPBC Act 1999	BC Act 2016	Other WA Conservation Code	*TPWC Act 1976*		
Green turtle (*Chelonia mydas*)	Vulnerable Migratory	Vulnerable	-	-	Breeding known to occur within area	Yes – refer to **Table 6-3**
Flatback turtle (*Natator depressus*)	Vulnerable Migratory	Vulnerable	-	-	Breeding known to occur within area	Yes – refer to **Table 6-3**
Hawksbill turtle (*Eretmochelys imbricata*)	Vulnerable Migratory	Vulnerable	-	Vulnerable	Breeding known to occur within area	Yes – refer to **Table 6-3**
Loggerhead turtle (*Caretta caretta*)	Endangered Migratory	Endangered	-	Vulnerable	Breeding known to occur within area	Yes – refer to **Table 6-3**
Olive ridley turtle (*Lepidochelys olivacea*)	Endangered Migratory	Endangered	-	-	Breeding known to occur within area	Yes – refer to **Table 6-3**
Leatherback turtle (*Dermochelys coriacea*)	Endangered Migratory	Vulnerable	-	Critically Endangered	Foraging feeding or related behaviour known to occur within area	Yes – refer to **Table 6-3**
Short-nosed seasnake (*Aipysurus apraefrontalis*)	Critically Endangered	Critically Endangered	-	-	Species or species habitat known to	None - No BIA defined

[3] An overview of WA fauna conservation codes is provided in **Section 5** (fish and sharks).

Species	Conservation Status				Likelihood of occurrence in EMBA	BIA in EMBA
	EPBC Act 1999	BC Act 2016	Other WA Conservation Code	*TPWC Act 1976*		
					occur within area	
Leaf-scaled seasnake (*Aipysurus foliosquama*)	Critically Endangered	Critically Endangered	-	-	Species or species habitat known to occur within area	None - No BIA defined
Salt-water crocodile *(Crocodylus porosus)*	Migratory	Specially protected species (other specially protected fauna)	-	-	Species or species habitat likely to occur within area	None - No BIA defined

6.1 Marine Turtles

Six species of marine turtle occur in, use the waters, and nest on sandy beaches, in and around the combined EMBA. These are the green turtle (*Chelonia mydas*), flatback turtle (*Natator depressus*), hawksbill turtle (*Eretmochelys imbricata*), loggerhead turtle (*Caretta caretta*), olive ridley turtle (*Lepidochelys olivacea)* and leatherback turtle (*Dermochelys coriacea*) (**Table 6-1**).

These six species are listed on the EPBC Act List of Threatened Species as either ‘endangered’ or ‘vulnerable’ and all six species are also listed as ‘migratory’. They are also listed as threatened species under the BC Act and the hawksbill turtle, loggerhead turtle and leatherback turtle are also protected under the NT *Territory Parks and Wildlife Conservation Act 1976.*

A summary of the different habitat types used during the various life stages of marine turtle species identified in the combined EMBA is given in **Table 6-2.**

Table 6-2: Summary of habitat types for the life stages of the six marine turtle species in the combined EMBA (DSEWPaC, 2012b)

Life Stage		Green turtle	Flatback turtle	Hawksbill turtle	Loggerhead turtle	Olive ridley turtle	Leatherback turtle
Post-hatchling		Open ocean pelagic habitats (poorly studied for Australian populations)	Coastal waters (poorly studied for Australian populations)	Open ocean pelagic habitats (poorly studied for Australian populations)	Pelagic (poorly studied for Australian populations)	Pelagic (poorly studied for Australian populations)	Pelagic (no data for Australian populations)
Adult	Mating	Offshore from nesting beaches.	Currently unknown for North West Shelf region.	Offshore from nesting beaches.	Little is known for North West Shelf region but expected to occur either en-route or adjacent to nesting beaches.	Not recorded within North West Shelf region.	Not recorded within North West Shelf region.
	Nesting	Typically, high energy, steeply sloped beaches with deep sand and deep water approach.	Typically, low-energy beaches that are narrow with a low to moderate slope. Beach approach obstructed by broad intertidal mud or limestone platforms.	Typically beaches close to nearshore coral reefs and sediment comprised of coarse sand and coral rubble.	Poorly studied for North West Shelf region by generally prefer high energy, relatively narrow, steeply sloped, coarse-grained beaches.	Not recorded within North West Shelf region.	Not recorded within North West Shelf region.
	Internesting	Shallow coastal waters within several kms of nesting beach. Inter-nesting buffers of 20 km identified around all nesting habitats.	Shallow nearshore waters within 5-60 km of nesting beach. Inter-nesting buffers of 40-60 km identified around all nesting habitats.	Shallow coastal waters within several kilometres of nesting beach. Inter-nesting buffers of 20 km identified around all nesting habitats.	Shallow coastal waters within several kilometres of nesting beach. Inter-nesting buffers of 20 km identified around all nesting habitats.	Not recorded within North West Shelf region. Inter-nesting buffers of 20 km identified around all nesting habitats.	Not recorded within North West Shelf region.
	Foraging	Neritic habitats associated with seagrass and algae, and mangrove habitats.	Turbid, shallow inshore waters, subtidal, soft-bottomed habitats of the continental shelf.	Subtidal and intertidal coral and rocky reef habitats of the continental shelf.	Subtidal and intertidal coral and rocky reefs, seagrass and deeper soft-bottomed habitats of the continental shelf.	Many feed within continental shelf waters, however it is not known if others are pelagic, as with the east Pacific population.	Mostly pelagic but will forage close to shore and over continental shelf in temperate waters.

6.1.1 Loggerhead Turtle

The loggerhead turtle (*Caretta caretta*) has a worldwide distribution, living and breeding in subtropical to tropical locations (Limpus 2008b). Breeding aggregations in Australia occur on both the east coast (Queensland and NSW) and the west. The annual nesting population in Western Australia is thought to be 3,000 females annually (Baldwin *et al*. 2003), and this is considered to support the third largest population in the world (Limpus 2008b). Loggerhead turtles have one genetic breeding stock within Western Australia (Commonwealth of Australia 2017a).

The WA distribution of sandy beach nesting areas extends from Shark Bay to the southern area of the North West Shelf, with occasional late summer nesting crawls recorded as far north as Barrow and Varanus Islands and the Lowendal and Rosemary Islands (DSEWPaC 2012d). Major nesting locations include the Muiron Islands, the Ningaloo Coast south to Carnarvon and the islands around Shark Bay, which includes Dirk Hartog Island, one of the principal nesting and internesting sites in WA (Limpus 2008). The Recovery Plan for Marine Turtles in Australia (2017) identifies the Muiron Islands (as a principal rookery), and all waters within a 20 km radius as habitat critical to the survival of loggerhead turtles (Commonwealth of Australia 2017a).

Estimates of up to 5,000 female loggerhead turtles have been predicted within the Ningaloo Marine Park and Muiron Islands Marine Management Area (Waayers 2010). Earlier surveys found higher proportions of nesting loggerheads in the southern areas of the reserves (CALM 2005a). Aerial surveys conducted in 2000 and 2001 in the Exmouth region recorded only 12 sightings in Commonwealth waters and these turtles were most likely loggerheads (BHP 2005). In a survey commissioned by Santos around the islands in the Exmouth Region, loggerhead turtles were recorded nesting on Flat Island north of the Exmouth Gulf which was the first time they had been recorded in that location (Astron 2014). Loggerhead nesting and breeding occurs from November to March, with a peak in late December/early January (Limpus 2008b).

Foraging areas are widespread for loggerhead turtle populations and migrations from nesting to feeding grounds can stretch thousands of kilometres, including feeding grounds as far north as the Java Sea of Indonesia for the WA population (Limpus 2008b). Loggerhead turtles have also been sighted in the Christmas and Cocos (Keeling) Islands. Shark Bay has been identified as an important foraging habitat for loggerhead turtles (Commonwealth of Australia 2017a). Loggerhead turtles are carnivorous and feed primarily on benthic invertebrates from depths of up to approximately 50 m to near shore tidal areas including areas of rocky and coral reef, muddy bays, sand flats, estuaries and seagrass meadows (Limpus 2008b).

Figure 6-1 illustrates the BIAs and habitat critical (draft) for loggerhead turtles (as defined in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017a).

Santos

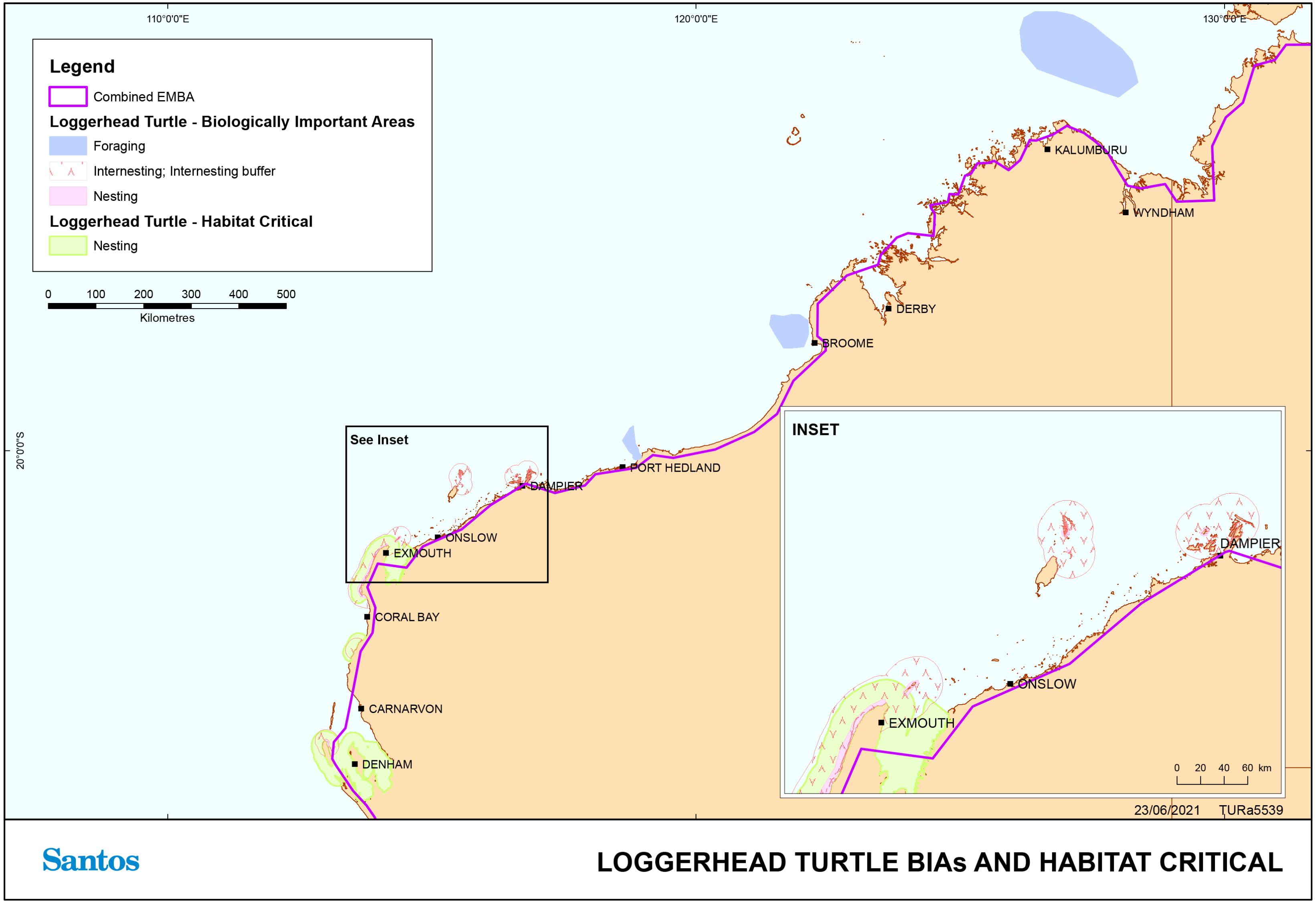

Figure 6-1: Biologically Important Areas and Habitat Critical – Loggerhead Turtle

6.1.2 Green Turtle

Australian population of green turtles is estimated to be approximately 70,000 and is divided into seven genetically distinct breeding aggregations. The species is widespread and abundant in WA and NT waters with an estimated 20,000 individuals occurring, arguably the largest population in the Indian Ocean (Limpus 2008a). There are three distinct breeding stocks in WA waters which include: the North west Shelf stock, the Scott-Browse stock and the Ashmore Stock (Commonwealth of Australia 2017a).

The North west Shelf population is one of the largest in the world and the most significant rookery is the western side of Barrow Island (Prince 1994, Limpus 2008a). Other principal rookeries include the Lacepede Islands, Montebello Islands, Dampier Archipelago, Browse Island and North West Cape (Prince 1994, Limpus 2008a, DSEWPaC 2012b). See **Table 6-3** for a complete list.

Surveys by Waayers (2010) within the Ningaloo Marine Park and Muiron Islands Marine Management Area estimated up to 7,500 female green turtles used these areas. In 2014, Santos commissioned a survey of the islands in the Exmouth Region which found that North and South Muiron Islands were significant nesting sites for green turtles with over 100 green turtles nesting overnight on one beach at North Muiron Island (Astron 2014). The green turtle is also known to breed in large numbers in the dunes above the extensive beaches found on Serrurier Island, with counts indicating the island supports the second largest rookery in the Pilbara (Oliver 1990).

Lower density green turtle nesting has also been recorded on Jurabi coast, Thevenard Island, Lowendal Islands and in Exmouth Gulf (Limpus 2008a). Only low numbers of green turtles have been observed nesting on Varanus Island, as well as Airlie Island (Pendoley Environmental 2011). From monitoring undertaken in 2016/17 by Santos on Varanus Island; three green turtles were observed to nest over a four week tagging effort (Astron 2017).

Green turtles have also been recorded nesting in the Bonaparte or Van Diemen Gulf bioregions and some nesting has been recorded on the west coast of Bathurst Island in the Tiwi Islands and Melville Island. BIAs for Green turtles occur on the north coast of the Tiwi Islands and an internesting buffer has been defined 20 km from the Tiwi Islands with internesting expected between October and April (DoEE, 2017).

Green turtle nesting abundance and timing fluctuates significantly from year to year depending on environmental variables, locality and food availability (Pendoley Environmental 2011). Nesting of green turtles has been recorded from August to March on Serrurier Island (Woodside 2002), from December to March along coast adjacent to Ningaloo (CALM 2005a) and from October to February on Varanus Island (Pendoley Environmental 2011). On Barrow Island, mating aggregations may commence from October with peak nesting from December to January, with hatchlings emerging through summer and early autumn. However, nesting on Barrow Island has been recorded all year round (Chevron 2005 and 2008, Pendoley 2005). Nesting on the Scott Reef-Sandy Islet and Browse Island has been observed all year round with peaks between December and January (Commonwealth of Australia 2017a).

In northern and eastern Australia, fluctuations in green nesting numbers have been linked the Southern Oscillation Index (Limpus & Nicholls, 1994, Limpus & Nicholls, 1988) and sea surface temperatures (Solow et al., 2002). In the NT nesting sites occur mostly from the western end of Melville Island to near the border with Queensland (Northern Territory Government, n.d). There are also four nationally significant nesting sites in the NT being the Cobourg Peninsula, the mainland from Gove to the northern edge of Blue Mud Bay, the southeast of Groote Eylandt and the northern beaches of islands in the Sir Edward Pellew group (Northern Territory Government, n.d). The Cobourg Peninsula genetic stock of Green turtles is the closest to those found within the combined EMBA on the Tiwi Islands. The nesting period for these are between October and April with the peak nesting period occurring between December and January.

Green turtles nest on both Christmas and Cocos (Keeling) Islands, though in low densities on Christmas Island. Up to 100 green turtles nest per year on Cocos (Keeling) Islands, mainly on the north atoll. Green turtles nesting on both Christmas and Cocos (Keeling) Islands are likely to be unique genetic stocks. They also use shallow reef habitats on both islands to forage (Brewer et al, 2009).

The re-nesting period for female green turtles is approximately five years (Hamann *et al*. 2002).

Green turtles spend the first five to ten years of their life drifting on ocean currents, before moving to reside in shallower benthic habitats, including tropical coral and rocky reefs and seagrass beds. Green turtles have been known to migrate more than 2,600 km between feeding and breeding grounds (Limpus 2008a).

Green turtles are omnivores, mainly feeding in shallow benthic habitats on seagrass and/ or algae, but are also known to feed on sponges, jellyfish and mangroves (Limpus 2008a). Green turtles are unlikely to forage or dwell within deeper offshore waters due to the water depths; however, they may occasionally migrate through it.

Figure 6-2 illustrates the BIAs and habitat critical (draft) for green turtles (as defined in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017a).

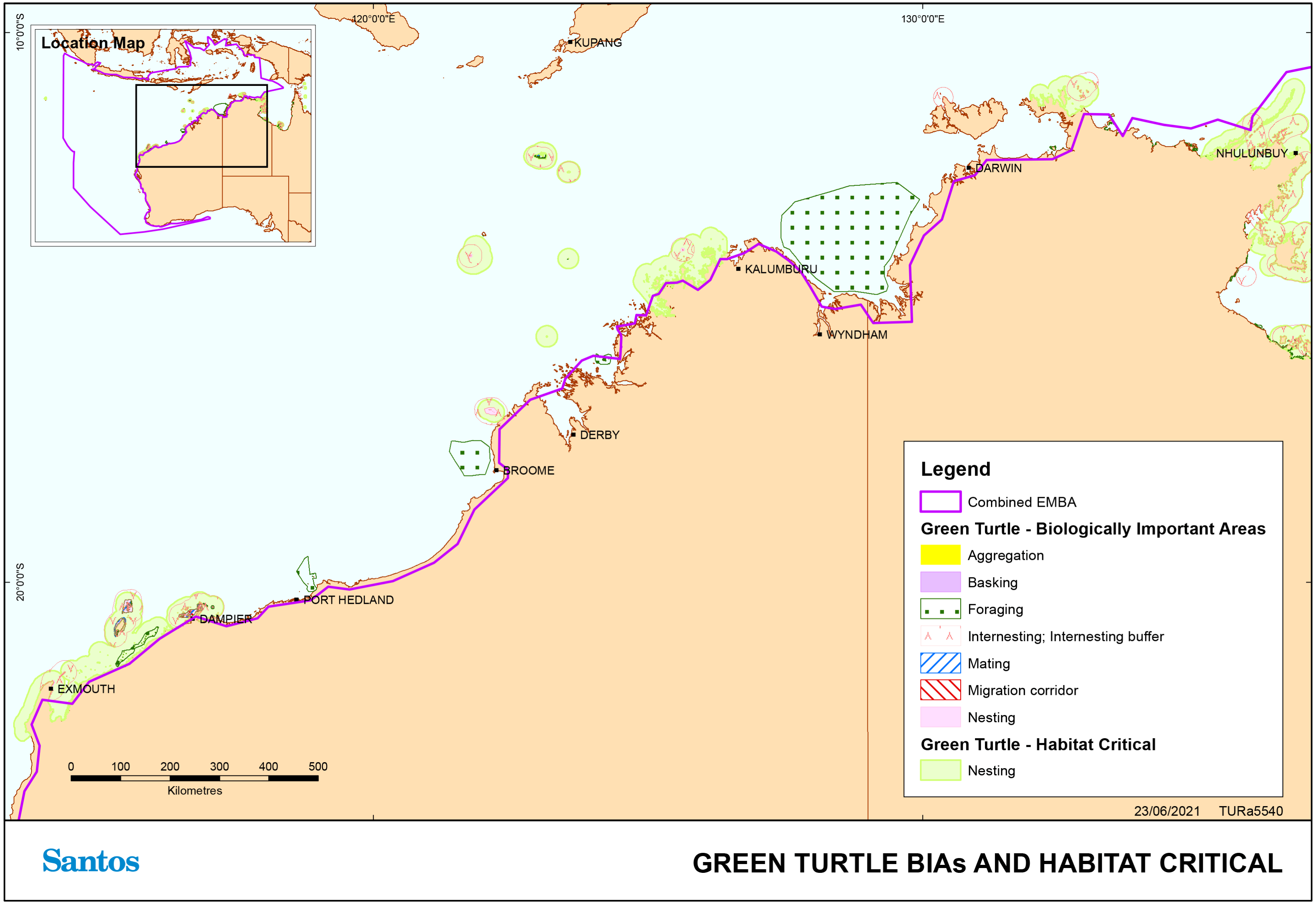

Figure 6-2: Biologically Important Areas and Habitat Critical – Green Turtle

6.1.3 Hawksbill Turtle

Hawksbill turtles (*Eretmochelys imbricata*) have a global distribution throughout tropical and sub-tropical marine waters. The Western Australian stock is concentrated on the North West Shelf (Dampier Archipelago) (Limpus 2009a),and is considered to be one of the largest hawksbill populations remaining in the world. The estimated number of nesting hawksbill turtles in WA waters is between 2,000 and 4,500 individuals (Morris 2004). There is a second major population of Hawksbill turtles in Australia, which is genetically isolated from the North West Shelf population located along the Northern Territory coast and north-eastern Queensland (Northern Territory Government, n.d).

In WA, their nesting range is relatively small and extends from the Muiron Islands to the Dampier Archipelago, a distance of approximately 400 km. The most significant breeding areas, that support hundreds of nesting females annually, are around sandy beaches within the Dampier Archipelago, Montebello Islands, Lowendal Islands and Barrow Island (Pendoley 2005, Limpus, 2009a).

The largest known nesting area for the North West Shelf population is the sandy shoreline of Rosemary Island, within the Dampier Archipelago, particularly on the north-western side of the Island. It is believed that the Rosemary Island rookery may support up to 1,000 nesting females annually (Limpus 2009). Low density nesting is also known from Barrow Island, Airlie Island, Muiron Islands and North West Cape/ Ningaloo coast (Cape Range) (Limpus 2009a). Nesting hawksbills have also been found on NE Regnard Island and SW Regnard Island, confirming the Regnard Islands as hawksbill rookeries (Pendoley Environmental 2009).

The hawksbill turtle nesting population within the Exmouth region is also considered important as the populations in Western Australia represent the largest remaining population in the Indian Ocean (CALM 2005). The best estimate of numbers within the Ningaloo Marine Park and Muiron Islands Marine Management Area is between 20–700 individuals (Waayers 2010).

A snapshot survey of Varanus Island and the Lowendal Islands conducted for Santos during October 2012 found the five most frequented beaches by hawksbills, based on the track counts, were Beacon Island (*n*=43), Parakeelya (*n*=41), Kaia (*n*=40), Rose (*n*=30) and Pipeline (*n*=28). Results of the October 2012 three-day track census program showed that Beacon Island also hosted the highest daily number of overnight emergences by hawksbills and is therefore an important nesting beach for hawksbill turtles (Pendoley Environmental 2013).

On Varanus Island, hawksbill turtle nesting activity is predominantly distributed on the island's east coast, including Pipeline, Harriet, and Andersons beaches (Pendoley Environmental 2019). Individual hawksbill turtles appear to show a strong fidelity to these beaches, often returning to the same beach to nest within the season (Pendoley Environmental 2019). Between 1986 and 2019, a total of 571 individual hawksbill turtles were tagged on Varanus Island. Recent baseline data was collected at the Montebello and Dampier AMPs by Keesing, 2019 showing that only one hawksbill turtle was identified during the survey at the Dampier AMP only. No marine turtle species were identified during the survey at Montebello AMP.

In the NT, nesting occurs on islands rather than on mainland beaches. In particular, NT nesting sites are concentrated around north-eastern Arnhem land and Groote Eylandt (Northern Territory Government, n.d). Within the combined EMBA, nesting is known to occur at Ashmore Reef. Although Scott Reef has been described as a nesting beach for hawksbill turtles, this is based on the tagging and recapture of a single hawksbill at this location (Guinea, 2009). Small numbers of Hawksbill turtles also nest on Cocos (Keeling) Islands (mainly the north island). However, thousands of individuals forage in the shallow reef environments feeding on encrusting algae and sessile invertebrates (Brewer et al , 2009).

Nesting is reported to occur between October and February in WA (Commonwealth of Australia 2017a). Hawksbill turtles have been observed breeding on the North West Shelf between July and March with peak nesting activity around the Lowendal Islands between October and December (Limpus 2009a). In the NT nesting is reported to occur from July – December (Chatto, 1997, 1998).

Female hawksbills skip annual breeding opportunities (Kendall & Bjorkland 2001), presumably due to high energy demands of breeding (Chaloupka & Prince 2012).

Individuals may migrate up to 2,400 km between their nesting and foraging grounds (DSWEPaC 2012a). Satellite tracking of nesting turtles on Varanus Island (32 km) and Rosemary Island has shown adult turtles to feed between 50 and 450 km from their nesting beaches (DSWEPaC 2012a).

Adults tend to forage in tropical tidal and sub-tidal coral and rocky reef habitat where they feed on an omnivorous diet of sponges, algae, jelly fish and cephalopods (DSWEPaC 2012a). Hawksbill turtles are unlikely to spend significant time within offshore waters as it is too deep to act as a feeding ground. However, it is likely they may migrate through those areas.

Figure 6-3 illustrates the BIAs and habitat critical (draft) for hawksbill and olive ridley turtles (as defined in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017a).

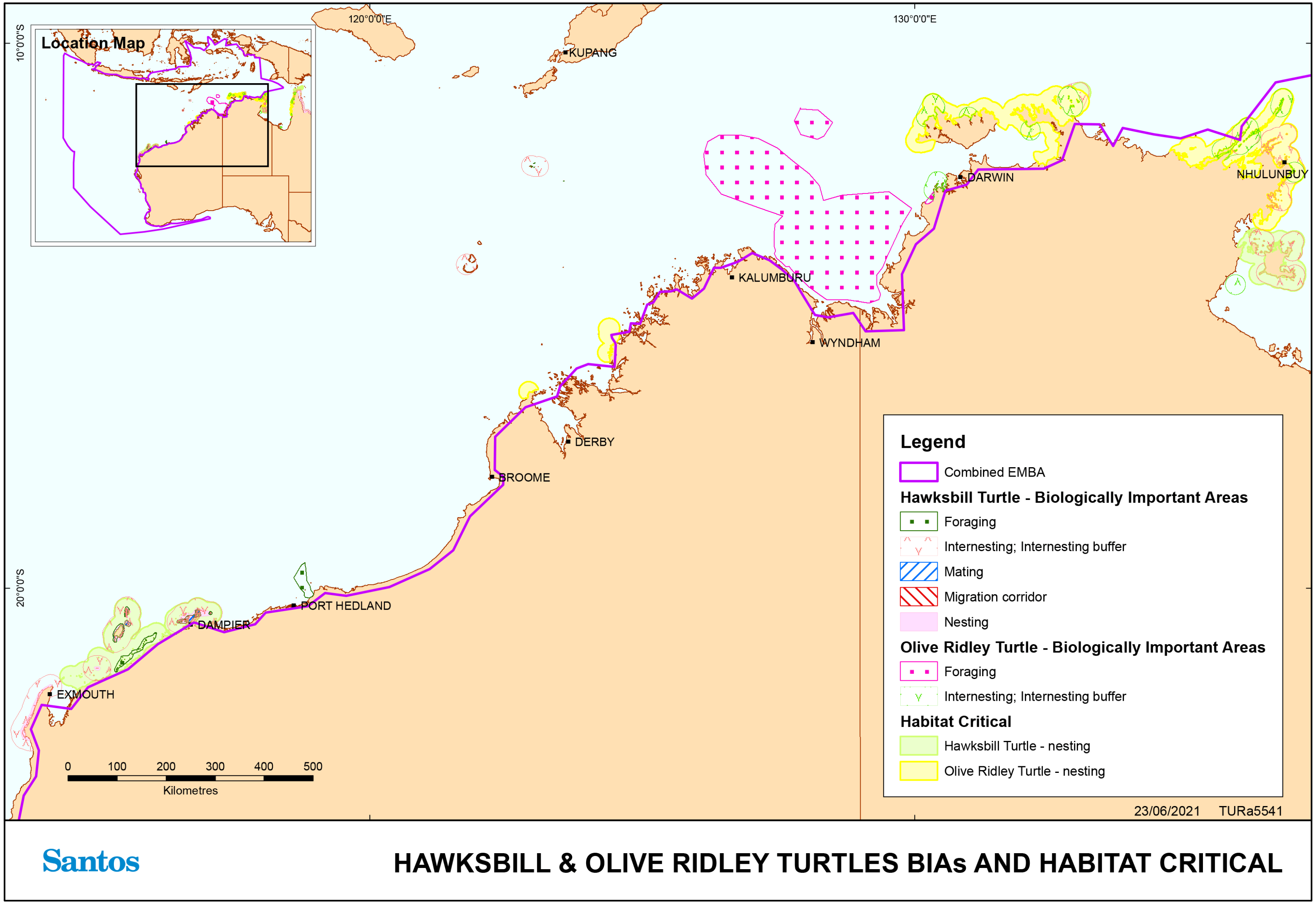

Figure 6-3: Biologically Important Areas and Habitat Critical – Hawksbill and Olive Ridley Turtle

6.1.4 Flatback Turtle

The flatback turtle (*Natator depressus*) has an Australasian distribution, with all recorded nesting beaches occurring within tropical to sub-tropical Australian waters. One third of the total breeding for the species occurs in Western Australia (WA) (Limpus, 2007). The management of the flatback turtle in Australia is broken up into five stocks currently described around Australia; eastern Queensland, Arafura Sea, Cape Domett, South-west Kimberley and Pilbara stocks (Commonwealth of Australia 2017). The Pilbara stock nests throughout the North West Shelf and is characterised by summer nesting (October to March), and the northern stock at Cape Domett breeds mainly in winter (July to September) (Commonwealth of Australia 2017a). The South-west Kimberley stock is also characterised by summer nesting. Populations in western NT are thought to nest all year round with nesting density reaching its peak in July. Populations in northern Australia also nest all year round, with nesting density reaching its peak between June and August (Limpus, 2007).

The southern WA nesting population of flatback turtles occurs from Exmouth to the Lacepede Islands off the Kimberley coast (DSEWPaC 2012c). On the North West Shelf, significant rookeries are centred on Barrow Island especially the east coast beaches (DSEWPaC 2012b). NT populations are typically found in the Gulf of Carpentaria, western Torres Strait, Wellesley Islands Group and Sand Islet.

Montebello Islands, Thevenard Island, Varanus Island, the Lowendal Islands, King Sound and Dampier Archipelago are also significant rookeries (Pendoley 2005, Limpus 2007, Pendoley Environmental 2011). Nesting is also widespread along the mainland beaches from Mundabullangana on the Pilbara coast north, including Cemetery Beach near Port Hedland, Eighty Mile Beach and to Broome (Limpus 2007, DSEWPaC 2012b).

Long term monitoring of flatback turtles nesting in the Port Hedland area, specifically at Cemetery Beach and Pretty Pool Beach, was undertaken between 2004 and 2014. Monitoring results indicated the main nesting season of flatback turtles in the area was between mid-October and January, which is consistent with other rookeries in the Pilbara region including Barrow Island, Mundabullangana, Karratha and Onslow (Waayers and Stubbs 2016). The onset of the nesting season appears to be relatively consistent each year and is thought to be associated with the southern movement of warmer sea surface temperatures along the northern WA coast.

There have been occasional records of nesting by flatback turtles on the Jurabi Coast and Muiron Islands (CALM 2005). During turtle surveys for Santos, WA flatback turtle nesting was recorded on Bessieres Islands (Astron 2014), Serrurier, Flat, Table and Round Island in previous surveys (Pendoley Environmental 2009). Flatback turtle tracks have been seen on Forty Mile beach and evidence of flatback nesting was recorded on the same beach the next day (Pendoley Environmental 2009). Previously the status of the flatback population(s) was undetermined and although not well quantified, it was estimated to be many thousands of females (Limpus 2007). However, Pendoley *et al*. (2014) reported both Barrow Island and Mundabullangana flatback turtles as substantial reproductive populations with 4,000 and 3,500 turtles tagged at each location between 2006/2006 and 2010/2011. Cemetery beach at Port Hedland had approximately 350 turtles were tagged over two seasons of monitoring (2009/2010 and 2011/12).

Satellite tracking of adult (female) flatback turtles shows they use a variety of inshore and offshore marine areas off the east and west coasts of Barrow Island. Females inter-nest close to their nesting beaches, typically in 0–10 m of water (Chevron 2008). However, flatback turtles also travel approximately 70 km and inter-nest in shallow nearshore water off the adjacent mainland coast, before returning to Barrow Island to lay another clutch of eggs. The average inter-nesting period is 13–16 days.

From long-term tagging studies on Varanus Island and Pendoley's observations, it appears that the nesting season for flatback turtles peaks in December and January with subsequent peak hatchling emergence in February and March. Flatbacks have been observed to nest on Varanus Island between November and February (Chevron 2008, Pendoley Environmental 2011 & 2013). Population monitoring of flatback turtles on Varanus Island, calculated from 16 seasons, indicates a mean population estimate of 226 (+/- 97). Modelled flatback turtle populations have shown a slight decline from 2008/09 to 2016/17, which is considered to be part of fluctuations in the natural cycle (Astron 2017). Flatback turtles tend to nest on all beaches on Varanus Island (Astron 2017). Flatback hatching and emergence success is noted as higher compared to that reported for other Western Australian rookeries (Pendoley et al. 2014; cited Astron 2017).

Unlike other sea turtles, the flatback turtle lacks a wide oceanic dispersal phase and adults tend to be found in soft sediment habitats within the continental shelf of northern Australia (DSEWPaC 2012b). Little information is known on the diets of flatback turtles (DSEWPaC 2012b), however, they are believed to forage on primarily soft-bodied invertebrates (Commonwealth of Australia 2017a).

Figure 6-4 illustrates the BIAs and habitat critical (draft) for flatback turtles (as defined in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017a).

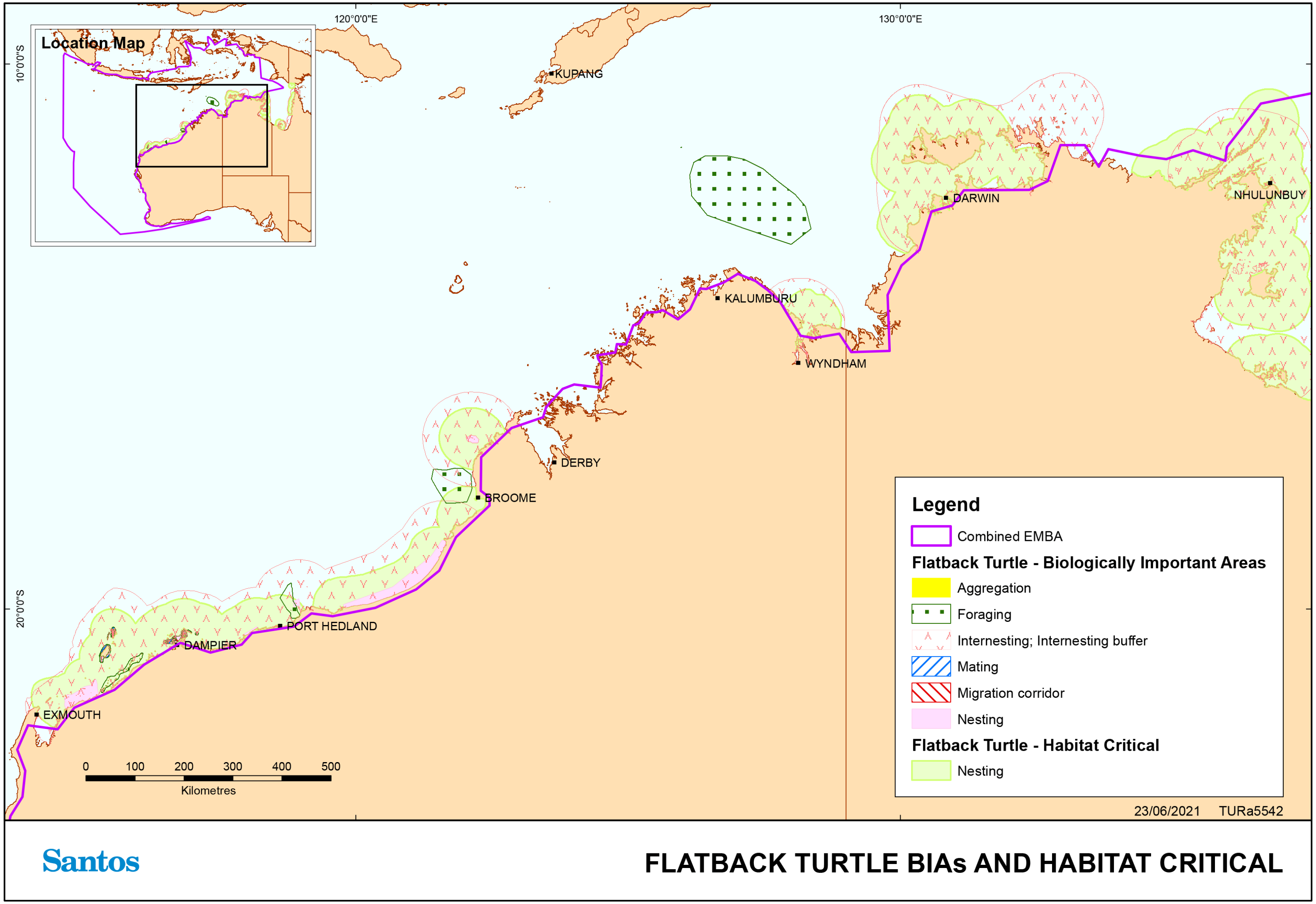

Figure 6-4: Biologically Important Areas and Habitat Critical – Flatback Turtle

6.1.5 Leatherback Turtle

The leatherback turtle *(Dermochelys coriacea*) has the widest distribution of any marine turtle, and can be found from tropical to temperate waters throughout the world (Márquez 1990). There are no major leatherback turtle centres of nesting activity that have been recorded in Australia, although scattered isolated nesting (one to three nests per annum) occurs in southern Queensland and the Northern Territory (Limpus and McLachlin 1994).

There have been several records of leatherback turtles off the coast of WA and NT, but no confirmed nesting sites (Limpus 2009c). Turtle observations have mainly occurred south of the North West Shelf area and in open waters (>200 m deep) (Limpus 2009c). Due to the lack of nesting sites around Australian coastal waters, it is presumed that leatherback turtles observed in Australian waters are migrating from neighbouring countries to utilise feeding grounds in Australia (Limpus 2009c).

The leatherback turtle will feed at all levels of the water column and is carnivorous feeding mainly on pelagic, soft-bodied marine organisms such as jellyfish, which occur in greatest concentrations in areas of upwelling or convergence (DSEWPaC 2012d). The leatherback turtle is a highly pelagic species with adults only going ashore to breed.

No leatherback turtle BIAs or habitat critical (draft) are found within the combined EMBA.

6.1.6 Olive Ridley Turtles

Olive ridley turtles (*Lepidochelys olivacea*) are the least common turtle species encountered with critical nesting habitat occurring near Vulcan Island, Darcy Island, Prior Point and Llanggi and Cape Leveque (Commonwealth of Australia 2017). They are also known to nest on Tiwi Islands, specifically on the west coast of Bathurst Island and the north coast of Melville Island. The turtles found nesting on the Tiwi Islands is the NT genetic stock whereby the long-term trends of this genetic stock are currently unknown (Commonwealth of Australia 2017). However, the number of females nesting on the Tiwi Islands are considered significant at the genetic stock, national and international level. Nesting of the NT genetic stock can occur year-round with a peak between April and June, and hatchling emergence peaking between June and August (Commonwealth of Australia, 2017).

Internesting habitat, critical to the survival of the olive ridley turtle, encompasses nearshore waters along the north, west and east coasts of the Tiwi Islands. Satellite tracking on a small sample of internesting olive ridley turtles in the region recorded that the individuals remained close to shore (waters depths typically less than 55 m deep) and within 37 km of the nesting beach during the internesting interval (Whiting et al. 2007, Whiting et al. 2005).

This species forages within the shallow benthic habitats of northern WA and the NT and is thought to feed primarily on gastropods and small crabs within the benthic, soft-bottomed communities of the continental shelf (Limpus 2009). Olive Ridley turtles forage as far south as the Dampier Archipelago-Montebello Islands and have also been sighted in the Christmas and Cocos (Keeling) Islands in the north of the combined EMBA.

BIAs for this endangered species are known to occur in the vicinity of Joseph Bonaparte Depression (DSEWPaC 2012b, Commonwealth of Australia 2017a). See **Figure 6-3** for identified olive ridley turtle BIAs and critical habitats (draft) within the combined EMBA (as defined in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017a).

6.2 Seasnakes

Storr *et al*. (1986) estimate nine genera and 22 species of sea snakes occur in WA waters, with 25 listed marine seasnake species being recorded in the search area of WA and NT waters (**Appendix A**). Little is known of the distribution of individual species, population sizes or aspects of their ecology. Seasnakes are essentially tropical in distribution, and habitats reflect influences of factors such as water depth, nature of seabed, turbidity and season (Heatwole and Cogger 1993). Seasnakes are widespread throughout waters of the North West Shelf in offshore and nearshore habitats. They can be highly mobile and cover large distances or they may be restricted to relatively shallow waters and some species must return to land to eat and rest. In the north-west region of Western Australia, no BIAs have been designated for seasnakes. However, both

Ashmore Reef and Cartier Island are characterised for both a high density and high diversity of seasnakes (DSEWPaC 2012b). The limited evidence available suggests that there are no sea snakes in at least the coastal waters of Cocos (Keeling) Islands, and few sea snake sightings in the waters of the Christmas Island territory (Brewer *et al,* 2009).

Two species of seasnakes listed as threatened under the EPBC Act were identified in the Protected Matters search within the combined EMBA (**Appendix A**):

- Short-nosed seasnake (*Aipysurus apraefrontalis*); and
- Leaf-scaled seasnake (*Aipysurus foliosquama*).

6.2.1 Short-nosed Seasnake

The short-nosed seasnake (*Aipysurus apraefrontalis*) is listed as critically endangered under the EPBC Act and the BC Act. 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 (Minton & Heatwole 1975, Guinea and Whiting 2005).

The species prefers the reef flats or shallow waters along the outer reef edge in water depths to 10 m (McCosker 1975, Cogger 2000). 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 seasnakes moved even as far as 50 m away from the reef flat and are therefore unlikely to be expected in high numbers in offshore, deeper waters.

6.2.2 Leaf-scaled Seasnake

The leaf-scaled seasnake *(Aipysurus foliosquama)* is listed as critically endangered under the EPBC Act and the BC Act. 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 WA, especially on Ashmore and Hibernia Reefs (Minton and Heatwole 1975). The leaf-scaled seasnake forages by searching in fish burrows on the reef flat (DoE 2014).

6.3 Crocodiles

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

In the NT salt-water crocodile has been found in the Mary, Adelaide, Daly, Moyle, Victoria, Finniss, Wildman, West Alligator, East Alligator, South Alligator, Liverpool, Blyth, Glyde, Habgood, Baralminar, Goromuru, Cator and Peter John Rivers with a total 79 individuals per km identified in these river systems (Fukuda, 2007).

6.4 Biologically Important Areas/Habitat Critical – Marine Reptiles

Table 6-3 provides an overview of BIAs in the combined EMBA for marine reptiles, as identified by the DAWE (Commonwealth) and critical habitats identified in associated recovery plans. The DAWE may make recovery plans for threated fauna listed under the EPBC Act. The EPBC Act requires that ‘habitat critical to the survival of the listed threatened species’ is identified in recovery plans, relevant recovery plans are listed in **Section 13.2**[4].

[4] Further background information on BIA and identification of critical habitat in recovery plans is provided in **Section 5.4**.

In addition, both the EPBC Act and WA BC Act and associated regulations (2018) provide for the listing of habitat critical - habitat ‘critical to the survival of the threatened species. To date no habitat critical in WA has been listed under either Act. No provision is made under the Territory Parks and Wildlife Conservation Act 1976 for listing critical habitat.

Table 6-3: Biologically important areas/critical habitats and geographic locations - reptiles

Species	Scientific name	Aggregation area and use	BIAs within EMBA	Habitat Critical within EMBA
Loggerhead turtle	*Caretta caretta*	Nesting, migration, foraging and internesting – Islands and coastline of the Kimberley region and islands of the North West Shelf, Ningaloo coast and Jurabi coast	Cohen Island De Grey River to Bedout Island Dirk Hartog Island Gnarloo Bay James Price Point Lowendal Island Montebello Island Muiron Island Ningaloo Coast and Jurabi coast Rosemary Island Western Joseph Bonaparte Depression	Exmouth and Ningaloo coast Gnaraloo Bay and beaches Shark bay, all coastal and island beaches out the to the northern tip of Dirk Hartog Island
Green turtle	*Chelonia mydas*	Nesting, migration foraging, aggregation, mating, basking and internesting – Offshore islands in the Browse Basin, North West Shelf and Kimberley/Pilbara coastlines Mating/nesting – Dampier Archipelago Basking – Middle Island	Ashmore Reef Barrow Island Browse Island Cartier Island Cassini Island Coral reef habitat west of the Montebello group. Extends the entire length of Montebellos Dampier Archipelago (islands to the west of the Burrup Peninsula) De Grey River area to Bedout Island Delambre Island Dixon Island Greens - inshore tidal and shallow subtidal areas around Barrow Island Hawksbills - shallow water coral reef and artificial reef (pipeline) habitat James Price Point Joseph Bonaparte Gulf Lacepede Island Legendre Island, Huay Island Middle Is. West Coast Barrow Island West Coast and North Coast Montebello Island - Hermite Island, NW Island, Trimouille Island Montebello Islands Montgomery Reef	Mainland east of Mary island to mainland adjacent to Murrara Island including all offshore islands Ashmore Reef and Cartier Reef Browse Island Scott Reef Adele Island Lacepede Island Dampier Archipelago Barrrow Island Montebello Islands Serrier Island and Thevenard Island Exmouth Gulf and Ningaloo Coast

Species	Scientific name	Aggregation area and use	BIAs within EMBA	Habitat Critical within EMBA
			North and South Muiron Island North Turtle Island North West Cape Scott Reef Scott Reef - Sandy Islet Seringapatam Reef String of islands between Cape Preston and Onslow, inshore of Barrow Is North-west of Melville Island	
Hawksbill turtle	*Eretmochelys imbricata*	Nesting, migration, mating, foraging and internesting – Offshore islands in the Browse Basin, North West Shelf and Kimberley/Pilbara coastlines Mating/ nesting/ internesting – Lowendal group, Montebello Islands	Ah Chong and South East Island Ashmore Reef Barrow Island Cartier Island Dampier Archipelago (islands to the west of the Burrup Peninsula) De Grey River area to Bedout Island Delambre Island Delambre Island (and other Dampier Archipelago Islands) Dixon Island Greens - inshore tidal and shallow subtidal areas around Barrow Island Hawksbills - shallow water coral reef and artificial reef (pipeline) habitat Lowendal Island Group Montebello Island - Hermite Island, NW Island, Trimouille Island Montebello Island, Trimoulle and NW islands Ningaloo coast and Jurabi coast Rosemary Island Scott Reef String of islands between Cape Preston and Onslow, inshore of Barrow Island Thevenard Island Varanus Island	Cape Preston to mouth of Exmouth Gulf (including Montebello Islands and Lowendal Islands) Dampier Archipelago (including Delambre Island and Rosemary Island) New Year Island 20 km internesting buffer

Species	Scientific name	Aggregation area and use	BIAs within EMBA	Habitat Critical within EMBA
Flatback turtle	*Natator depressus*	Nesting, migration, mating, aggregation, foraging, internesting – Islands of the North West Shelf and the Pilbara/Kimberley coastlines Mating, nesting – Barrow Island	Eighty Mile beach Barrow Island Cape Domett Cape Thouin/ Mundabullangana/ Cowrie Beach Coral reef habitat west of the Montebello group. Extends the entire length of Montebellos Dampier Archipelago (islands to the west of the Burrup Peninsula) De Grey River area to Bedout Island Delambre Island Dixon Island Holothuria Zone (Northern Kimberley, Holothuria Banks) Intercourse Island James Price Point Lacepede Island Legendre Island, Huay Is Montebello Island - Hermite Island, NW Island, Trimouille Island North Turtle Island Port Hedland, Cemetery Beach Port Hedland, Paradise Beach Port Hedland, Pretty Pool String of islands between Cape Preston and Onslow, inshore of Barrow Is The main nesting beach at Cape Domett is a 1.9-km-long north-west-facing sandy beach on the east of the Cambridge Gulf, East Kimberley, Western Australia (14 48.10S, 128 24.50E), located approximately 80 km north-north-east of the nearest town, Wyndham. Thevenard Island - South coast West of Cape Lambert	Cape Domett and Lacrosse Island Lacepede Islands Eighty Mile beach Cemetary beach Eco Beach Mundabullangana Beach Dampier Archipelago Barrow Island, Montebello Island, coastal islands from Cape Preston to Locker Island Soldier Point to Pirlangimpi including Seafull Island 60 km internesting buffer Brace point to One Tree Point, including all offshore islands 60 km internesting buffer Waigait Beach to south of Point Blaze, including all offshore islands 60 km internesting buffer.

Species	Scientific name	Aggregation area and use	BIAs within EMBA	Habitat Critical within EMBA
			Western Joseph Bonaparte Depression Melville Island, Cobourg Peninsula	
Leatherback turtle	*Dermochelys coriacea*	None within EMBA	None within EMBA	All sandy beaches from Coburg Peninsula to Cape Arnhem including Danger Point and Elcho Island 20 km internesting buffer
Olive ridley turtle	*Lepidochelys olivacea*	Foraging, migration – Joseph Bonaparte Gulf – Kimberley region	Western Joseph Bonaparte Depression Northern Joseph Bonaparte Gulf	Cape Leveque Prior Point and Llanggi Darcy Island Vulcan Island Soldier Point to Pirlangimpi including Seafull Island 20 km internesting buffer Brace Point to One Tree Point, including all offshore islands 20 km internesting buffer Croker Island, Coburg Peninsula, west of Murganella to the West Alligator River 20 km internesting buffer

7. Marine Mammals

Forty-four species of listed marine mammals are known to occur in Australian waters in the combined EMBA, according to the Protected Matters search (**Appendix A**). An examination of the species profile and threats database (DAWE 2020a) showed that some listed mammal species are not expected to occur in significant numbers in the marine and coastal environments in the combined EMBA due to their terrestrial distributions. Hence, these species are not discussed further.

Of the remaining listed species, five are listed as threatened and migratory, one is listed as threatened and ten are listed as migratory under the Commonwealth EPBC Act (BIAs for marine mammals are discussed in **Table 7-3**). These species are shown in **Table 7-1** along with their conservation listing under the WA BC Act and *Territory Parks and Wildlife Conservation Act 1976* (as applicable).

The section below gives further details on marine mammal species listed as threatened and migratory and a summary is presented in **Table 7-2**. Identified BIAs are presented in **Table 7-3**.

In addition, the New Zealand fur-seal *(Arctocephalus forsteri)*, has been identified as a species of relevance to the combined EMBA. The New Zealand fur seal is listed as a protected species under WA BC Act (other specially protected), but not listed as threatened under the EPBC Act.

Table 7-1: Marine mammals listed as threatened or migratory under the EPBC Act

Species	Conservation Status				Likelihood of occurrence in EMBA	BIA in EMBA
	EPBC Act 1999 (Cwth)	BC Act 2016 (WA)	Other WA Conservation Code	TPWC Act 1976		
Sei whale *(Balaenoptera borealis)*	Vulnerable Migratory	Endangered	-	-	Foraging, feeding or related behaviour likely to occur within area	None - No BIA defined
Blue whale *(Balaenoptera musculus)*	Endangered Migratory	Endangered	-	-	Foraging, feeding or related behaviour known to occur within area Migration route known to occur within area	Yes – Refer to **Table 7-3**
Fin whale (*Balaenoptera physalus)*	Vulnerable Migratory	Endangered	-	-	Foraging, feeding or related behaviour likely to occur within area	None - No BIA defined
Southern right whale (*Eubalaena australis)*	Endangered Migratory	Vulnerable	-	-	Breeding known to occur within area	Yes – Refer to **Table 7-3**
Humpback whale (*Megaptera novaeangliae)*	Vulnerable Migratory	Specially protected (special conservation interest)	-	-	Breeding known to occur within area	Yes – Refer to **Table 7-3**
Sperm whale (*Physeter macrocephalus)*	Migratory	Vulnerable	-	-	Foraging, feeding or related behaviour known to occur within area	Yes – Refer to **Table 7-3**
Antarctic minke whale *(Balaenoptera bonaerensis)*	Migratory	-	-	-	Species or species habitat likely to occur within area	None - No BIA defined
Bryde's whale *(Balaenoptera edeni)*	Migratory	-	-	-	Species or species habitat likely to occur within area	None - No BIA defined
Pygmy right whale (*Caperea marginate)*	Migratory	-	-	-	Foraging, feeding or related behaviour likely to occur within area	None - No BIA defined

Species	Conservation Status				Likelihood of occurrence in EMBA	BIA in EMBA
	EPBC Act 1999 (Cwth)	BC Act 2016 (WA)	Other WA Conservation Code	TPWC Act 1976		
Killer whale *(Orcinus orca)*	Migratory	-	-	-	Species or species habitat may occur within area	None - No BIA defined
Indo-Pacific humpback dolphin (*Sousa chinensis)*	Migratory	-	-	-	Breeding known to occur within area	Yes – Refer to **Table 7-3**
Spotted bottlenose dolphin (Arafura/ Timor Sea Populations) *(Tursiops aduncus)*	Migratory	-	-	-	Species or species habitat known to occur within area	Yes – Refer to **Table 7-3**
Irrawaddy dolphin (Australian snubfin dolphin) *(Orcaella heinsohni)*	Migratory	-	P4	-	Species or species habitat known to occur within area	Yes – Refer to **Table 7-3**
Dusky dolphin (*Lagenorhynchus obscurus)*	Migratory	-	-	-	Species or species habitat likely to occur within area	None - No BIA defined
Australian sea lion (*Neophoca cinerea)*	Vulnerable	Vulnerable	-	-	Breeding known to occur within area	Yes – Refer to **Table 7-3**
Dugong (*Dugong dugon)*	Migratory	Specially protected (species otherwise in need of special protection)	-	-	Breeding known to occur within area	Yes – Refer to **Table 7-3**

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7.1 Threatened and Migratory Species

7.1.1 Sei Whale

Sei whales have a worldwide, oceanic distribution, ranging from polar to tropical waters. Sei whales tend to be found further offshore than other species of large whales (Bannister *et al*. 1996).

Sei whales move between Australian waters and Antarctic feeding areas; however, they are only infrequently recorded in Australian waters (Bannister *et al*. 1996) and their movements and distribution in Australian waters is not well known (DAWE 2020a). There are no known mating or calving areas in Australian waters (Parker 1978 in DAWE 2020a). The National Conservation Values Atlas currently record no BIAs for this species (DAWE 2020b). Surveys of the Bonney Upwelling (outside of the combined EMBA) between 2000 and 2003 recorded sightings of sei whales feeding during summer and autumn, indicating that this is potentially an important feeding ground (DAWE 2020b).

7.1.2 Blue Whale

Two sub-species of blue whale are recorded in Australian waters: the southern (or true) blue whale (*Balaenoptera musculus intermedia*) and the pygmy blue whale (*Balaenoptera musculus brevicauda*). Southern blue whales are believed to occur in waters south of 60°S and pygmy blue whales occur in waters north of 55°S (i.e. not in the Antarctic) (DEWHA 2008a). By this definition all blue whales in waters from Busselton to the NT are assumed to be pygmy blue whales and are discussed below.

Pygmy blue whales have a southern hemisphere distribution, migrating from tropical water breeding grounds in winter to temperate and polar water feeding grounds in summer (Bannister *et al*. 1996, Double *et al*. 2014). The WA migration path takes pygmy blue whales down the WA coast to coastal upwelling areas along southern Australia (Gill 2002) and south at least as far as the Antarctic convergence zone (Gedamke *et al*. 2007).

Tagging surveys have shown pygmy blue whales migrating northward relatively near to the Australian coastline (100 km) until reaching North West Cape after which they travelled offshore (240 km) to Indonesia. Passive acoustic data documented pygmy blue whales migrating along the Western Australian shelf break (Woodside 2012). Tagging data collected by Gales *et al.* (2010) has provided the first definitive link between the blue whales that feed off the Perth Canyon and those that occur around Indonesia. This is movement is concordant with the proposed ‘Tasmania to Indonesia’ population described by Branch *et al.* (2007).

The northern migration passes the Perth Canyon from January to May and north bound animals have been detected off Exmouth and the Montebello Islands between April and August (Double *et al*. 2012a, McCauley & Jenner 2010). A noise monitoring study conducted in 2014-15 recorded pygmy blue whales moving in a northward direction in August 2014 and between late-May to early July 2015 (JASCO Applied Sciences, 2016; McPherson, Craig et al., 2015). During the southern migration, pygmy blue whales pass south of the Montebello Islands and Exmouth from October to the end of January, peaking in late November to early December (Double *et al*. 2012b). No detections of the species were made during the period of their southward migration during the noise monitoring study.

Generally, they appear to travel as individuals or in small groups based on acoustic data. For example, analysis of pygmy blue whale calls from noise loggers deployed around Scott Reef (2006 to 2009) for the Woodside Browse project showed that 78% of the calls were from lone whales, 18% were from two whales and 4% were from three or more whales (McCauley 2011; Woodside 2014).

Pygmy blue whales appear to feed regularly along their migration route (i.e. at least once per week or more frequently) and are likely to have multiple food caches along their migratory route (e.g. Rowley Shoals and Ningaloo Reef) (ConocoPhillips 2018).

Recognised feeding areas of significance to this species, located within the combined EMBA include Ningaloo Reef and the Perth Canyon (DoE 2015a). The Ningaloo Reef area has the capacity to offer feeding opportunities to pygmy blue whales through unique biophysical conditions able to support large biomasses of marine species (Double *et al*. 2014). Surface lunge feeding of pygmy blue whales has been observed at North West Cape and Ningaloo Reef in June (C. Jenner & M-N Jenner, unpublished data, 2001 in Double *et al*. 2014). Outside of the recognised feeding areas, possible foraging areas for pygmy blue whales include the greater region around the Perth Canyon, off Exmouth and Scott Reef in WA (DoE 2015a). These steep gradient features tend to stimulate upwelling and, therefore increased productivity (seasonally variable) (ConocoPhillips 2018). Hence, they provide a favourable foraging area.

Breeding areas have not yet been identified; however, it is likely that pygmy blue whales calve in tropical areas of high localised production such as deep offshore waters of the Banda and Molucca Seas in Indonesia (Double *et al*. 2014, DAWE 2020a). There are no known breeding areas of significance to blue whales in waters from Busselton to the NT.

The BIAs for blue whale and pygmy blue whale are detailed in **Table 7-3** and depicted in **Figure 7-2** and **Figure 7-1.**

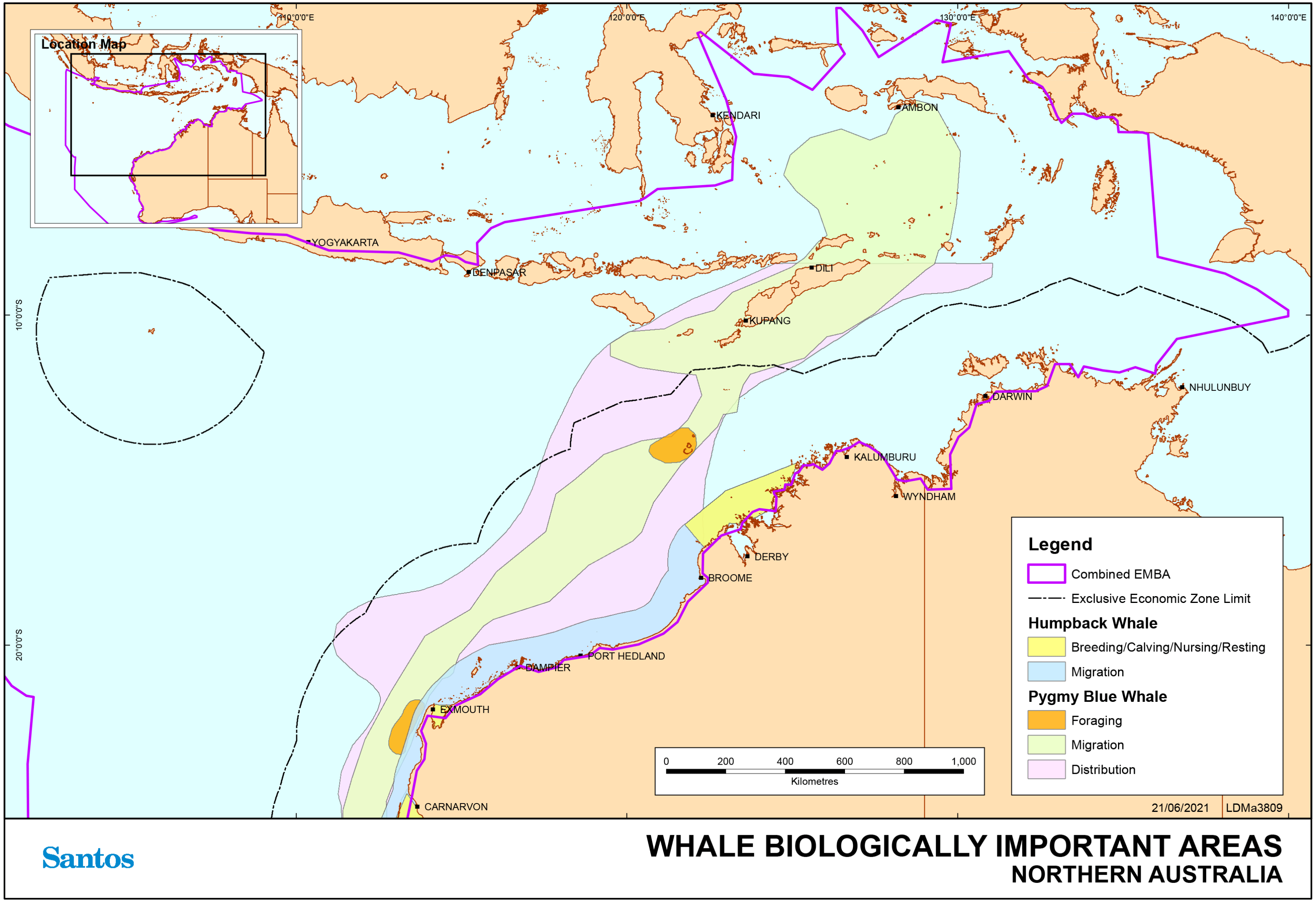

Figure 7-1: Biologically important areas – whales – Northern WA

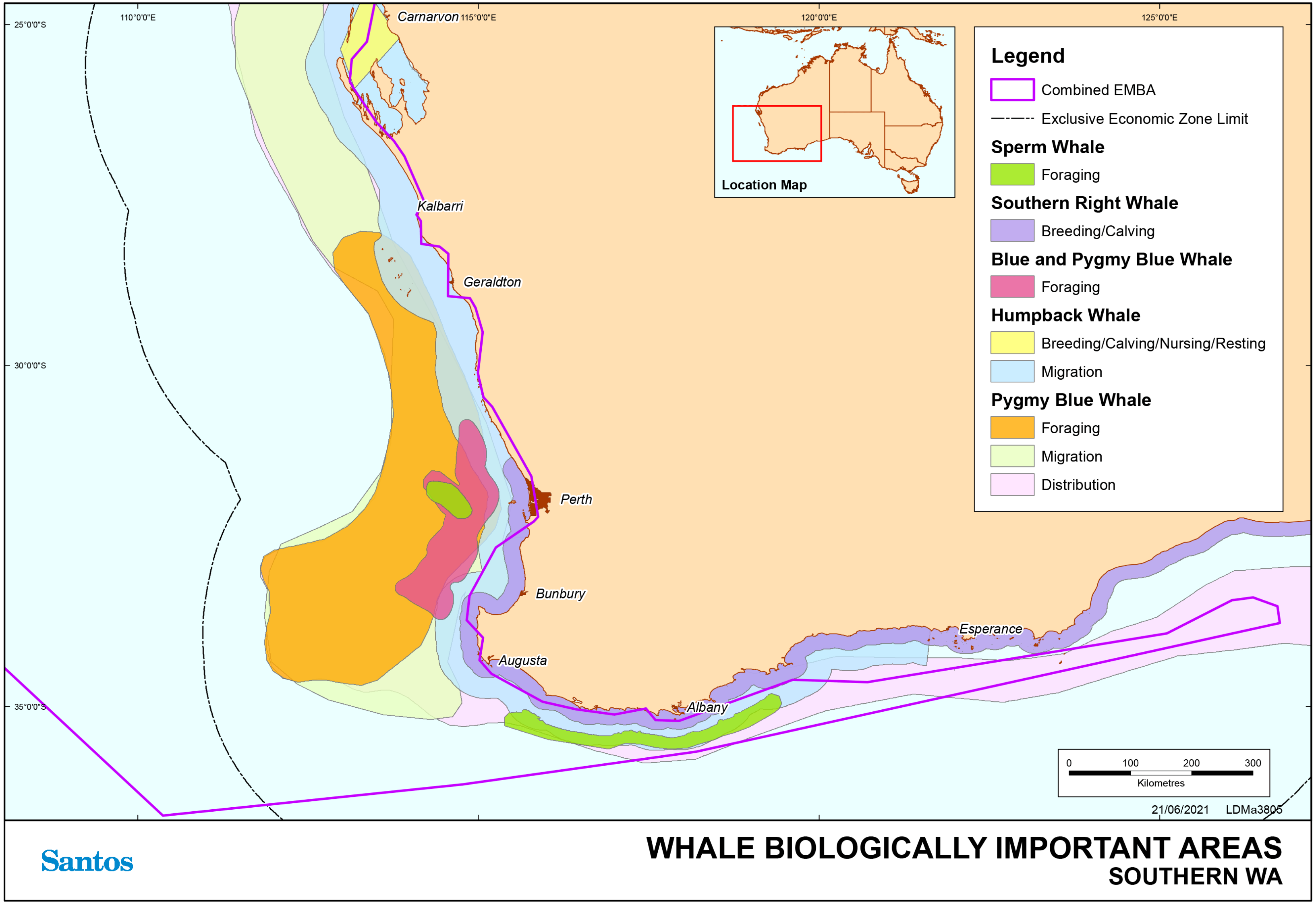

Figure 7-2: Biologically important areas – whales – Southern WA

7.1.3 Fin Whale

Fin whales have a worldwide distribution generally in deeper waters, with oceanic migrations between warm water breeding grounds and cold water feeding grounds.

The fin whale distribution in Australia is not clear due to the sparsity of sightings. Information is known primarily from stranding events and whaling records. According to the Species Profile and Threats database (DAWE 2020a); fin whales are thought to be present from Exmouth, along the southern coastline, to southern Queensland.

Migration paths are uncertain but are not thought to follow Australian coastlines (Bannister *et al*. 1996). There is insufficient data to prescribe migration times for fin whales. During summer and autumn this species has been recorded acoustically at the Rottnest Trench.

There are no known mating or calving areas in Australian waters (DoEE 2019a) and no BIAs for the fin whale are currently identified by the National Conservation Values Atlas (DAWE 2020b).

7.1.4 Southern Right Whale

The southern right whale 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).

BIAs including calving and aggregation areas are recorded for this species along the southern coastline of Australia (DAWE 2020b). Details on the BIA for southern right whale are provided in **Table 7-3** and depicted in **Figure 7-2** and **Figure 7-1**.

7.1.5 Humpback Whale

Humpback whales have a worldwide distribution, migrating along coastal waters from polar feeding grounds to subtropical breeding grounds. Geographic populations are distinct and at least six southern hemisphere populations are thought to exist based on Antarctic feeding distribution and the location of breeding grounds on either side of each continent (Bannister *et al*. 1996). The population of humpback whales migrating along the WA coastline was recently estimated to be greater than 33,000 whales and likely increasing at exceptionally high growth rates between 10–12% (Hedley *et al*. 2011, Salgado Kent *et al*. 2012).

Humpback whale populations have increased since being placed on the threatened species list for exploitation from whaling, resulting in a higher abundance of species off our Western Australian coastline. Humpback whales have been able to thrive and increase in numbers despite the heavy oil and gas exploration. A study presented by Bejder et al (2016) has prompted a review of the species being down listed under Commonwealth legislation and regulations, as they are not eligible for listing as a threatened species under all statutory criteria.The west coast Australian humpback whale population migrates from Southern Polar Ocean 'summer' feeding grounds to their northern tropical 'winter' calving/ breeding grounds in coastal waters of the Kimberley. The northern migration tends to follow deeper waters of the continental shelf, whilst the southward migration concentrates whales closer to the mainland (Jenner *et al*. 2001; Irvine et al., 2018). Recent satellite tagging of southbound humpback whales indicate that whales generally migrated close to the coastline, within a few tens of kilometres of shore and in a corridor frequently less than 100 km (Double *et al*. 2010). Aerial surveys and noise logger recordings undertaken for Chevron's Wheatstone Project indicated that the main distribution of humpback whales was sighted at an average distance of 50 km from the mainland during the northern migration and 35 km during the southbound migration (RPS 2010a). Woodside have conducted aerial surveys that have confirmed that the reported distribution of migrating humpback whales off the North West Cape is consistent with baseline surveys first conducted in 2000 to 2001 (RPS, 2010 in Woodside 2020).

The precise timing of the migration varies between years by up to six weeks, influenced by water temperature, sea ice distribution, predation risk, prey abundance and the location of feeding grounds (DEWR 2007).

Peak northward migration across the North West Shelf is identified as from late July to early August, and peak southward migration from late August to early September (DoEE 2015c). Data collected between 1995 and 1997 by the Centre for Whale Research indicates that the period for peak northern migration into the calving grounds in the Kimberley is mid to late July. The peak for southern migration is in the first half of September (Jenner *et al.* 2001). Actual timing of annual migration may vary by as much as three weeks from year to year due to food availability in the Antarctic (DMP 2003).

Satellite tagging data collected for migrating northbound humpback whales identified a consistent narrow inshore distribution, unlike the southward migration. There was little evidence that the whales tended to venture further from shore and into deeper water at any point on their northward migration. Whales were seen with calves off the North West Cape outside the ‘calving grounds; of Lacepede Islands to Camden Sound. This indicates some potential for this area being used as a ‘calving site’ as well as a migratory corridor. Consequently, the region from the Lacepede Islands to Camden Sound should not be seen as the exclusive ‘calving ground’ for this population (Double *et al.* 2012b).

Details on the BIA for humpback whales are provided in **Table 7-3** and depicted in **Figure 7-2** and **Figure 7-1**.

7.1.6 Sperm Whale

Sperm whales typically occur in WA along the southern coastline between Cape Leeuwin and Esperance (Bannister *et al.* 1996). Sperm whales are distributed worldwide in deep waters (greater than 200 m) off continental shelves and sometimes near shelf edges, averaging 20 to 30 nautical miles offshore (Bannister *et al.* 1996). The sperm whale is known to migrate northwards in winter and southwards in summer, however, detailed information on the distribution of sperm whales is not available for the timing of migrations. Sperm whales have been recorded in deep water off the North West Cape on the west coast of Western Australia (RPS 2010b) and appear to occasionally venture into shallower waters in other areas (RPS 2010b). Details on the BIA for sperm whales are provided in **Table 7-3** and are shown in **Figure 7-2** and **Figure 7-1.**

7.1.7 Antarctic Minke Whale

The Antarctic minke whale is distributed throughout the Southern Hemisphere from 55°S to the Antarctic ice edge during the austral summer and has been recorded in all Australian States (Bannister et al. 1996; Perrin & Brownell 2002). Detailed information on timing and location of migrations and breeding grounds on the west coast of Australia is largely unknown. However, it is believed that the Antarctic minke whale migrates up the WA coast to approximately 20°S during Australian winter to feed and possibly breed (Bannister *et al.* 1996).

7.1.8 Bryde’s Whale

The Bryde’s whale is found all year round in tropic and temperate waters (Kato 2002). Two forms are recognised: inshore and offshore Bryde’s whales. It appears that the inshore form is restricted to the 200 m depth isobar whilst the offshore form is found in deeper waters of 500-1,000 m (DoEE 2019c). Both forms are expected to be found in zones of upwelling where they feed on shrimp like crustaceans (Bannister *et al.* 1996). Little is known about the population abundance of Bryde’s whale, the location of exact breeding and calving grounds and large-scale migration patterns (DoEE 2019c). It is however, suggested that the offshore form migrates seasonally, heading towards warmer tropical waters during the winter.

7.1.9 Pygmy Right Whale

The pygmy right whale is considered the most elusive baleen whale and as a result very little is known about the whale's distribution in Australian waters. Records of the pygmy right whale in Australian waters are distributed between 32°S and 47°S and are restricted in the west by the Leeuwin current (Kemper 2002). It is possible that the pygmy right whale will be encountered in the southern extent of the combined EMBA, particularly in coastal areas of upwelling (Kemper 2002).

7.1.10 Killer Whale

The killer whale has a widespread global distribution and has been recorded in waters of all Australian states/territories (Bannister *et al.* 1996). Whilst more commonly found in cold, deeper waters, killer whales have been observed along the continental slope, shelf and shallower coastal areas. Killer whales are known to make seasonal movements and are most likely to follow the migratory routes of their prey, however, little is known about these movements (DoEE, 2019). They are more likely to be observed around seal colonies, with a significant seal colony within the combined EMBA being located in WA at the Abrolhos Islands.

7.1.11 Indo-Pacific Humpback Dolphin

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

The Indo-Pacific humpback dolphin BIA in the combined EMBA is detailed in **Table 7-3** and shown on **Figure 7-3.**

7.1.12 Spotted Bottlenose Dolphin (Indo-Pacific bottlenose dolphin)

The spotted bottlenose dolphin (*Tursiops aduncus*) (Arafura/ Timor Sea populations) is generally considered to be a warm water subspecies of the spotted bottlenose dolphin, occurring in shallow (often <10 m deep) inshore waters (Bannister et al., 1996; Hale et al., 2000). The known distribution of the spotted bottlenose dolphin extends from Shark Bay north to the western edge of the Gulf of Carpentaria in Australia (DoEE 2016b). The spotted bottlenose dolphin BIA in the combined EMBA is detailed in **Table 7-3** and shown on **Figure 7-3.**

7.1.13 Irrawaddy Dolphin (Australian Snubfin Dolphin)

The Irrawaddy dolphin, also known as the snubfin dolphin (*Orcaella heinsohni*) is known to occur within the waters off northern Australia, extending north from Broome in Western Australia to the Brisbane River in Queensland (DoEE 2016c). Surveys have indicated that the species is typically found in protected shallow nearshore waters, generally less than 20 m deep, adjacent to river and creek mouths close to seagrass beds (DoEE 2016c). The snubfin dolphin was not recorded during any of the aerial surveys undertaken along the Dampier Peninsula coastline in the vicinity of James Price Point but were observed in Roebuck Bay from vessels on several occasions (RPS, 2010b). Based on the extensive survey effort and amenable conditions within the James Price Point coastal area during the survey, it is concluded that this species is seldom found outside of shallow and sheltered bays and inlets (DSD 2010). The Irrawaddy dolphin BIA in the combined EMBA is detailed in **Table 7-3** and shown on **Figure 7-3.**

7.1.14 Dusky Dolphin

The dusky dolphin's distribution is strongly linked to colder waters. In Australia, the dusky dolphin has been sighted in southern Australia from WA to Tasmania. It is presumed to be primarily an inshore species but has been known to move further offshore, possibly due to its desire for colder waters (Gill *et al.* 2000). Dusky dolphins are expected to be limited in their distribution along the WA coastline due to the presence of the southward-flowing warm water of the Leeuwin Current.

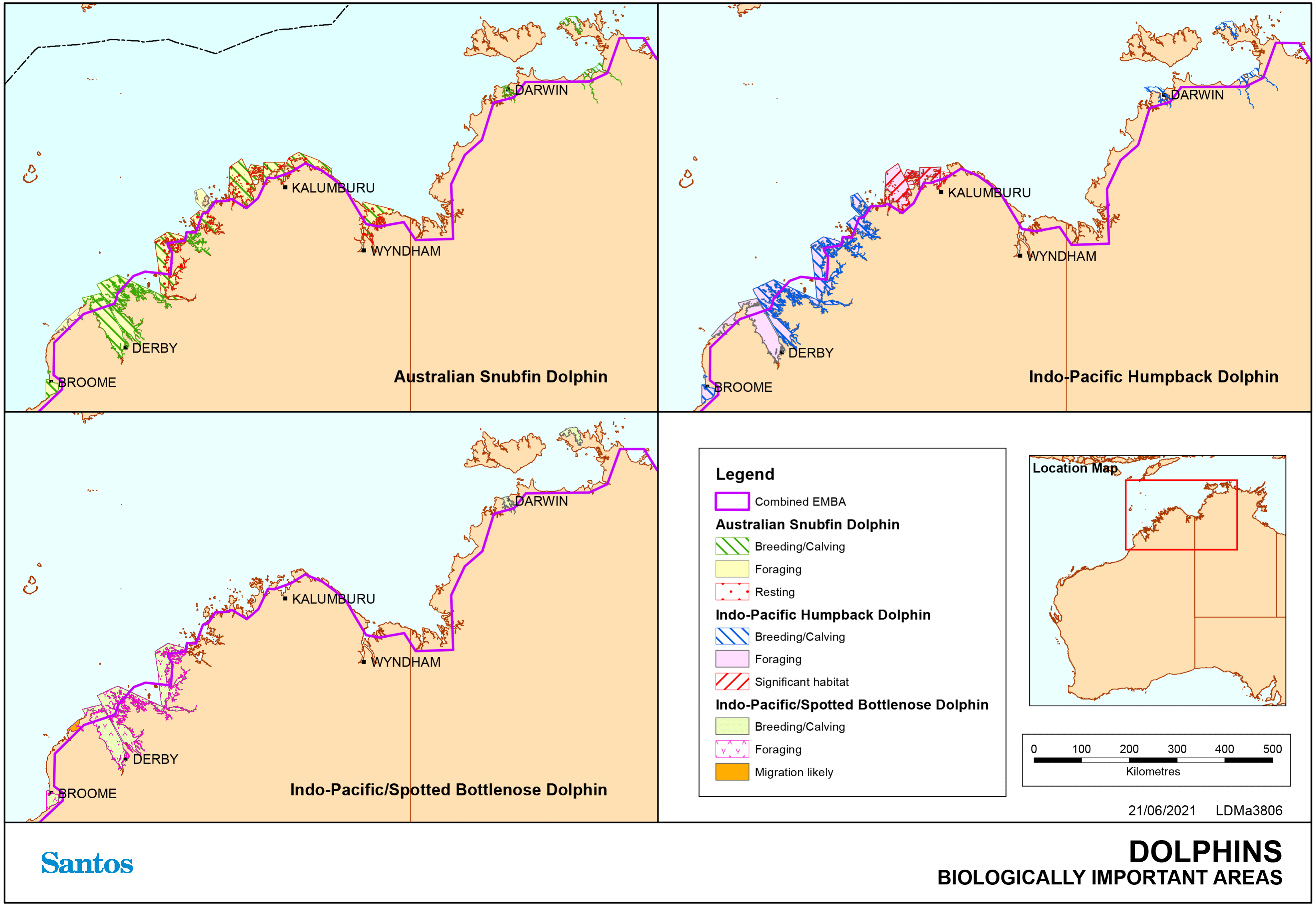

Figure 7-3: Biologically important areas – dolphins

7.1.15 Australian Sea Lion

The Australian sea lion is endemic to Australia. Breeding colonies are found only in South Australian and Western Australian waters. There are currently 76 known Australian sea lion pupping locations along the coast and offshore islands between the Houtman Abrolhos Islands in Western Australia to the Pages Islands in South Australia (DSEWPaC 2013c). The species has also been recorded at Shark Bay (DoE 2014a).

BIAs for foraging, haul-out and breeding sites identified by the National Conservation Values Atlas are located south of the waters from Busselton to the NT (DAWE 2020b). Male Australian sea lions have been recorded foraging in areas up to 60 km away from their birth colonies, with potentially larger dispersal ranges up to 180 km (Hamer *et al*. 2011). However, female Australian sea lions have restricted home ranges, with high rates of natal site fidelity and limited gene flow with other regions (Campbell 2005). The Australian sea lion BIA in the combined EMBA is outlined in **Table 7-3** and is depicted in **Figure 7-4.**

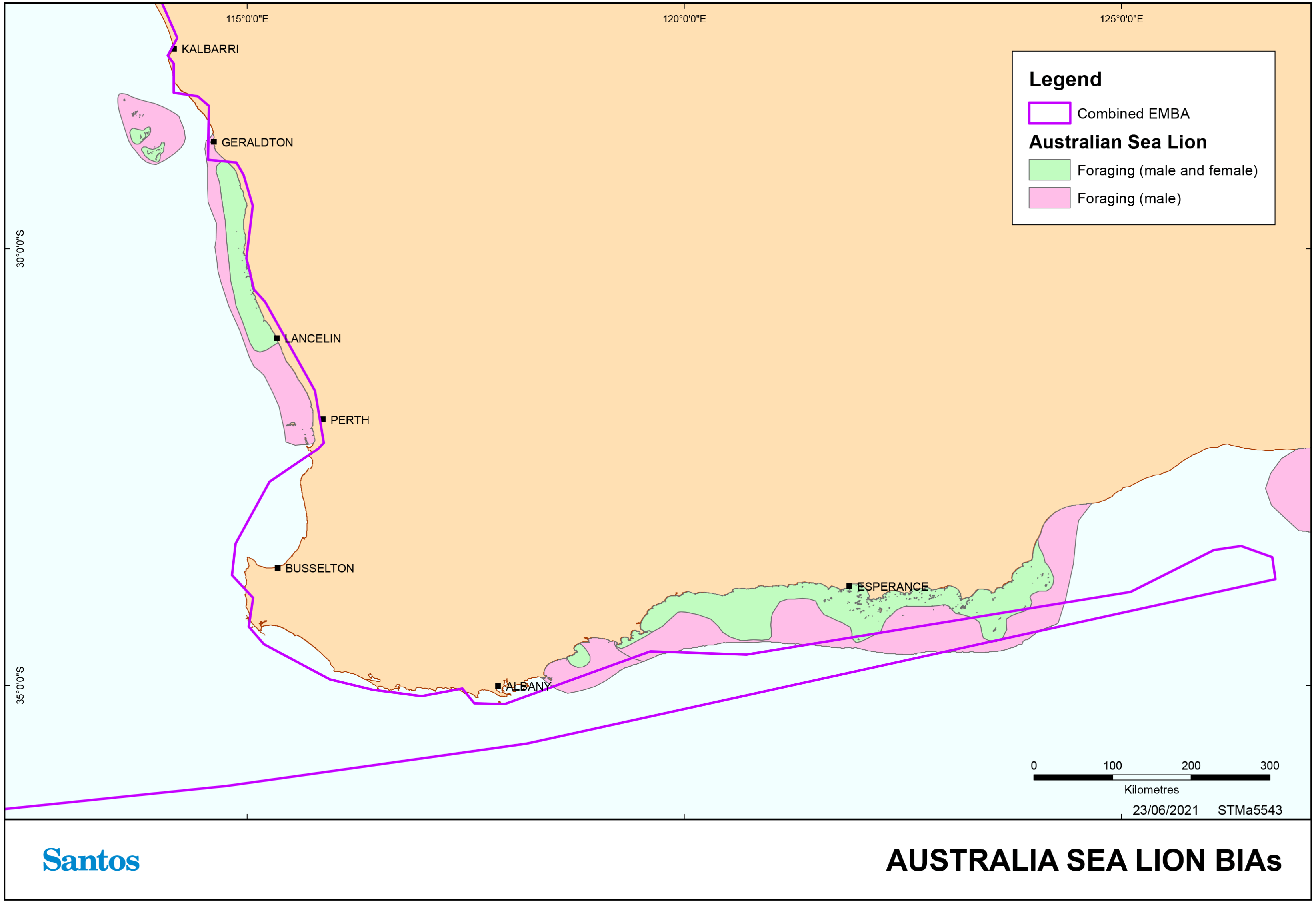

Figure 7-4: Biologically important areas – Australian sea lion

7.1.16 Dugongs

Dugongs (*Dugong dugon*) are large herbivorous marine mammals (up to 3 m) that feed off seagrass and generally inhabit coastal areas. Key populations along the WA coast are principally located at: Shark Bay (the largest resident population in Australia), Ningaloo Marine Park and Exmouth Gulf, the Pilbara coast and offshore areas including Montebello/ Barrow/ Lowendal Islands, and further north at Eighty Mile Beach and off the Kimberley Coast, particularly Roebuck Bay and Dampier Peninsula (Marsh *et al*. 2002; DSEWPaC 2012). Populations are also present at Ashmore Reef, and the north coast of the Tiwi Islands is recognised as a key site for the conservation of dugongs. A well-known major dugong aggregation of approximately 4, 400 individuals occurs in waters seaward (within approximately 50 km) of the Tiwi Islands and ranks in the top eight of dugong populations in the world.

Dugong distribution and movement is based on the abundance, size and species of seagrass meadow. Dugongs can migrate hundreds of kilometres between seagrass habitats. Dugongs have been tracked moving long distances of up to 300 km between the Australia mainland and the Tiwi Islands (Whiting et al., 2009). Satellite-tracking data from dugongs tagged as part of the INPEX Ichthys Project baseline surveys observed that dugongs around the Vernon Islands, south of Melville Island, spent time in Darwin Harbour and around the Tiwi Islands (INPEX, 2010). Routine sightings occur in various locations along the NT coastline, including within Darwin Harbour, to the south of Melville Island.

Dugongs in the NT coastal waters have been observed foraging in intertidal rocky reef flats supporting sponges and algae as seagrass habitat is thought to be rare in the north marine region bioregion (INPEX, 2010; Whiting et al., 2009). However, seagrass communities are known to exist along the north coast of the Tiwi Islands.

The dugong BIAs in the combined EMBA are detailed in **Table 7-3** and shown in **Figure 7-5**.

7.1.17 New Zealand fur-seal

The New Zealand fur-seal (also known as the long-nosed fur seal) (*Arctocephalus forsteri*) is a specially protected species (other specially protected) under the BC Act. The New Zealand fur seal is found in Ngari Capes Marine Park (two colonies) and along other parts of Australia's southern coast.[5]

[5] Identified as a relevant species through review of *Biodiversity Conservation Act 2016* listed species for marine species without an EBPC Act listing.

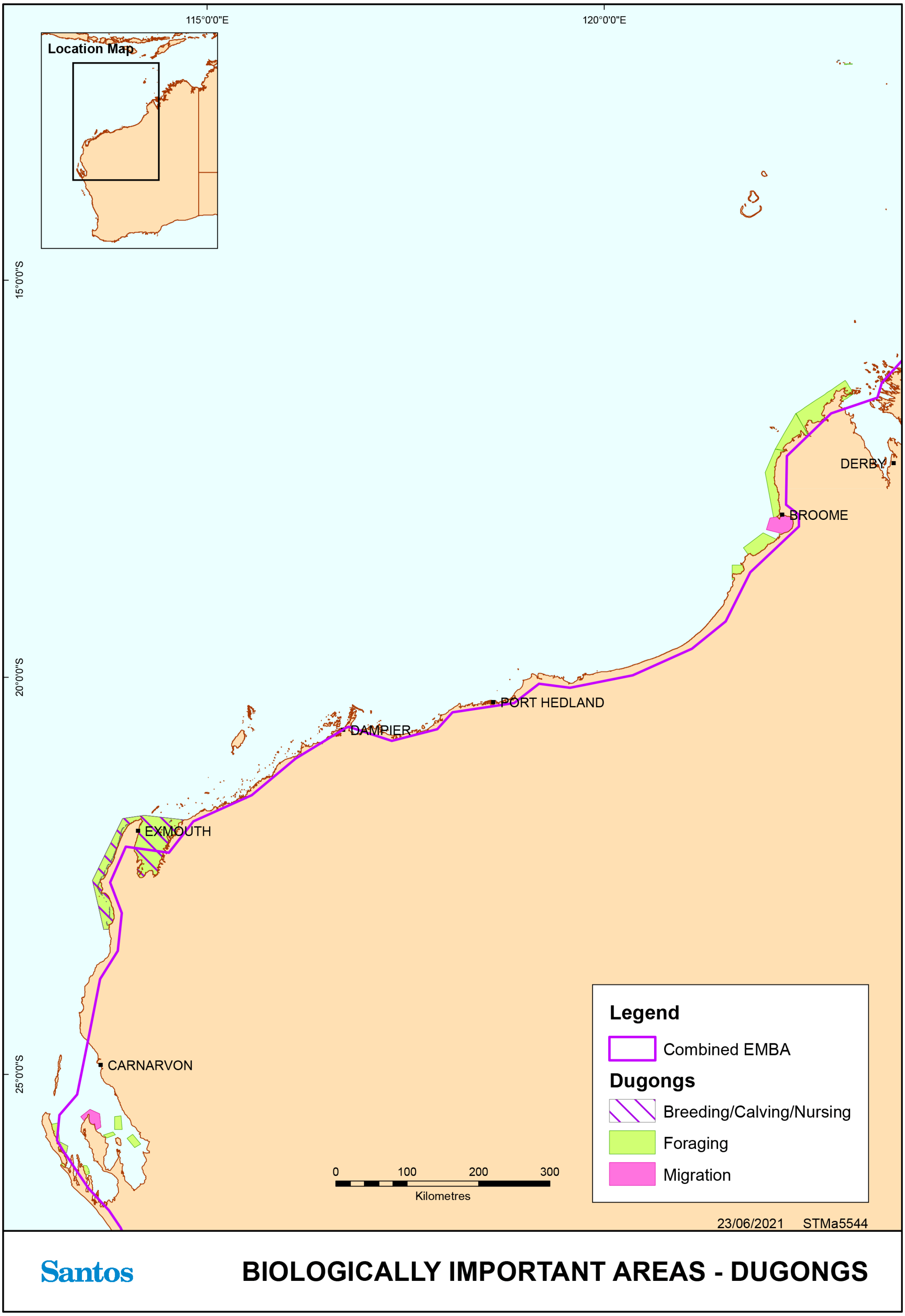

Figure 7-5: Biologically important areas – dugongs

Table 7-2: Summary of information for marine mammals listed as threatened under the EPBC Act

Aspect	Sei whale	Blue and pygmy blue whales	Fin whale	Southern right whale	Humpback whale	Australian sea lion
Species expected in area	Unknown	Yes	Unknown	Unlikely, southern distribution	Yes	Unlikely, southern distribution
Migration depth (m)	Unknown, prefers offshore waters	500-1,000	Unknown	n/a	Up to 100	n/a
Migration seasonality	Unknown	Apr to Aug (north), Oct to Jan (south)	Unknown	n/a	Jun to Nov	n/a

7.2 Biologically Important Areas / Critical Habitat – Marine Mammals

Table 7-3 below provides an overview of BIAs in the combined EMBA for marine mammals

The DAWE may also make recovery plans for threated fauna listed under the EPBC Act. The EPBC Act requires that 'habitat critical to the survival of the listed threatened species' is identified in recovery plans, relevant recovery plans are listed in **Section 13.2**[6].

In addition, both the EPBC Act and WA BC Act and associated regulations (2018) provide for the listing of critical habitat - habitat 'critical to the survival of the threatened species'. To date no critical habitat in WA has been listed under either Act. No provision is made under the Territory Parks and Wildlife Conservation Act 1976 for listing critical habitat.

Table 7-3: Biologically important areas – marine mammals

Species	Scientific name	Aggregation area and use	BIAs within EMBA
Blue and pygmy blue whales	*Balaenoptera musculus*	Migration – along the continental shelf edge off the WA coastline, extending offshore near Scott Reef and into Indonesian waters Foraging – along Ningaloo reef, around Scott Reef, around the Perth canyon Distribution – along the WA coastline towards and beyond Indonesia.	Blue and pygmy blue whale - Head of the Perth Canyon Outer continental shelf from Cape Naturaliste to south of Jurien Bay Outer Perth Canyon Head of the Perth Canyon Pygmy blue whale - Augusta to Derby. Tend to pass along the shelf edge at depths of 500 m to 1000 m; appear close to coast in the Exmouth-Montebello Islands area on southern migration. From Mandurah to south of Cape Naturaliste, seaward to the 50 m depth contour Indonesia- Banda Sea Ningaloo Perth canyon

[6] Further background information on BIA and identification of critical habitat in recovery plans is provided in **Section 5.4**.

Species	Scientific name	Aggregation area and use	BIAs within EMBA
			Scott Reef
Southern right whale	*Eubalaena australis*	Breeding/calving – along the south west and southern coastline of WA/SA	Bunbury area, WA Camac Island/Fremantle, WA Coast Cape Naturaliste to Cape Leeuwin Coast Perth region to Cape Naturaliste Geographe Bay, WA Perth to Kangaroo Island
Humpback whale	*Megaptera novaeangliae*	Breeding/calving/nursing/resting – Kimberley/Coastal North Lacepede Island, Campden Sound, Exmouth Gulf, Shark Bay Migration - northern migration deeper waters of the continental shelf, southward migration – along the WA mainland	Cape Leeuwin to Houtman Abrolhos Cape Naturaliste Cape Naturaliste to Cape Leeuwin Exmouth Gulf Flinders Bay Geographe Bay Houtman Abrolhos Islands Kimberley/Coastal North Lacepede Island, Camden Sound North of Houtman Abrolhos Shark Bay The migration corridor extends from the coast to out to approximately 100 km offshore in the Kimberley region extending south to North West Cape. From North West Cape to south of shark Bay the migration corridor is reduced to approximately 50 km. West coast - Lancelin to Kalbarri West coast- Bunbury to Lancelin including Rottnest Island
Sperm whale	*Physeter macrocephalus*	Foraging - west end of Perth Canyon and Albany Canyons	Western end of Perth canyon Albany Canyons - Immediately south of the continental shelf edge extending over the continental slope
Indo-Pacific humpback dolphin	*Sousa chinensis*	Breeding, calving, foraging – Kimberley coastal waters and islands Significant habitat – unknown behavior – Admiralty Gulf & Parry Harbour and Bougainville Peninsula Significant habitat - Vansittart Bay, Anjo Peninsula	Admiralty Gulf & Parry Harbour Bougainville Peninsula Camden Sound Area - Walcott Inlet, Doubtful Bay, Deception Bay, Augustus Island (Kuri Bay) Carnot & Beagle bay King Sound North and Yampi Sound and Talbot Bay Fjord area near Horizontal Falls King Sound Southern Sector Maret and Biggee Island Pender bay Port Nelson, York Sound, Prince Frederick Harbour Prince Regent River Roebuck Bay Vansittart Bay, Anjo Peninsula

Species	Scientific name	Aggregation area and use	BIAs within EMBA
			Willie Creek
Indo-Pacific/spotted bottlenose dolphin	*Tursiops aduncus*	Breeding, calving, foraging – Kimberley coastal waters and islands Migration – Pender Bay	Camden Sound Area - Walcott Inlet, Doubtful Bay, Deception Bay, Augustus Island (Kuri Bay) King Sound North and Yampi Sound and Talbot Bay Fjord area near Horizontal Falls King Sound Southern Sector Pender bay Roebuck Bay
Irrawaddy dolphin (Australian snubfin dolphin)	*Orcella heinsohni*	Breeding, calving, foraging, resting– Kimberley coastal waters and islands	Admiralty Gulf and Parry Harbour Bougainville Peninsula Camden Sound Area - Walcott Inlet, Doubtful Bay, Deception Bay, Augustus Island (Kuri Bay) Cape Londonderry and King George River Carnot and Beagle bay King Sound North and Yampi Sound and Talbot Bay Fjord area near Horizontal Falls King Sound Southern Sector Maret and Biggee Island Ord River Pender bay Port Nelson, York Sound, Prince Frederick Harbour Prince Regent River Roebuck Bay Vansittart Bay, Anjo Peninsula Willie Creek
Australian sea lion	*Neophoca cinerea*	Foraging – male and female – Houtman Abrolhos Island, mid-west coast (more restricted spatial extent than males) Foraging – males Houtman Abrolhos Island, mid-west coast down to Perth Breeding – Buller Island, North Fisherman Island, Beagle Island, Albrolhos Island Haul Out Sites – North Cervantes Island, Sandland Island, Albrolhos Island	Houtman Abrolhos Islands Mid-west coast, includes Beagle Island, Fisherman Island, Jurien Bay, Cervantes and Buller Colonies From Recherche Archipelago to Doubtful Islands – Key colonies, Kimberly island, Glenny and Wickham Island. Haul-Off rock
Dugong	*Dugong dugon*	Foraging –Dampier Peninsula, Roebuck Bay, Shark Bay, Exmouth and Ningaloo coastline Migration – Roebuck Bay and North East Peron Peninsula, Shark Bay	Ashmore Reef - Far West Ashmore Reef - South (located on sea reef side only, not interior) Between Peron Peninsula and Faure Island, Shark Bay Dirk Hartog Island, Shark Bay East of Faure Island, Shark Bay

Species	Scientific name	Aggregation area and use	BIAs within EMBA
		Breeding/calving/nursing – Exmouth and the Ningaloo coastline	Exmouth Gulf Kimberley coast, Dampier Peninsula Middle Island, Kimberley coast North East Peron Peninsula, Shark Bay North of Faure Island, Shark Bay Pilbara and Kimberley coast near Dampier Peninsula Pilbara and Kimberley coast near James Price Point Roebuck Bay, Broome South Passage, Shark Bay Useless Loop, Shark Bay

8. Birds

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

Coastal or terrestrial species inhabit the offshore islands and coastal areas of the mainland throughout the year. These species are either primarily terrestrial, or they may forage in coastal waters. Resident coastal and terrestrial species include osprey (*Pandion cristatus*), white-bellied sea eagle (*Haliaeetus leucogaster*), silver gull (*Larus novaehollandiae*) and eastern reef egret (*Egreta sacra*) (DEWHA 2008a).

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

Shorebirds, including waders, inhabit the intertidal zone and adjacent areas. Some shorebird species, including oystercatchers are resident (Surman & Nicholson 2013). Other shorebirds are migratory and include species that utilise the East Asian–Australasian Flyway, a migratory pathway for millions of migratory shorebirds that travel from Northern Hemisphere breeding grounds to Southern Hemisphere resting and foraging areas. Shorebirds that regularly migrate through the area include the Scolopacidae (curlews, sandpipers etc.) and Charadriidae (plovers and lapwings) families.

Surveys in the area by Santos and other agencies have built a picture of diverse avifauna. A summary of research is discussed below, followed by information on threatened and migratory birds. Wetlands of international importance are discussed in **Section 9.1.3**.

8.1 Regional Surveys

8.1.1 Abrolhos Islands

The Abrolhos Islands are one of the most significant seabird nesting areas in the eastern Indian Ocean with over two million birds breeding on the islands and small rocky atolls in the Abrolhos (DoF 2012). The mixture of species is unique, as subtropical and tropical species, and littoral and oceanic foragers, share the breeding islands. A total of 95 bird species have been recorded as residents or visitors to the Abrolhos Islands. Of these 35 species are known to breed at the Abrolhos (DoF, 2012):

+ Common noddy (rookery – Pelseart Island): The Abrolhos supports 80%of the Australian breeding population of the common noddy (*Anous stolidus*) with up to 250,000 common noddies breed at Pelsaert Island. These birds lay their eggs in spring, but the actual month can vary, depending on their food supply and the weather conditions existing in offshore waters (DoF 2012);
+ Caspian tern (rookeries – Leo Island, West Wallabi Island and Pelsaert Island): Unlike other more social terns, Caspian terns (*Hydroprogne caspia*) are usually solitary nesters. There are less than 150 of these breeding at the Abrolhos, across 22 islands (DoF 2012);
+ Wedge-tailed shearwaters (rookeries): The Abrolhos are the most important breeding sites in Australia for the wedge tailed shearwater (*Ardenna pacifica*), with between 500,000 and 1,000,000 of these birds breeding there every year, predominantly on West Wallabi Island. The wedge-tailed shearwater breeding colonies at the Abrolhos are the largest in Australia (DoF 2012);
+ Bridled tern (rookeries – Gun Island, Leo Island, Pelsaert Island, Little North Island, Fisherman Islands, Beagle Islands and Penguin Island): Bridled terns (*Onychoprion anaethetus*) breed on 90 islands throughout the Abrolhos. These birds fly north for the winter, through Indonesia to waters around the Phillippines. There are approximately 4,000 bridled terns who return to the Abrolhos around October

every year to lay their eggs. Bridled terns nest on more islands in the Abrolhos than any other bird species (DoF, 2012);

- Osprey (nesting area – Pelseart Island): Up to 100 eastern ospreys (*Pandion cristatus*) nest at a number of sites throughout all three island groups at the Abrolhos, including nesting platforms made from converted rock lobster pots and stacked fishing equipment on jetties (DoF 2012);
- White-bellied sea eagle (nesting area – West Wallabi Island): At the Abrolhos, there are up to 50 breeding white-bellied sea eagles (*Haliaeetus leucogaster*), spread across all three island groups (DoF 2012);
- Australian lesser noddy (feeding area and rookeries Morley Island, Wooded Island and Pelseart Island): In Australia the Australian lesser noddy is only known to breed in this area and is known to forage between the islands and the continental shelf edge; and
- Other areas rookeries identified for both the wedge-tailed shearwater and bridled tern within the south west area include Lancelin Island, Rottnest Island and Safety Bay.

8.1.2 North West Cape

Avifauna surveys of the North West Cape have recorded 144 bird species, one third of which are seabirds and shorebirds (resident and migratory) (May *et al*. 1983). Approximately 33 species of seabirds and shorebirds are found in the Ningaloo Marine Park with the main breeding areas at Mangrove Bay, Mangrove Point, Point Maud, the Mildura wreck site and Fraser Island (CALM & MPRA 2005a).

8.1.3 Muiron Islands and Exmouth Gulf Islands

Muiron Islands and Exmouth Gulf Islands are generally lacking in published bird observations data. Early indications from surveys commissioned by Santos in 2013/14 indicate that South and North Muiron Islands are regionally significant in terms of wedge-tailed shearwater (*Ardenna pacifica*) nesting, whilst Bessiers and Fly islands are also significant (Surman pers comm. 2013). Nine coastal/terrestrial species and 21 shorebirds were identified on the Muiron and Exmouth Gulf Islands during the first of these surveys and seven bird species were recorded nesting (Surman 2013).

8.1.4 Dampier Archipelago/Cape Preston Region

The Dampier Archipelago/Cape Preston region is a nesting area for at least 16 species of seabirds. Many of the islands and rocks in the area are known breeding grounds for birds, including wedge-tailed shearwaters (*Ardenna pacifica*), Caspian terns (*Sterna caspia*), bridled terns (*Onychoprion anaethetus*) and roseate terns (*Sterna dougallii*). Small islands and islets such as Goodwyn Island, Keast Island and Nelson Rocks provide important undisturbed nesting and refuge sites, and Keast Island provides one of the few nesting sites for pelicans in WA (CALM & MPRA 2005).

8.1.5 Barrow Island Group

Barrow Island and surrounding islands have a diverse avifauna comprising at least 110 species, including 11 resident land birds, eight resident seabirds, 17 seabirds, 22 species of migratory waders, six resident shorebirds and 43 irregular visitors (Surman 2003). The avifauna of Barrow Island is thus poor in terms of land birds and waterfowl compared to mainland areas of the Pilbara, but rich in migratory waders and seabirds. Compared to other nearby offshore islands, Barrow Island has substantially more migratory waders but fewer breeding seabirds (Surman 2003).

8.1.6 Lowendal Island Group and Airlie and Serrurier Islands

The Lowendal Island Group has a diverse avifauna comprising 89 recorded species (Dinara Pty Ltd. 1991, Burbidge *et al*. 2000). Six species of resident land birds and six species of raptors have been recorded at the Lowendal Islands (Surman & Nicholson 2012). Up to fourteen seabird species have been observed at any one time during annual surveys of the Lowendal Islands between 2004 and 2012. Surveys at the Montebello Islands have recorded 70 bird species. This includes 12 species of seabirds and 14 species of migratory shorebirds (Burbidge *et al*. 2000).

Wedge-tailed shearwaters have been identified to nest on Varanus, Airlie, Serrurier and Bridled Islands (Astron 2017a). Breeding participation on the islands appears to be largely influenced by pre-breeding oceanographic conditions (Astron 2017a). Monitoring in 2016/17 was undertaken by Santos and demonstrated the colony sizes for wedge-tailed shearwaters to be within or above previously reported ranges (Astron 2017a). This is informed though monitoring that has been undertaken under the Integrated Shearwater Monitoring Program (ISMP), established in 1994.

In 2016/17, areas of potential wedge-tailed shearwater nesting habitat were recorded on Varanus Island (5.53 ha) and Airlie Island (12.47 ha) and surrounding islands of Bridled (2.94 ha), Serrurier (130.89 ha), Abutilon (2.02 ha) and Parakeelya (1.66 ha) (Astron 2017a). The number of wedge-tailed shearwater breeding pairs was also estimated for each of Varanus (1,492 +/- 702), Airlie (600 +/- 124), Bridled (1,039 +/- 342), Serrurier (23,240 +/- 4,341), Abutilon (317 +/- 210) and Parakeelya (172 +/- 138) islands (Astron 2017a).

Other seabird species utilising Abutilon, Beacon, Bridled and Parakeelya islands for nesting include bridled terns, silver gulls, crested terns and lesser crested terns. Monitoring for these seabirds in 2016/17 was also completed by Santos, with monitoring results concluded to support previous trends for all species. Bridled terns mainly utilise Abutilon, Bridled and Parakeelya islands for breeding, with smaller numbers noted on Beacon and Varanus Islands. The bridled terns have not been recorded on Airlie Island and only in very small numbers on Varanus Island (Astron 2017b).

Silver gull numbers appear to be growing across the region (2010/2011). However, reasons for this are unknown but considered possibly to be due to greater prey availability or immigration from the mainland (Astron 2017b). Silver gulls have been found to utilise Bridled, Parakeelya, Abutilon and Beacon islands longer term for breeding. Silver gulls have not been identified to nest on Varanus island and were only recorded nesting on Airlie island for the first time in 2016/17 since monitoring commencement in 2004/05 (Astron 2017b).

The crested tern and lesser crested tern are noted as nomadic breeders that appear to use a consistent subset of islands for breeding. In 2016/17, Beacon Island was the favourable nesting site for the crested tern and lesser crested tern (Astron 2017b). Surveys in the vicinity of Port Hedland (Bennelongia 2011) recorded 23 species of migratory shorebird between 2002 and 2011. Terrestrial/coastal and seabird species were not targeted. A total of 4,248 migratory shorebirds of 18 species were observed during the field survey in April 2011.

8.2 Threatened Species

A Protected Matters search of the combined EMBA identified 33 bird species (**Appendix A**) listed as threatened under the EPBC Act.

An examination of the Species Profile and Threats database (DAWE 2020a) and The Action Plan for Australian Birds (Garnet 2011) showed that some listed bird species are not expected to occur in significant numbers in the marine and coastal environments in the combined EMBA due to their terrestrial or southern distributions. Hence, these species are not discussed further.

EPBC Act threatened species expected to occur in the area are listed in **Table 8-1** along with their WA and NT conservation status (as applicable), and discussed below. There are an additional 51 migratory species listed under the EPBC Act, with these detailed in **Section 8.3** (**Table 8-3**). BIAs for birds are detailed in **Table 8-6** and depicted in **Figure 8-1** and **Figure 8-2**.

Table 8-1: Birds listed as threatened under the EPBC Act

Species	Conservation Status				Likelihood of occurrence in EMBA	BIAs in EMBA
	EPBC Act 1999	BC Act 2016	Other WA Conservation Code	*TPWC Act 1976*		
Shorebirds						
Red knot (Calidris canutus)	Endangered, Migratory	Endangered	-	Vulnerable	Species or species habitat known to occur within area	None - No BIA defined
Christmas Island Goshawk (*Accipiter fasciatus natalis*)	Endangered	Endangered	-	-	Species or species habitat known to occur within area	None - No BIA defined
Curlew sandpiper (*Calidris ferruginea*)	Critically endangered, Migratory	Critically endangered	-	Vulnerable	Species or species habitat known to occur within area	None - No BIA defined
Great knot (*Calidris tenuirostris)*	Critically endangered, Migratory	Critically endangered	-	Vulnerable	Roosting known to occur within area	None - No BIA defined
Greater sand plover (*Charadrius leschenaultii)*	Vulnerable, Migratory	Vulnerable	-	Vulnerable	Roosting known to occur within area	None - No BIA defined
Lesser sand plover (*Charadrius mongolus)*	Endangered, Migratory	Endangered	-	Vulnerable	Roosting known to occur within area	None - No BIA defined
Western Alaskan bar-tailed godwit (*Limosa lapponica baueri)*	Vulnerable, Migratory[7]	Vulnerable, Specially protected (migratory)[7]	-	Vulnerable	Species or species habitat known to occur within area	None - No BIA defined
Northern Siberian bar-tailed godwit (*Limosa lapponica menzbieri)*	Critically endangered, Migratory[7]	Critically endangered, Specially protected (migratory)[7]	-	Vulnerable	Species or species habitat known to occur within area	None - No BIA defined
Eastern curlew (*Numenius madagascariensis)*	Critically endangered, Migratory	Critically endangered	-	Vulnerable	Species or species habitat known to occur within area	None - No BIA defined

[7] Listed as migratory at species level

Species	Conservation Status				Likelihood of occurrence in EMBA	BIAs in EMBA
	EPBC Act 1999	BC Act 2016	Other WA Conservation Code	*TPWC Act 1976*		
Australasian bittern (*Botaurus poiciloptilus)*	Endangered	Endangered	-	-	Species or species habitat known to occur within area	Yes – refer to **Table 8-6**
Australian painted snipe (*Rostratula australis)*	Endangered	Endangered	-	Vulnerable	Species or species habitat may occur within area	None - No BIA defined
Seabirds						
Australian lesser noddy (*Anous tenuirostris melanops)*	Vulnerable	Endangered	-	-	Breeding known to occur within area	Yes – refer to **Table 8-6**
Fairy prion (southern) (*Pachyptila tutur subantarctica)*	Vulnerable	-	-	-	Species or species habitat known to occur within area	None - No BIA defined
Southern royal albatross (*Diomedea epomophora)*	Vulnerable, Migratory	Vulnerable	-	-	Foraging, feeding or related behaviour likely to occur within area	None - No BIA defined
Northern royal albatross (*Diomedea sanfordi)*	Endangered, Migratory	Endangered	-	-	Foraging, feeding or related behaviour likely to occur within area	None - No BIA defined
Amsterdam albatross (*Diomedea amsterdamensis*)	Endangered, Migratory	Critically endangered	-	-	Species or species habitat may occur within area	None - No BIA defined
Antipodean albatross (*Diomedea antipodensis)*	Vulnerable	-	-	-	Foraging, feeding or related behaviour likely to occur within area	None - No BIA defined
Sooty Albatross (*Phoebetria fusca)*	Vulnerable, Migratory	Endangered	-	-	Species or species habitat may occur within area	None - No BIA defined

Species	Conservation Status				Likelihood of occurrence in EMBA	BIAs in EMBA
	EPBC Act 1999	BC Act 2016	Other WA Conservation Code	*TPWC Act 1976*		
Tristan albatross (*Diomedea dabbenea)*	Endangered, Migratory	Critically endangered	-	-	Species or species habitat may occur within area	None - No BIA defined
Wandering albatross (*Diomedea exulans)*	Vulnerable, Migratory	Vulnerable	-	-	Foraging, feeding or related behaviour likely to occur within area	None - BIA not found in EMBA
Christmas island frigatebird (*Fregata andrewsi)*	Endangered, Migratory	Specially protected (migratory)	-	-	Foraging, feeding or related behaviour known to occur within area	Yes – refer to **Table 8-6**
Southern giant petrel (*Macronectes giganteus)*	Endangered, Migratory	Specially protected (migratory)	-	-	Species or species habitat may occur within area	None - BIA not found in EMBA
Northern giant petrel (*Macronectes halli)*	Vulnerable, Migratory	Specially protected (migratory)	-	-	Species or species habitat may occur within area	None - BIA not found in EMBA
Abbott's booby (*Papasula abbotti)*	Endangered	-	-	-	Species or species habitat likely to occur within area	Yes – refer to **Table 8-6**
Soft-plumaged petrel (*Pterodroma mollis)*	Vulnerable	-	-	-	Foraging, feeding or related behaviour known to occur within area	Yes – refer to **Table 8-6**
Blue petrel (*Halobaena caerulea)*	Vulnerable	-	-	-	Species or species habitat may occur within area	None - No BIA defined
Australian fairy tern (*Sternula nereis nereis)*	Vulnerable	Vulnerable	-	-	Breeding known to occur within area	Yes – refer to **Table 8-6**

Species	Conservation Status				Likelihood of occurrence in EMBA	BIAs in EMBA
	EPBC Act 1999	BC Act 2016	Other WA Conservation Code	*TPWC Act 1976*		
Indian yellow-nosed albatross (*Thalassarche carteri)*	Vulnerable, Migratory	Endangered	-	-	Foraging, feeding or related behaviour may occur within area	Yes – refer to **Table 8-6**
Shy albatross (*Thalassarche cauta)*	Endangered, Migratory	Vulnerable	-	-	Foraging, feeding or related behaviour likely to occur within area	None - BIA not found in EMBA
White-capped albatross (*Thalassarche steadi)*	Vulnerable, Migratory	Vulnerable	-	-	Foraging, feeding or related behaviour likely to occur within area	None - BIA not found in EMBA
Black-browed albatross (*Thalassarche melanophris)*	Vulnerable, Vulnerable	Endangered	-	-	Species or species habitat may occur within area	None - BIA not found in EMBA
Campbell albatross (*Thalassarche impavida)*	Vulnerable, Migratory	Vulnerable	-	-	Species or species habitat may occur within area	None - BIA not found in EMBA
Christmas Island white-tailed tropicbird (*Phaethon lepturus fulvus)*	Endangered	-	-	-	Species or species habitat may occur within area	None - No BIA defined

8.2.1 Shorebirds

Red Knot (New Siberian Islands and north-eastern Siberia)

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

Curlew Sandpiper

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

Great Knot

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

Greater Sand Plover and Lesser Sand Plover

The greater sand plover and lesser sand plover are congeners that breed in China, Mongolia and Russia. The greater sand plover spends the non-breeding season along coasts from Japan through southeast Asia to Australasia, while the lesser sand plover spends the non-breeding season along coasts from Taiwan to Australasia (Banford *et al*. 2008). Non-breeding birds occur along all Australian coasts, especially in the north for the greater sand plover and in the east for the lesser sand plover (DAWE 2020a).

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

Bar-tailed Godwit (Western Alaskan and Northern Siberian Subspecies)

Two subspecies of the bar-tailed godwit exist, as determined by their breeding locations in Siberia and Alaska (Bamford *et al*. 2008). Non-breeding birds migrate to the coasts of Australia. The western Alaskan subspecies occurs especially on the north and east coasts of Australia whilst the northern Siberian subspecies occurs especially along the coasts of north Western Australia (DAWE 2020a).

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

Eastern Curlew

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

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

Australian Painted Snipe

The Australian painted snipe has been recorded at wetlands in all states of Australia (DoE 2014g). The Australian painted snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia or canegrass or sometimes tea-tree (*Melaleuca*). The Australian painted snipe sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber (DoE 2014g).

Australasian Bittern

The Australasian bittern is found in coastal and sub-coastal areas of south-eastern and south-western mainland Australia and the eastern marshes of Tasmania (Birdlife Australia 2017). The Australasian Bittern occurs mainly in freshwater wetlands and, rarely, in estuaries or tidal wetlands (Marchant & Higgins 1990). It favours wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. *Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus*) or cutting grass (*Gahnia*) growing over a muddy or peaty substrate (Marchant & Higgins 1990). The diet of the Australasian Bittern includes aquatic animals such as small fish, frogs, freshwater crayfish, spiders, insects and small reptiles at night. Breeding occurs during summer from October to January.

All remaining natural habitat (including constructed wetlands) is considered critical habitat for this species. This species is known to occur on the western coastal plain between Lancelin and Busselton and the southern coastal region from Augusta to east of Albany within the combined EMBA (**Table 8-6**).

8.2.2 Seabirds

Australian Lesser Noddy

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

Breeding apparently occurs only on Morley, Wooded and Pelsaert Islands at the Houtman Abrolhos Islands (Higgins and Davies 1996 in DoE 2014b). Mangrove stands support approximately 68,000 breeding pairs spread over the three islands (Surman & Nicholson 2006). Breeding may also occur on Ashmore Reef (Stokes & Hinchey 1990). The breeding season extends from mid-August to early April (Higgins & Davies 1996 in DoE 2014b).

The National Conservation Values Atlas identifies BIAs for this species in the area of the Houtman Abrolhos islands (**Table 8-6**). The Species Group Report Card – Seabirds (DSEWPaC 2012b) states that the entire Australian population of this species breeds in the South-west Marine Region, south of Busselton.

Albatrosses

A Protected Matters search of the waters in the combined EMBA (**Appendix A**) identified several albatross species that may occur in the area, comprising of the southern royal albatross, northern royal albatross, Amsterdam albatross, Antipodean albatross, Tristan albatross, sooty albatross, wandering albatross, Indian yellow-nosed albatross, shy albatross, white-capped albatross, black-browed albatross and Campbell albatross. All these species predominantly occur in subantarctic to subtropical waters and breed on islands in the southern oceans (DAWE 2020a).

The National Conservation Values Atlas (DAWE 2020b) and the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC 2011) do not identify any BIAs for these species in the area from Busselton to the NT border. However, a BIA for the Indian yellow-nosed albatross is identified for foraging north to Shark bay and extending east into Bass Strait.

Christmas Island Frigatebird

The Christmas Island frigatebird is a very large seabird. Breeding colonies of the Christmas Island frigatebird is currently confined to Christmas Island in the Indian Ocean (Birdlife International 2019) but forages and roosts widely in south-east Asia and Indian Ocean No breeding colonies have ever been found away from Christmas Island. The Christmas Island Frigatebird predominantly nests in forests on shore terraces that are protected from prevailing south-east trade winds (TSSC 2020a). All forest containing nesting and roosting sites, including currently known nesting and roosting colonies and any other smaller groups of nests and roosts on Christmas Island is considered critical habitat (TSSC 2020a).

Christmas Island Goshawk

The Christmas Island Goshawk 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.

Southern Giant Petrel

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 2020a).

The National Conservation Values Atlas (DAWE 2020b) and the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC 2011) do not identify any BIAs for this species in the area from Busselton to the NT border.

Northern Giant Petrel

The northern giant petrel occupies the Antarctic Polar Front. In summer, it occurs predominantly in sub-Antarctic to Antarctic waters, usually between 40 and 64° The northern giant-petrel breeds on sub-Antarctic islands. Its breeding range extends into the Antarctic zone at South Georgia. It nests in coastal areas where vegetation or broken terrain offers shelter, on sea-facing slopes, headlands, in the lee of banks, under or against vegetation clumps, below cliffs or overhanging rocks, or in hollows. On Campbell Island, it nests on the edge of the coastal plateau. Tussock-grass is widespread at many breeding sites. Its nests are built in secluded, coastal sites, sheltered by heavy vegetation. On Antipodes Island, it nests under *Senecio antipoda* (DoE 2014d).

The National Conservation Values Atlas (DAWE 2020b) does not identify any BIAs for this species in the area spanning SW WA to the NT border.

Soft-Plumaged Petrel

The soft-plumaged petrel 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 2020a).

A BIA for this species is identified for foraging in seas north to 21°30’S off WA.

Blue Petrel

The blue petrel is marine species of the Sub Antarctic and Antarctic seas. In summer, it occurs mainly over waters of -2 to 2° C in surface temperature, but it also ranges south to the edge of the pack-ice and north to approximately 30° south, or further north over cool currents (DoE 2014e). In the Antarctic, it generally avoids the pack-ice, and only occasionally approaches the edge of the ice. Given the location of the combined EMBA, this species is unlikely to occur.

The National Conservation Values Atlas (DAWE 2020b) does not identify any BIAs for this species in the area spanning SW WA to the NT border.

Abbott’s Booby

Currently, Abbott's booby is only known to breed on Christmas Island and to forage in the waters surrounding the island and south-east Asia (TSSC 2020b). Within Christmas Island, most nests are found in the tall plateau forest on the central and western areas of the island, and in the upper terrace forest of the northern coast.

The National Conservation Values Atlas (DoEE 2019b) does not identify any BIAs for this species in the area spanning SW WA to the NT border. Critical habitat is considered all known nesting trees and all forest vegetation within a 200m radius of known nesting trees on Christmas Island (TSSC 2020).

Australian Fairy Tern

The Australian fairy tern is distributed in 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 occurs along the coasts of Victoria, Tasmania, South Australia and WA; occurring as far north as the Dampier Archipelago (DAWE 2020a). 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 in DoE 2014b, Lindsey 1986).

Australian fairy terns nest on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The Australian fairy tern breeds from August to February depending on the location of the breeding colony (Higgins & Davies 1996 in DAWE 2020a). They generally nest in small colonies of up to 100 birds, although larger colonies of more than 1400 pairs have been reported in Western Australia (Hill *et al*. 1988).

The National Conservation Values Atlas (DAWE 2020b) identifies the vicinity of the lower north-west coast (north to Dampier Archipelago) and west coast (south to Peel inlet) as BIAs for foraging. Biologically important breeding areas were also identified scattered along the coast between Shark Bay and the Pilbara (**Table 8-6**).

Christmas Island White-tailed Tropicbird

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

The National Conservation Values Atlas (DAWE 2020b) does not identify any BIAs for this species within the combined EMBA.

Fairy Prion (southern)

The fairy prion is distributed off the cold-water coasts of Antarctica and southern Australia and New Zealand. The southern subspecies is known to breed on Macquarie Island, Langdon Point, Davis Point and Bishop and Clerk islands (Garnett & Crowley 2000). It is estimated that the population of the fairy piron (southern) is a little over 50 pairs (Brothers 1984).

The National Conservation Values Atlas (DAWE 2020b) does not identify any BIAs for this species within the combined EMBA.

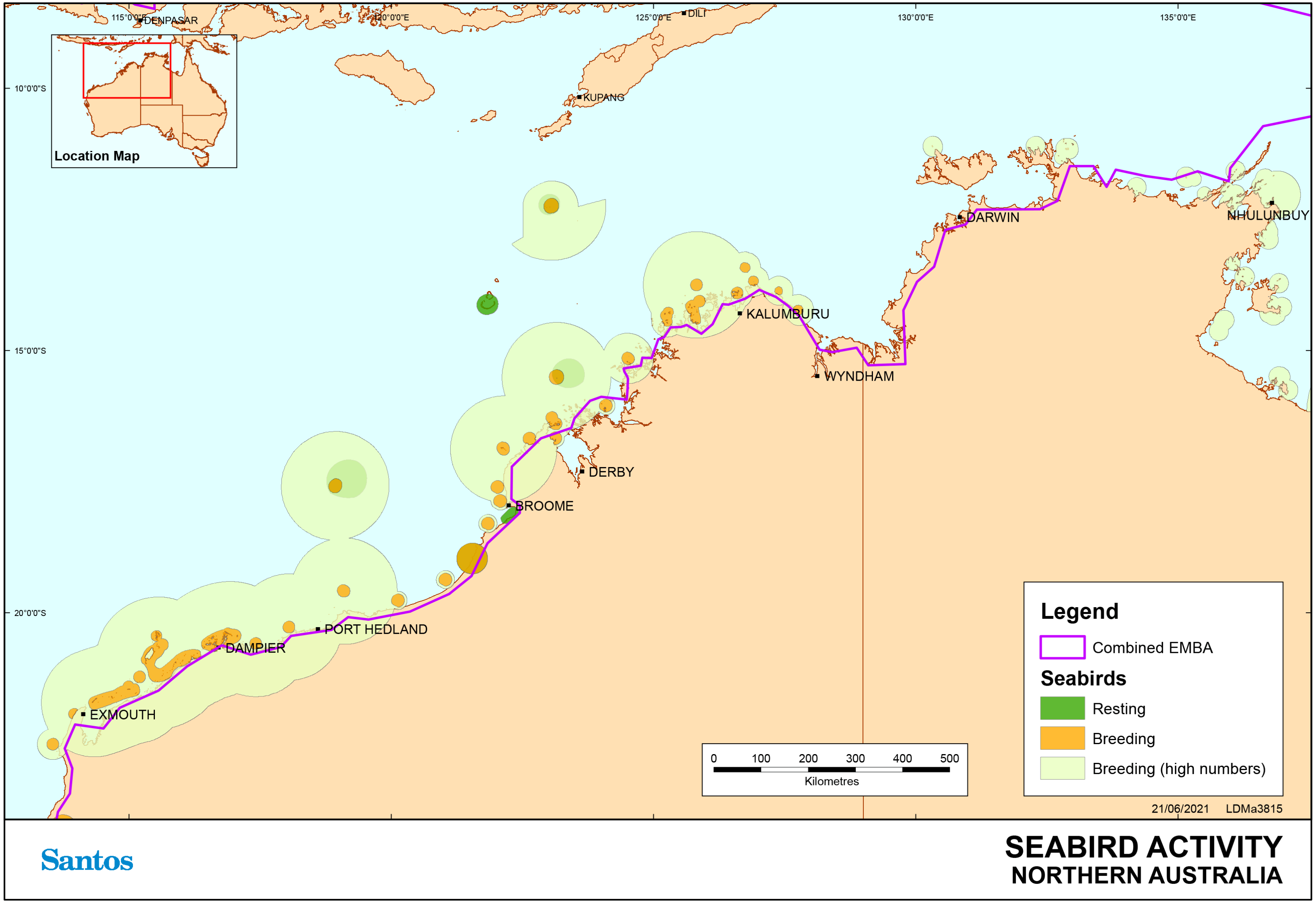

Figure 8-1: Biologically important areas – birds – Northern WA

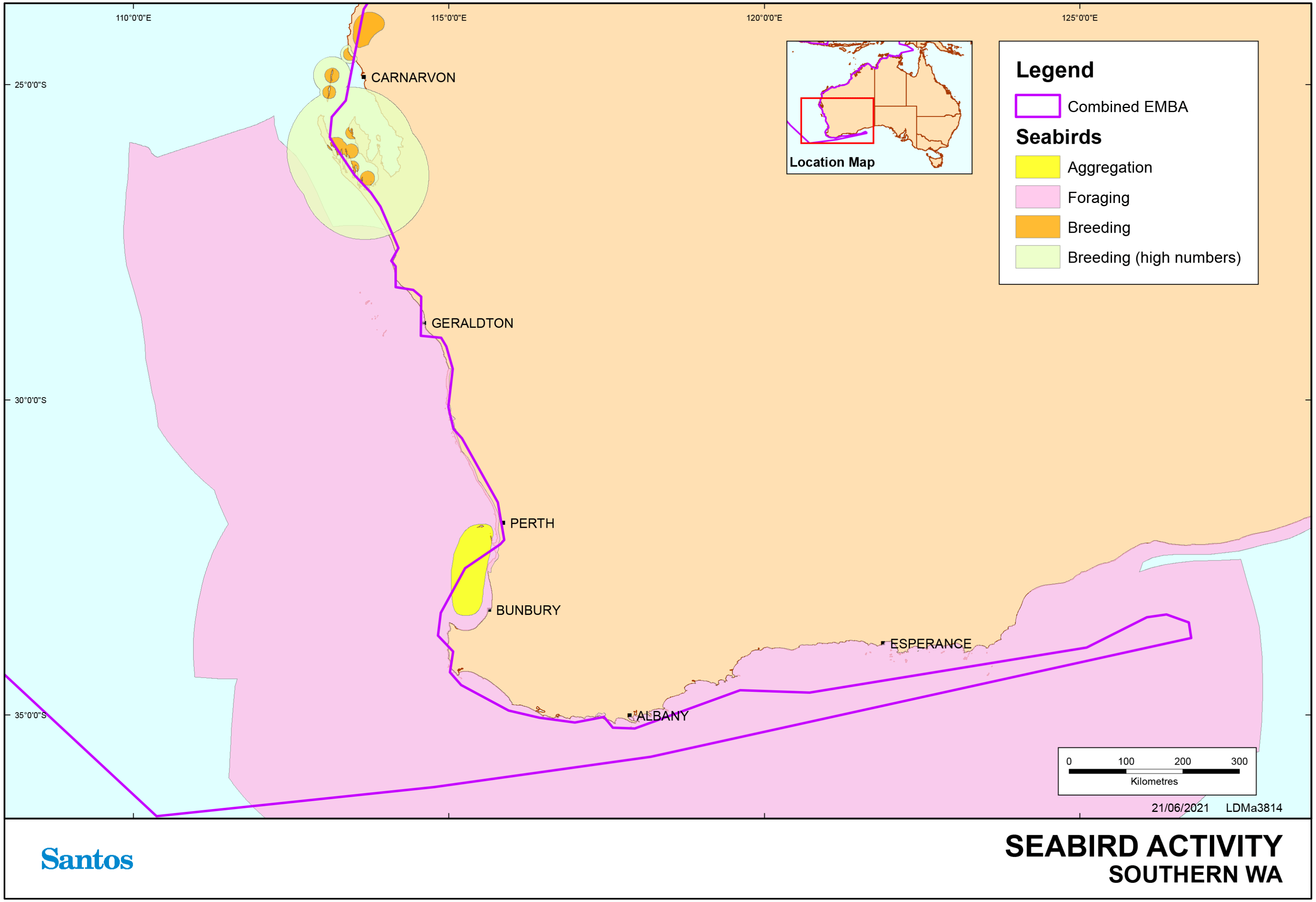

Figure 8-2: Biologically important areas – birds – Southern WA

Table 8-2: Summary of information for birds listed as threatened under the EPBC Act that may be in the combined EMBA

Species	Species Expected in EMBA	Breeding in the Area /Seasonality	Foraging
Shorebirds			
Red knot	Yes	No	Intertidal invertebrates
Curlew sandpiper	Yes	No	Polychaete worms, molluscs and crustaceans taken from shorelines
Great knot	Yes	No	Bivalves, gastropods, crustaceans and other invertebrates taken from shorelines
Greater sand plover/lesser sand plover	Yes	No	Marine invertebrates taken from shorelines
Bar-tailed godwit	Yes	No	Annelids, bivalves and crustaceans taken from shorelines
Eastern curlew	Yes	No	Marine invertebrates associated with seagrass
Australasian bittern	Yes	No	Other small animals, insects, snails and spiders
Australian painted snipe	Yes	No	Seeds and small invertebrates
Western Alaskan bar-tailed godwit	Yes	No	Worms, molluscs, crustaceans, insects
Northern Siberian bar-tailed godwit	Yes	No	Worms, molluscs, crustaceans, insects and some plant material
Seabirds			
Australian lesser noddy	May forage from Kalbarri to Shark Bay	No	Small fish taken from marine and coastal waters (DoE 2014b)
Amsterdam albatross	Low densities	No	Cephalopods, fish and crustaceans taken from marine and coastal waters.
Antipodean albatross	Low densities	No	Cephalopods, fish and crustaceans taken from marine and coastal waters.
Black-browed albatross	Low densities	No	Cephalopods, fish and crustaceans taken from marine and coastal waters.
Campbell albatross	Low densities	No	Cephalopods, fish, salps, jellyfish and crustaceans taken from marine and coastal waters.
Indian yellow-nosed albatross	Low densities	No	Cephalopods, and fish taken from marine and coastal waters.
Northern royal albatross	Low densities	No	Cephalopods, fish, salps and crustaceans taken from marine and coastal waters.
Shy albatross	Low densities	No	Cephalopods, fish and crustaceans taken from marine and coastal waters.
Sooty Albatross	Low densities	No	Cephalopods, fish, crustaceans, siphonophores and penguin carrion taken from marine waters.

Species	Species Expected in EMBA	Breeding in the Area /Seasonality	Foraging
Southern royal albatross	Low densities	No	Cephalopods, and fish taken from marine and coastal waters.
Tristan albatross	Low densities	No	Cephalopods, fish and crustaceans taken from marine waters.
Wandering albatross	Low densities	No	Cephalopods, fish and crustaceans taken from marine and coastal waters.
White-capped albatross	Low densities	No	Cephalopods and fish taken from marine and coastal waters.
Southern & Northern giant petrel	Low densities	No	Scavenges penguin, seal and whale carcasses. Hunts live birds, penguin chicks' cephalopods and krill. Marine and coastal waters (DoE 2014b)
Soft-plumaged petrel	Low densities	No	Cephalopods, fish and crustaceans taken from marine and coastal waters (DoE 2014b)
Australian fairy tern	Yes	Yes Aug to Feb	Bait fish taken from coastal waters
Fairy prion (southern)	Very low densities	No	Small pelagic crustaceans, small fish and squid
Christmas Island frigatebird	Low densities	No	Planktonic crustaceans, fish and squid
Abbott's booby	Low densities	No	Fish and squid
Blue petrel	Low densities	No	Crustaceans, small fish and squid
Christmas Island white-tailed tropicbird	Very low densities	No	Squid and flying fish

8.3 Migratory Species

The EPBC PMST search identified an additional 51 species listed as migratory under the EPBC Act that may occur within the combined EMBA. These species are listed in **Table 8-3**. All of these species are also listed as migratory under the BC Act, with the exception of the flesh-footed shearwater, which is listed as vulnerable under the BC Act. Those species that are listed as both migratory and threatened under either the EPBC Act and/or BC Act are outlined in **Table 8-1** and are not repeated within **Table 8-3**.

Table 8-3: Summary of migratory birds that may occur within the combined EMBA

Species	Common Name	Likelihood of occurrence in EMBA
Limnodromus semipalmatus	Asian dowitcher	Roosting known to occur within area
Limosa lapponica	Bar-tailed godwit	Species or species habitat known to occur within area
Limosa limosa	Black-tailed godwit	Roosting known to occur within area
Onychoprion anaethetus	Bridled tern	Breeding known to occur within area
Limicola falcinellus	Broad-billed sandpiper	Roosting known to occur within area
Sula leucogaster	Brown booby	Breeding known to occur within area
Hydroprogne caspia	Caspian tern	Breeding known to occur within area

Species	Common Name	Likelihood of occurrence in EMBA
Tringa nebularia	Common greenshank	Species or species habitat known to occur within area
Anous stolidus	Common noddy	Breeding known to occur within area
Tringa totanus	Common redshank	Roosting known to occur within area
Actitis hypoleucos	Common sandpiper	Species or species habitat known to occur within area
Thalasseus bergii	Crested tern	Breeding known to occur within area
Charadrius bicinctus	Double-banded plover	Roosting known to occur within area
Ardenna carneipes	Flesh-footed shearwater	Breeding known to occur within area
Apus pacificus	Fork-tailed swift	Species or species habitat likely to occur within area
Thalasseus bergii	Greater crested tern	Breeding known to occur within area
Fregata minor	Greater frigatebird	Breeding known to occur within area
Pluvialis squatarola	Grey plover	Roosting known to occur within area
Tringa brevipes	Grey-tailed tattler	Roosting known to occur within area
Fregata ariel	Lesser frigatebird	Breeding known to occur within area
Numenius minutus	Little curlew	Roosting known to occur within area
Tringa stagnatilis	Little greenshank	Roosting known to occur within area
Sternula albifrons	Little tern	Breeding known to occur within area
Calidris subminuta	Long-toed stint	Species or species habitat known to occur within area
Sula dactylatra	Masked booby	Breeding known to occur within area
Tringa stagnatilis	Marsh sandpiper	Roosting known to occur within area
Charadrius veredus	Oriental plover	Roosting known to occur within area
Glareola maldivarum	Oriental pratincole	Roosting known to occur within area
Pandion haliaetus	Osprey	Breeding known to occur within area
Pluvialis fulva	Pacific golden plover	Roosting known to occur within area
Calidris melanotos	Pectoral sandpiper	Species or species habitat known to occur within area
Gallinago stenura	Pin-tailed snipe	Roosting known to occur within area
Sula sula	Red-footed booby	Breeding known to occur within area
Phalaropus lobatus	Red-necked phalarope	Roosting known to occur within area
Calidris ruficollis	Red-necked stint	Roosting known to occur within area
Phaethon rubricauda	Red-tailed tropicbird	Breeding known to occur within area
Sterna dougallii	Roseate tern	Breeding known to occur within area
Arenaria interpres	Ruddy turnstone	Roosting known to occur within area
Philomachus pugnax	Ruff (reeve)	Roosting known to occur within area
Calidris alba	Sanderling	Roosting known to occur within area
Calidris acuminata	Sharp-tailed sandpiper	Roosting known to occur within area
Erythrotriorchis radiatus	Short-tailed shearwater	Species or species habitat may occur within area
Ardenna grisea	Sooty shearwater	Species or species habitat may occur within area

Species	Common Name	Likelihood of occurrence in EMBA
Calonectris leucomelas	Streaked shearwater	Species or species habitat known to occur within area
Gallinago magala	Swinhoe's snipe	Roosting known to occur within area
Xenus cinereus	Terek sandpiper	Roosting known to occur within area
Tringa glareola	Wandering Tattler	Roosting known to occur within area
Ardenna pacifica	Wedge-tailed shearwater	Breeding known to occur within area
Numenius phaeopus	Whimbrel	Roosting known to occur within area
Phaethon lepturus	White-tailed tropicbird	Breeding known to occur within area
Tringa glareola	Wood sandpiper	Roosting known to occur within area

Australia is signatory to three international treaties with China, Japan and the Republic of Korea to safeguard migratory bird species, predominantly shorebirds. To facilitate observance of the three agreements, 36 species of migratory shorebirds have been listed as specially protected under both the Commonwealth EPBC Act and the WA BC Act.

Eleven internationally recognised areas that can support shorebird migrations are protected as wetlands of international importance. These wetlands are discussed further in **Section 9.1.3**.

The EPBC Act Policy Statement 3.21 sets out criteria for determining the significance of sites to migratory shorebirds based on the number of migratory species and the proportion of a species population that is supported by the site (Commonwealth of Australia 2017b). Site significance can be difficult to assess, particularly for ephemeral inland wetlands. These areas may be used rarely, depending weather conditions, but still provide important habitat for migratory shorebird species.

Migratory shorebirds require a particular conservation approach due to their migration patterns that take them across international boundaries (Bamford *et al*. 2008). These species and their habitats are sensitive to threats due to their high site fidelity, tendency to aggregate, high energy demands and the need for habitat networks containing both roosting and foraging sites (Commonwealth of Australia 2017b). Migratory shorebirds are known to use networks of connected sites (also known as site complexes). They move within these networks depending on the time of day, availability of resources and environmental conditions at the site (Commonwealth of Australia 2017b).

The types of habitat used by migratory shorebirds in Australia vary across the species identified in the PMST search. Migratory shorebirds use both coastal and inland habitats that most commonly include:

- Coastal habitats: coastal wetlands, estuaries, mudflats, rocky inlets, reefs and sandy beaches, sometimes supporting mangroves; and
- Inland habitats: inland wetlands, floodplains and grassland areas, often with ephemeral water sources (Commonwealth of Australia 2017b).

Feeding guilds provide an explanation for much of the shorebird distribution pattern in the north Western Australia. For example, Rogers (1999) classified shorebirds (and others) in Roebuck Bay as belonging to seven guilds on the basis of prey choice and foraging method. In order of abundance, these are summarised in **Table 8-4**.

Table 8-4: Feeding guilds based on prey choice and foraging method (Rogers 1999) adapted from DEC (2003) and Bennelongia (2008)

Feeding habitat	Feeding guild	Species
Sea edge	Tactile hunters of macrobenthos	Great knot, red knot, bar-tailed godwit, black-tailed godwit, Asian dowitcher

Feeding habitat	Feeding guild	Species
Along sandy sea edges or near tidal creeks	Tactile hunters of microbenthos	Curlew sandpiper, red-necked stint, broad-billed sandpiper, marsh sandpiper, sharp-tailed sandpiper
Reefs or mangrove fringes	Visual hunters of slow surface-dwelling prey	Common sandpiper, sooty oystercatcher, pied oystercatcher, silver gull, ruddy turnstone
Sandier western parts of Roebuck Bay, often near-shore	Visual hunters of small fast prey	Grey plover, red-capped plover, greater sand plover, lesser sand plover, grey-tailed tattler, terek sandpiper
Soft mudflats in north-east Roebuck Bay	Visual hunters of fast large prey	Eastern curlew, whimbrel, greenshank, striated heron and black-necked stork
Soft mudflats in north-east Roebuck Bay	Kleptoparasites	Gull-billed tern (robs large crabs from whimbrels)
Creek-lines in eastern Roebuck Bay	Pelagic hunters of nekton (animals of the pelagic zone) and neuston (animals that live on the surface film)	Black-winged stilt, red-necked avocet, reef egret, little egret, great white egret, white-faced heron, royal spoonbill

The Wildlife Conservation Plan for Migratory Shorebirds (DoE 2015) provides a framework to guide the conservation of migratory shorebirds and their habitat in Australia and, in recognition of their migratory habits, outlines national activities to support their appreciation and conservation throughout the East Asian-Australasian Flyway.

The following migratory shorebird species are subject to the Wildlife Conservation Plan for Migratory Shorebirds 2015 (DoE 2015).

Table 8-5: Birds subject to the Wildlife Conservation Plan for Migratory Shorebirds 2015

Migratory species	DoEE SPRAT information on distribution within the area of interest
Asian dowitcher	The Asian dowitcher is a regular visitor to the north-west between Port Hedland and Broome. Elsewhere they are sporadic and rare. In the NT, the Asian dowitcher is found in Darwin and Arnhem Land. In WA, the species has been recorded at Albany, Lake McLarty, Lake McLeod, north-east Pilbara and the south-west Kimberley division. It has also been recorded at the Port Hedland Saltworks, Roebuck Bay, Ashmore Reed and Eighty Mile Beach.
Bar-tailed godwit	The bar-tailed godwit has been recorded in the coastal areas of all Australian states. In WA, it is widespread around the coast, from Eyre to Derby, with a few scattered records elsewhere in the Kimberley. In the NT populations have been recorded from Darwin and Melville Island. Sites of international importance from WA and the NT include; + Eighty Mile Beach, WA (110,290 individuals); + Roebuck Bay, WA (65,000 individuals); + Milingimbi coast, NT (7,000 individuals); and + Elcho Island, NT (5,000 individuals).
Black-tailed godwit	The black-tailed godwit is found in all states and territories of Australia; however, it prefers coastal regions and the largest populations are found on the north coast between Darwin and Weipa. The population that inhabits Roebuck Bay is approximately 7,374 (>1% of the species total population).
Broad-billed sandpiper	In WA, few records occur in the south-west, but the broad-billed sandpiper may be regular in small numbers at scattered locations, from Warden Lake Nature Reserve and Coramup Creek to Guraga Lake Nature Reserve and Hurstview Lake. Individuals mostly occur on the coasts of the Pilbara and Kimberley between Onslow and Broome but are also recorded north to the mouth of Lawley River, and inland at Lake Daley.
Common greenshank	The common greenshank occurs around most of the coast from Cape Arid in the south to Carnarvon in the north-west. In the Kimberley region, it is recorded in the south-west and

Migratory species	DoEE SPRAT information on distribution within the area of interest
	the north-east, with isolated records from the Bonaparte Archipelago. WA has three sites of international importance for the common greenshank which include: + Eighty Mile Beach (2,240 individuals); + Wilson Inlet (568 individuals); and + Roebuck Bay (560 individuals). The NT does not have any sites of international importance.
Common redshank	In Western Australia (WA), the species is vagrant to the south-west with records at Peel Inlet, Coodanup, the Gascoyne region, Coral Bay and Carnarvon.
Common sandpiper	WA distribution includes: + Roebuck Bay; and + Nuytsland Nature Reserve. NT distribution includes: + Kakadu National Park; and + Darwin area.
Double-banded plover	The double-banded plover can be found in both coastal and inland areas. There are no nationally significant sites within WA.
Fork-tailed swift	In WA, there are sparsely scattered records of the fork-tailed swift along the south coast, ranging from near the Eyre Bird Observatory and west to Denmark. They are widespread in coastal and subcoastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands. They are scattered along the coast from south-west Pilbara to the north and east Kimberley region, near Wyndham. There are sparsely scattered inland records, especially in the Wheatbelt, from Lake Annean and Wittenoom. They are found in the north and north-west Gascoyne Region, north through much of the Pilbara Region, and the south and east Kimberley (Higgins 1999). In the NT scattered records exist around some offshore islands, mostly south to Victoria River Downs.
Great knot	The great knot has been recorded around the entirety of the Australian coast, with a few scattered records inland. The greatest numbers are found in northern Australia; where the species is common on the coasts of the Pilbara and Kimberley, from the Dampier Archipelago to the Northern Territory border. Important sites for great knot in Western Australia include: + Eighty Mile Beach (169,044 individuals); and + Roebuck Bay (22,600 individuals).
Greater sand plover	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. In northern Australia, the species is especially widespread between North West Cape and Roebuck Bay in Western Australia and are sparsely scattered records from the largely inaccessible area between Roebuck Bay and Darwin. Internationally important sites within Western Australia include: + Eighty Mile Beach (64,548 individuals); + Roebuck Bay (26,900 individuals); and + Ashmore Reef (1,196 individuals).
Grey plover	In Australia, the grey plover has been recorded in all states, where it is found along the coasts and are recorded frequently between Albany and the northern Kimberley coast. Internationally important sites include: + Eighty Mile Beach (1,650 individuals); + Roebuck Bay (1,300 individuals); + Peel Inlet (600 individuals); and

Migratory species	DoEE SPRAT information on distribution within the area of interest
	+ Nuytsland Nature Reserve (409 individuals).
Grey-tailed tattler	There are a few scattered records for the species along the south coast near the Eyre Bird Observatory, Point Malcolm, Rossiter Bay, Shark Lake Nature Reserve and surrounding swampland. It is found in the south-west between Augusta and Cervantes. The grey-tailed tattler is widespread from Houtman Abrolhos and the mainland adjacent to the Kimberley Division. It has also been recorded inland at Lake Argyle and on islands off the coast.
Lesser sand plover	Within Australia, the lesser sand-plover is widespread in coastal regions and has been recorded in all states. It mainly occurs in northern and eastern Australia, in south-eastern parts of the Gulf of Carpentaria, western Cape York Peninsula and islands in Torres Strait, and along the entire east coast, though it occasionally also occurs inland. In Western Australia, the following are important sites: + Eighty Mile Beach (1,575 individuals); + Roebuck Bay (1,057 individuals); + Broome (745 individuals); and + Port Hedland Saltworks (668 individuals).
Little greenshank	The marsh sandpiper is found on coastal and inland wetlands throughout Australia found mainly on the coast in Western Australia. National sites of importance within Western Australia include: + Port Hedland Saltworks (500 individuals); + Peel inlet (276 individuals); and + Eighty Mile Beach (140 individuals).
Long-toed stint	In Western Australia, the species is found mainly along the coast, with a few scattered inland records. On the south coast the Long-toed Stint is found from Esperance to Albany and inland to Lake Cassencarry and Dumbleyung. On the south-west coast the species is known from the Vasse River estuary, Guraga Lake and the Namming Nature Reserve. The species has occasionally been recorded in the Gascoyne Region, around Lake Wooleen, Meeberrie Station and McNeill Claypan. It is widespread around the Pilbara region and the Kimberley Division between Karratha and Wyndham-Kununurra. Inland records include Lake Brown, Hannan Lake, Lake Biolet, Newman Sewage Farm and Lake Gregory.
Oriental plover	Internationally important marine sites: + Eighty Mile Beach, WA (approximately 60,000 birds); and + Roebuck Bay, WA (Approximately 8,500 birds).
Oriental pratincole	Internationally important site: + Eighty Mile Beach, WA (2.88 million birds). The species occurs at numerous and widespread sites in northern Australia, especially near the Pilbara and Kimberley coasts of northern WA, and throughout the entire coastline of the NT.
Pacific golden plover	In Western Australia, the species is seldom recorded along the southern or south-western coasts but is more widespread along the Pilbara and Kimberley coasts between North-West Cape. Internationally important sites include Eighty Mile Beach with 440 individuals.
Pectoral sandpiper	In Australasia, the pectoral sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire.

Migratory species	DoEE SPRAT information on distribution within the area of interest
Red knot	The red knot large numbers are regularly recorded in north-west Australia, with 80 Mile Beach and Roebuck Bay being particular strongholds.
Red-necked phalarope	The red-necked phalarope is a regular at the Port Hedland Saltworks and Rottnest Island, Western Australia. The species is also found at the ICI Saltworks in South Australia.
Red-necked stint	The red-necked stint has been recorded in all coastal regions and found inland in all states when conditions are suitable. The red-necked stint probably travels in flocks and has been observed to feed in dense flocks. The Australian population was estimated at 353,000. Internationally important sites include: + Eighty Mile Beach (60,000 individuals); + Port Hedland Salt Works (23,000 individuals); + Roebuck Bay (19,800 individuals); + Wilson Inlet (15,252 individuals) + Alfred Cove Nature Reserve (10,000 individuals); + Lake Macleod (8,312 individuals); and + Peel Inlet (8,063 individuals).
Ruddy turnstone	The ruddy turnstone is widespread within Australia during its non-breeding period of the year. Australian sites of international importance include: + Eighty Mile Beach (3,480 individuals); + Ashmore Reef (2,230 individuals); + Roebuck Bay (2,060 individuals); + Barrow Island (1,733 individuals); and + Lacepede Islands (1,050 individuals).
Ruff (reeve)	In Western Australia, the species has been recorded at the lower King River and it is mostly found in the south-west region of the state. It has been sighted at the Vasse River estuary, north to Namming Lake and Lake McLarty. It has been periodically recorded at Port Hedland, Kununurra and the Argyle Diamond Mine. There are unconfirmed reports at Curlewis Camp, Millstream Chichester, Broome and Roebuck Bay.
Sanderling	They occur on most of the coast from Eyre to Derby, and also around Wyndham. They are more often recorded on the south and southwest coasts, north to around southern Shark Bay, with more sparsely scattered records further north in Gascoyne and Pilbara Regions and the Kimberley Division. Important sites include: + Eighty Mile Beach (2,230 individuals); + Ashmore Reef (1,132 individuals); and + Roebuck Bay (1,510 individuals).
Sharp-tailed sandpiper	They are widespread from Cape Arid to Carnarvon, around coastal and subcoastal plains of Pilbara Region to south-west and east Kimberley Division (Higgins & Davies 1996).
Streaked shearwater	Exmouth Gulf to the north.
Swinhoe's snipe	No conclusive records exist for this species in Australia so the number of individuals that appear in Western Australia are unknown. In WA the species has been recorded in parts of the Pilbara, the Kimberley, Mount Goldsworthy, Mount Blaize. It has also been found in the north west-regions around the Mitchell Plateau
Terek sandpiper	In Western Australia (WA), the terek sandpiper is rarely seen on the south coast: occasionally around Eyre and several records around Albany. On Swan River plain, it has been recorded between Bunbury and the mouth of the Moore River. The species is widespread in the Pilbara region and Kimberley Division, from Dampier to Wyndham, with occasional records around Shark Bay. Internationally important sites include:

Migratory species	DoEE SPRAT information on distribution within the area of interest
	+ Eighty Mile Beach (8,000 individuals); and + Roebuck Bay (1,840 individuals).
Whimbrel	It is common and widespread from Carnarvon to the north-east Kimberley Division, Western Australia. It is occasionally seen on the south coast of Western Australia and has occasionally been recorded in south-west Western Australia and further north to Shark Bay.
Wood sandpiper	The wood sandpiper has its largest numbers recorded in north-west Australia, with all areas of national importance located in Western-Australia: + Parry Floodplain (Wyndham) (355 individuals) + Camballin (185 individuals) + Lake Argyle (90 individuals) + Shark Bay area, (80 individuals) + Vasse-Wonnerup estuary (61 individuals) + Lake McLarty (64 individuals) + Kogolup Lakes (60 Individuals)

Shorebird migration patterns are seasonal and vary according to species (DSEWPaC 2012). Generally, shorebirds migrate to northern Australia in August to November. Many birds remain in northern Australia but others disperse southwards (Bennelongia 2011). Migratory shorebird numbers on northern beaches peak in November then again in March as the majority of birds begin their return to the northern hemisphere between March and May. Most migratory shorebirds do not breed in Australia and juvenile birds may spend several years in Australia before reaching maturity and returning north to breed (DEWHA 2009).

8.4 Biologically Important Areas / Critical Habitat– Birds

Table 8-6 below provides an overview of BIAs in the combined EMBA for birds. The DAWE may make recovery plans for threated fauna listed under the EPBC Act. The EPBC Act requires that ‘habitat critical to the survival of the listed threatened species’ is identified in recovery plans, relevant recovery plans are listed in **Section 13.2**[8].

In addition, both the EPBC Act and WA BC Act and associated regulations (2018) provide for the listing of critical habitat - habitat ‘critical to the survival of the threatened species’. No provision is made under the Territory Parks and Wildlife Conservation Act 1976 for listing critical habitat.

Table 8-6: Critical habitat/ biologically important areas - birds

Species	Scientific name	Aggregation area and use	Specific geographic locations for species
Abbott’s booby	*Papsula abbotti*	All known nesting trees and all forest vegetation within a 200m radius of known nesting trees for Abbott’s booby	Christmas Island
Australasian bittern	*Botaurus poiciloptilus*	All natural habitat (including constructed wetlands with suitable habitat)	Western coastal plain between Lancelin and Busselton Southern coastal region from Augusta to east of Albany
Australian fairy tern	*Sternula nereis*	Foraging – Kimberley, Pilbara and Gascoyne coasts and islands	Found in the vicinity of lower north-west coast (north to Dampier Archipelago), west coast (south to Peel Inlet) and south coast (from

[8] Further background information on BIA and identification of critical habitat in recovery plans is provided in Section 5.4.

Species	Scientific name	Aggregation area and use	Specific geographic locations for species
			Flinders Bay east to Israelite Bay), including islands (as far offshore as Trimouille Island and Houtman Abrolhos. Pilbara and Gascoyne coasts and islands
Australian lesser noddy	*Anous tenuirostris melanops*	Foraging - Houtman Abrolhos Islands	Houtman Abrolhos Islands
Bridled tern	*Onychoprion anaethetus*	Foraging - West coast of Western Australia and around to Recherche Archipelago	West coast of WA and around to Recherche Archipelago including offshore waters
Brown Booby	*Sula leucogaster*	Breeding, foraging - Kimberley and northern Pilbara coasts and islands also Ashmore Reef.	Kimberley and northern Pilbara coasts and islands also Ashmore Reef.
Caspian tern	*Sterna caspia*	Foraging - mainly islands (as far offshore as Adele, Bedout, Trimouille and the Houtman Abrolhos)	In WA found on most coasts, mainly islands (as far offshore as Adele, Bedout, Trimouille and the Houtman Abrolhos) and at Lake Argyle, Lake Gregory and Lake MacLeod; accidental elsewhere in the interior.
Common noddy	*Anous stolidus*	Foraging	Around Houtman Abrolhos Around Lancelin Island
Flesh footed shearwater	*Ardenna carneipes*	Foraging, aggregation (pre-migration) - Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef	Foraging from Cape Naturaliste to Eyre, 1-150 km offshore. Pre-departure zone in some years from Rottnest Island to Bunbury.
Christmas Island frigatebird	*Fregeta andrewsii*	All forest containing nesting and roosting sites, including currently known nesting and roosting colonies and any other smaller groups of nests and roosts	Christmas Island
Greater crested tern	*Thalasseus bergii*	Breeding (high numbers)	Melville Island
Greater frigatebird	*Fregata minor*	Breeding, foraging - Kimberley and Ashmore Reef	Kimberley and Ashmore Reef
Great-winged petrel	*Pterodroma macroptera*	Foraging - Offshore south of Shark Bay	Offshore south of Shark Bay, extending around south-west corner of WA and east past Kangaroo Island
Indian Yellow-nosed Albatross	*Thalassarche carteri*	Foraging - south-west marine region, north to Shark Bay and extending east into Bass Strait	Throughout offshore waters of south-west marine region, north to Shark Bay and extending east into Bass Strait
Lesser crested tern	*Sterna bengalensis*	Breeding, foraging - Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef	Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef

Species	Scientific name	Aggregation area and use	Specific geographic locations for species
Lesser frigatebird	*Fregata ariel*	Breeding, foraging – Kimberley and Pilbara coasts and islands also Ashmore Reef.	Kimberley and Pilbara coasts and islands also Ashmore Reef.
Little penguin	*Eudyptula minor*	Foraging - Perth to Bunbury	Perth to Bunbury
Little shearwater	*Puffinus assimilis*	Foraging - From Kalbarri to Eucla	From Kalbarri to Eucla including offshore waters
Little tern	*Sternula albifrons*	Breeding, foraging, resting - Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef Resting - Roebuck Bay	Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef Roebuck Bay Ramsar site
Pacific gull	*Larus pacificus*	Foraging –west coast and islands	West coast and islands from Point Quobba (24º30'S) south to Wedge Island (formerly south to Warnbro Sound and at Cape Naturaliste); casual further north (Point Cloates and Lake MacLeod).
Red-footed Booby	*Sula sula*	Breeding, foraging - north west Kimberley and Ashmore reef	North west Kimberley and Ashmore reef
Roseate tern	*Sterna dougallii*	Breeding, foraging – Islands and coastline in the Kimberley, Pilbara and Gascoyne regions Resting – Eighty Mile Beach	Eighty Mile Beach (northern end) Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef Low Rocks and Stern Island in Admiralty Gulf North-east and North-west Twin Islets near the mouth of King sound North-western and west coasts and islands from Sir Graham Moore Is (13º50'S), south to Mandurah (32º32'S) and as far offshore as Ashmore Reef, Bedout Island and the Houtman Abrolhos.
Soft plumage petrel	*Pterodroma mollis*	Foraging - seas north to 21º30'S	In WA found in seas north to 21º30'S.
Sooty tern	*Sterna fuscata*	Foraging – Timor sea	Timor Sea S to 14º30, off northwest coast from Lacepede I SW to 117ºE including Abrolhos, Fisherman & Lancelin Is, accidental on lower west coast to Hamelin Bay. Breeding visitor (late Aug - early May) Abrolhos & Lancelin Is; casual winter (Nov - Apr) to Fisherman
Wedge-tailed shearwater	*Ardenna pacifica*	Breeding, foraging – west coast from Ashmore Reef to Carnac I. Kimberley, Pilbara, Gascoyne coasts, Ashmore reef	Breeding (in hundreds of thousands) off west coast from Ashmore Reef (12º15'S) to Carnac Island (32º07'S), and ranging in western seas between 12º00'S and 33º20'S. Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef
White-faced storm petrel	*Pelagodroma marina*	Foraging (in high numbers) - Offshore areas of the south-west marine region and into the adjacent south-east marine region and the north-	Offshore areas of the south-west marine region and into the adjacent south-east marine region and the north-west marine region to north of Shark Bay

Species	Scientific name	Aggregation area and use	Specific geographic locations for species
		west marine region to north of Shark Bay	
White-tailed tropic bird	*Phaethon lepturus*	Breeding, foraging - Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef	Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef

9. Protected Areas

A number of areas in the combined EMBA are protected under state and federal legislation. Protected areas include World Heritage Areas, Wetlands of International Importance (Ramsar), Wetlands of National Importance, National and Commonwealth Heritage Places, and terrestrial conservation reserves (National Parks, Nature Reserves and Conservation Parks) that bound marine waters. These areas are listed in **Table 9-1**, and shown in **Figure 9-2**, **Figure 9-3**, **Figure 9-4** and **Figure 9-4** and discussed below. Other protected areas include Key Ecological Features (discussed in **Section 10**) and State and Commonwealth Marine Parks/Reserves (discussed in **Section 11** and **Section 12**). A Protected Matters search of the combined EMBA (**Appendix A**) identified several protected areas which were deemed to be irrelevant to Santos' petroleum activities due to their terrestrial location (e.g. Forrestdale and Thomsons Lakes – Ramsar wetland).

The Register of the National Estate (RNE) provides a listing of more than 13,000 natural, historic and indigenous sites of significance. However, in 2012 all references to the RNE were removed from the EPBC Act and the *Australian Heritage Council Act 2003*.The RNE is now maintained on a non-statutory basis as a publicly available archive and educational resource. The RNE places are not discussed further here but are listed in **Appendix A**.

Table 9-1: Summary of protected areas in waters within the combined EMBA

Area type	Title
World Heritage Area	Shark Bay
	The Ningaloo Coast
	Kakadu National Park
Wetland of International Importance (Ramsar)	Eighty Mile Beach
	Roebuck Bay
	Ashmore Reef National Nature Reserve
	Becher Point wetlands
	Peel-Yalgorup System
	Vasse-Wonnerup System
	Hosnies Spring
	Cobourg Peninsula
	Kakadu National Park
	Ord River Floodplain
	The Dales
Wetlands of National Importance	Ashmore Reef
	Mermaid Reef
	Vasse-Wonnerup Wetland System
	"The Dales", Christmas Island
	Adelaide River Floodplain System
	Eighty Mile Beach System
	Exmouth Gulf East
	Hosnies Spring, Christmas Island
	Kakadu National Park
	Mary Floodplain System

Area type	Title
	Hutt Lagoon System
	Lake Macleod
	Lake Thetis
	Learmonth Air Weapons Range – Saline Coastal Flats
	Leslie (Port Hedland) Saltfields System
	Prince Regent River System
	Roebuck Bay
	Rottnest Island Lakes
	Shark Bay East
	Cape Leeuwin System
	Doggerup Creek System
	Cape Range Subterranean Waterways
	Cobourg Peninsula System
	Daly-Reynolds Floodplain-Estuary System
	Finniss Floodplain and Fog Bay Systems
	Moyle Floodplain and Hyland Bay System
	Murgenella-Cooper Floodplain System
	Ord Estuary System
	Port Darwin
	Shoal Bay - Micket Creek
	Yalgorup System
National Heritage Place	HMAS Sydney II and HSK Kormoran Shipwreck Sites (Historic)
	Batavia Shipwreck Site and Survivor Camps Area 1629- Houtman Abrolhos (Historic)
	Dirk Hartog Landing Site 1616 - Cape Inscription Area (Historic)
	Dampier Archipelago (including Burrup Peninsula) (Indigenous)
	Kakadu National Park (Natural)
	The West Kimberley (Natural)
	The Ningaloo Coast (Natural)
	Shark Bay (Natural)
	Fitzgerald River National Park (Natural)
	Lesueur National Park (Natural)
Commonwealth Heritage Place	Scott Reef and Surrounds – Commonwealth Area
	Ningaloo Marine Area - Commonwealth Waters
	Mermaid Reef - Rowley Shoals
	Ashmore Reef National Nature Reserve
	Garden Island

Area type	Title
	Christmas Island Natural Areas
	Yampi Defence Area
	Learnmonth Air Weapons Range Facility
	Bradshaw Defence Area
	Lancelin Defence Training Area
Threatened Ecological Communities	Monsoon Vine Thickets on the Ridge on the Coastal Sand Dunes of Dampier Peninsula
	Roebuck Bay mudflats
	Subtropical and Temperate Coastal Saltmarsh
	Trombolite (microbialite) Community of a Coastal Brackish Lake (Lake Clifton)
Terrestrial Conservation Reserves e.g. national parks, nature reserves, and conservation parks.	Numerous bounding marine waters – refer to **Section 9.6.**

9.1 World Heritage Areas

There are two World Heritage Areas located in marine waters of WA, both of which occur in the waters from the South Australian border to the NT border: the Ningaloo Coast and Shark Bay (DEC 2012). One WHA is within the combined EMBA adjacent to NT, although most of the area is terrestrial: Kakadu National Park.

9.1.1 Shark Bay

Shark Bay was included on the World Heritage List in 1991 and is one of the few properties inscribed for all four outstanding natural universal values:

- An outstanding example representing the major stages in the earth's evolutionary history;
- An outstanding example representing significant ongoing ecological and biological processes;
- An example of superlative natural phenomena; and
- Containing important and significant habitats for in situ conservation of biological diversity.

Since 1997, an agreement established the joint management of the Shark Bay WHA by the Australian Commonwealth government and the Western Australian state government, with the operational responsibility by the Western Australian agencies (DEWHA 2008a). This agreement also created a Community Consultative Committee and a Scientific Advisory Committee, both of which provide advice as required. The entire WHA encompasses islands and peninsulas, with an area of approximately 2.2 million hectares (70% of which is marine waters), and includes the following areas (UNESCO 2020):

- Hamelin Pool Marine Nature Reserve;
- Francois Peron National Park;
- Shell Beach Conservation Park;
- Monkey Mia Reserve;
- Monkey Mia Conservation Park;
- Zuytdorp Nature Reserve;
- Bernier, Dorre and Koks Islands Nature Reserves;
- Dirk Hartog Island National Park; and

- Various pastoral leases.

The marine environment of the Shark Bay World Heritage Area is protected as a State Marine Reserve and is discussed further in **Section 11.1.3**.

9.1.2 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 State Marine Park, a Commonwealth Marine Park, and is discussed further in **Section 11.1.4** and **Section 12.3.4**, respectively.

9.1.3 Kakadu National Park

Kakadu National Park was included on the World Heritage List in 1981 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 significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals; 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 Kakadu National Park WHA covers an area of around 1,916,000ha and is the largest national park in Australia. The WHA is managed by the Director of National Parks who performs functions and exercises powers under the *Environment Protection and Biodiversity Conservation Act 1999* (the Act) in accordance with the park's management plan and relevant decisions of the Kakadu National Park Board of Management. Approximately 50% of Kakadu National Park is Aboriginal land under the Aboriginal Land rights (Northern Territory) Act 1976.

9.2 Wetlands of International Importance (Ramsar)

There are eleven wetlands of international importance (Ramsar wetlands) in waters from the South Australian border to the NT; all were listed in 1990 with the exception of the Cobourg Peninsula which was listed in 1974, Kakadu National Park which was listed in 1980 and further expanded in 1995, Becher Point which was listed in 2001, and The Dales which was listed in 2002. The Ashmore Reef National Nature Reserve (listed in 2002) is also a Commonwealth Marine Park and is discussed further in **Section 12.3.12.**

9.2.1 Eighty Mile Beach

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

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

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

Eighty Mile Beach also supports a high diversity and abundance of wetland birds. A total of 97 wetland bird species have been recorded within the beach portion of the Ramsar site (Hale & Butcher 2009). This includes 42 species that are listed under international migratory agreements CAMBA (38), JAMBA (38) and ROKAMBA (32) as well as an additional 22 Australian species that are listed under the EPBC Act. In addition, there is a single record for Nordmann's Greenshank (*Tringa guttifer*) from the beach, which is listed as endangered under the IUCN Red List (IUCN 2019).

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

Eighty Mile Beach is used for beach based recreation, including four-wheel driving, motorcycling, fishing and shell collecting. Mandora Salt Marsh is mainly used for cattle grazing. The site is traditionally part of Karajarri Country in the north, Nyangumarta Country in the south and Ngarla Country in the southern end of Eighty Mile Beach. The site has artefacts such as middens, pinka (large baler shells used to scoop and carry water for drinking), wilura (used for sharpening spear heads), axes, and flakes, and kurtanyanu and jungari (grinding stones). The Ramsar wetland is managed under the Eighty Mile Beach Marine Park Management Plan 2014-2024 (DPAW, 2014).

9.2.2 Roebuck Bay

The Roebuck Bay Ramsar site is located at Roebuck Bay near Broome in northern WA totalling 34,119 ha. Roebuck Bay has a large tidal range which exposes around 160 km^2 of mudflat, covering most of the Ramsar site (DoE 2014c). Waters more than 6 m deep at low tide are excluded from the site (Bennelongia 2009). The eastern edge of the site is made up of microscale linear tidal creeks (DoE 2014c).

The intertidal mud and sand flats support a high abundance of bottom dwelling invertebrates (between 300—500 benthic invertebrate species), which are a key food source for waterbirds (Bennelongia 2009). The site is one of the most important migration stop-over areas for shorebirds in Australia and globally. For many shorebirds, Roebuck Bay is the first Australian landfall they reach on the East Asian Australasian Flyway. The total numbers of waders using the site each year is estimated at over 300,000 (DoE 2014c). The northern beaches and Bush Point provide important high tide roost sites.

The site receives tidal seawater as well as fresh surface and groundwater, and the balance between the two influences the residual groundwater salinity and the distribution of plants and animals (DoE 2014c). Mangrove swamps line the eastern and southern edges of the site and extend up into the linear tidal creeks (DoE 2014c). They are important nursery areas for marine fishes and crustaceans, particularly prawns.

Extensive seagrass beds occur in the bay, providing an important feeding ground for dugongs and loggerhead and green turtles (Bennelongia 2009). Flatback turtles nest in small numbers, while marine fish (including sawfish) regularly breed in the tidal creeks and mangroves. Dolphins also regularly use the site (DoE 2014c).

The site is used for recreational or tourism activities such as fishing, crabbing, sightseeing and bird watching. Broome Bird Observatory, a small reserve at the northern end of the site, engages in shorebird research and public education.

Roebuck Bay lies in the traditional estate of Indigenous people belonging to both Jukun and Yawuru groups. The site was an important area for seasonal meetings, exchanging gifts, arranging marriages and settling disputes. Numerous shellfish middens, marking former camping places, can still be seen along coastal cliffs and dunes. Indigenous people continue to make extensive use of Roebuck Bay's natural resources for activities such as gathering shellfish, fishing and hunting. The Ramsar wetland is currently managed under the Preliminary Draft Roebuck Bay Ramsar Site Management Plan (RBWG, 2010).

9.2.3 Ashmore Reef National Nature Reserve

In addition to being listed as a National Nature Reserve, Ashmore Reef has been designated a Ramsar Wetland of International Importance due to the importance of the islands in providing a resting place for migratory shorebirds and supporting large breeding colonies of seabirds (Hale and Butcher, 2013). The reserve provides a staging point for many migratory wading birds from October to November and March to April as part of the migration between Australia and the northern hemisphere (Commonwealth of Australia, 2002). Migratory shorebirds use the reserve’s islands and sand cays as feeding and resting areas during their migration.

Ashmore is the largest of the atolls in the Timor Province bioregion. The three islands within the site are also the only vegetated islands in the bioregion. Each of the wetland types present are in near natural condition and the site has the largest seagrass coverage in the bioregion. The reserve supports 64 species of internationally and nationally threatened species. This includes 41 species of hard reef forming coral, eight fish, six reptiles (including endangered and critically endangered sea turtles and seasnakes), five sea cucumbers, two giant clams, one soft coral and the dugong.

Ashmore Reef plays a primary role in the maintenance of biodiversity in reef systems in the region. The Reserve supports 275 species of reef building coral, 13 species of sea cucumbers, and high numbers of mollusc species. There are over 760 fish species, 13 species of sea snake, 99 species of decapod crustacean and 47 species of waterbird listed as migratory under international treaties. It supports breeding of 20 species of waterbirds including the brown booby, lesser frigatebird, crested tern, bridled tern, sooty tern and common noddy. The Ramsar site is also important for feeding for green turtles, hawksbill turtle and loggerhead turtle and critical nesting and inter-nesting habitats for green and hawksbill turtles.

Ashmore Reef regularly supports more than 20,000 waterbirds and has been known to support more than 65,000 waterbirds. The Ramsar site regularly supports more than one per cent of at least six species of waterbird including the sooty tern, bar-tailed godwit, grey-tailed tattler, ruddy turnstone, sanderling and greater sand plover. The Ramsar site is managed under the Ashmore Reef National Nature Reserve and Cartier Island Marine Reserve Management Plan (Commonwealth of Australia, 2002).

9.2.4 Becher Point

The Becher Point Wetlands Ramsar site is a system of about sixty small wetlands located near Rockingham in south-west Western Australia and covers 677 ha. The wetlands are made up of chains of small, linear ovoid or irregular shaped basins arranged in five groups, each roughly parallel to the coast and separated by sand ridges (DoE 2014l). The wetlands are an example of shrub swamps and seasonal marshes that have formed in an extensive sequence of inter-dunal depressions that have arisen from seaward advancement of the coastline over recent millennia.

The wetlands in the site are shallow and fill seasonally. Rainfall in winter and spring recharges the groundwater, which rise up to waterlog the wetland basins. The wetlands then dry out again for summer to autumn. When flooded the wetlands are mainly freshwater (DoE 2014l).

The wetlands support sedgelands, herblands, grasslands, open-shrublands and low open-forests. The sedgelands that occur within the linear wetland depressions of the Ramsar site are a nationally listed threatened ecological community. At least four species of amphibians and 21 species of reptiles have been recorded within the wetlands, as well as the Southern Brown Bandicoot (DoE 2014l). The Ramsar wetland is managed under the Rockingham Lakes Regional Park Management Plan (DEC, 2010c).

9.2.5 Peel-Yalgorup System

The Peel-Yalgorup System located adjacent to the city of Mandurah in Western Australia, is a large and diverse system of shallow estuaries, coastal saline lakes and freshwater marshes. The site includes the Peel Inlet, Harvey Estuary, Lake McLarty, Lake Mealup and ten Yalgorup National Park wetlands and covers an area of 26, 530 ha (DoE 2014m). Lake Clifton, which is part of the wetlands is one of the few locations in the word where thrombolites occur in inland, hyposaline waters. Thrombalites are underwater rock-like structures that are formed by the activities of microbial communities.

The Peel-Yalgorup System Ramsar site is the most important area for waterbirds in south-western Australia, supporting in excess of 20,000 waterbirds annually (DoE 2014m). It also supports a wide variety of invertebrates and estuarine and marine fish. The Rasmar site is managed under the Swan Coastal Plain South Management Plan (DPAW, 2016c).

9.2.6 Vasse-Wonnerup System

The Vasse-Wonnerup System Ramsar wetland is situated in the Perth Basin, south-western Western Australia and covers an area of 1,115 ha. It is an extensive, shallow, nutrient-enriched wetland system of highly varied salinities. The site is located on a narrow, flat plain separated from the ocean by a narrow system of low dunes. The system is comprised of two former estuaries – the Vasse and Wonnerup lagoons (DoE 2014n).

The system supports tens of thousands of resident and migrant waterbirds of a wide variety of species. More than 33,000 waterbirds have been counted at the Vasse-Wonnerup System and more than 80 species have been recorded in the System including Red-necked Avocets and Black-winged Stilts, Wood Sandpiper, Sharp tailed Sandpiper, Long-toed Stint, Curlew Sandpiper and Common Greenshank (DoE 2014n). This Rasmar site is also managed under the Swan Coastal Plain South Management Plan (DPAW, 2016c).

9.2.7 Hosnies Spring

The Hosnies Spring Ramsar site is located on Christmas Island and 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 covering an area of approximately 199 ha. The site includes surrounding terrestrial areas with rainforest grading to coastal scrub and includes an area of shoreline and coral reef (DoEE 2019).

The Hosnies Spring Ramsar site supports a unique wetland of Christmas Island with the mangrove forest present at the site unique within the bioregion and possibly worldwide. The two species of mangroves that make up the stand, which normally grow intertidally, grow to a height of 24–37 m above sea level that have been estimated to have persisted for 120,000 years. Additionally, the site is important to blue crabs which rely on the freshwater provided by the spring and as a likely migratory route for the endemic red crab during breeding migrations (DoEE 2019). The Ramsar site is managed under the Christmas Island National Park Management Plan (DNP, 2002).

9.2.8 The Dales

The Dales Ramsar site is located on Christmas Island and is comprised of a near-pristine system of seven watercourses collectively known as The Dales and covers an area of 585 ha. The Dales includes permanent and perennial streams, permanent springs, and include the majority of surface water on the Island. Most rainfall on Christmas Island filters down through the soil and limestone, and surface runoff only occurs after heavy rain. The Dales contain numerous wetland types including surface and karst features, and inland and coastal wetlands (DoEE 2019a).

The Dales support a number of unique ecological and geomorphic features including anchialine cave communities, surface karst including the unique stepped tufa deposits at Hugh's waterfall, a stand of Tahitian chestnuts, a large number of endemic terrestrial species and a significant number of seabirds including Abbott's booby, red-footed booby and the brown booby, all of which breed at the site, and provide essential habitat for the Christmas Island frigatebird (DoEE 2019a). This Ramsar site is also managed under the Christmas Island National Park Management Plan (DNP, 2002).

9.2.9 Cobourg Peninsula

Under the Ramsar convention, the Cobourg peninsula site is listed as a Wetland of International Importance. The site is located 163km north-east of Darwin within the Timor Sea Drainage Division. Within 220’700 hectares, the site covers the entire peninsula and several nearby islands including the Sir George Hope Islands, Sandy Island No. I and II, Allaru Island, High Black Rock and Buford Island. Under the Cobourg Peninsula Aboriginal Land, Sanctuary and Marine act 1996, Cobourg peninsula and surrounding waters was declared a Nation Park (Garig Gunak Barlu National Park) BMT WBM (2011).

The Cobourg site is composed of a diverse coastal and inland wetland types. Wetland types present include intertidal forested wetlands and salt flats, seasonal freshwater marshes and permanent freshwater pools. Ramsar topology identifies ten coastal and ten inland types within the site. The site contains unique biodiversity and wildlife including terrestrial, riverine, freshwater, brackish and coastal/marine ecosystems. Identifiable wetland types include intertidal forested wetland and salt flats, seasonal freshwater marshes, and permanent freshwater pools.

Cobourg Peninsula is listed as a Wetland of International importance due to the diversity of coastal and inland wetland types that support population of threatened species, including a number of endangered turtles. The Cobourg site meets five of the current nine nomination criteria of the Ramsar Convention and is therefore recognised as a representative wetland habitat that is at bioregional level, support of populations of threatened species, support for key life-cycle functions such as marine turtle and waterbird breeding, refugia values, and its importance for supporting fish and nursery spawning habitats BMT WBM (2011). The Ramsar site is managed under the Cobourg Marine Park Plan of Management (DNREAS, 2011).

9.2.10 Kakadu National Park

Kakadu National Park Ramsar site is composed of a diversity of coastal and inland wetland types that range form intertidal forested wetlands and mudflats to seasonal freshwater marshes and permanent freshwater pools. Ramsar topology identifies 13 coastal types and 15 inland types throughout Kakadu National Park. Hydrology, fire regimes and notable biological processes, with supporting processes including climate, tidal hydraulics, groundwater, water quality, geology and geomorphology are ecosystem processes present in Kakadu National Park habitats (BMT WBM, 2010).

The site also meets all nine Nomination Criteria of the Convention, recognising the representative wetland habitats of the site at a bioregional level, support of populations of vulnerable wetland species, its characteristics as a centre of endemism and high biodiversity including its diversity of habitats, support for key life-cycle functions such as waterbird breeding and refugia values, its importance for supporting substantial populations of waterbirds and fish diversity and fish nursery and spawning habitats and its support of at least one percent of the national population of several non-avian wetland species (BMT WBM, 2010). The Ramsar site is managed under the Kakadu National Park Management Plan 2016-2026 (DNP, 2016).

9.2.11 Ord River Flood Plains

Site lies within the Victoria-Bonaparte bioregion and contains a wide range of wetland types and includes all inland and marine components. This Ramsar site comprises of Parry Lagoons, Ord Estuary and the False Mouths of the Ord. Parry Lagoons includes both the permanent waterholes, such as Marglu Billabong, as well as the broader area of the flood plain within the Parry Lagoons Nature Reserve that are subject to periodic inundation. The area from the boundary near Adolphis Island to the Rocks is known as the Ord Estuary. The False Mouths of the Ord is an area of extensive intertidal creeks and flats in the north of the Ramsar site.

The Ord River Floodplain Ramsar site meets seven of the nine Nomination Criteria. The site represents the best example of wetlands associated with the floodplain, and estuary of a tropical river system in the Kimberly Region of Western Australia. Ord River contains extensive and diverse mangrove community containing 14 of the 18 species of mangrove known to occurs in Western Australia (Hale, 2008).

A number of threatened species including Freshwater Sawfish (*Pristis microdon*), the Green Sawfish (*Pristis zijsron*) and the Australian Painted Snipe (*Rostratula australis*), which are listed as vulnerable under the EPBC Act are supported in this area. The site also provides one of the two known habitats for the nationally endangered Northern River Shark (*Glypis* sp. C). The Ord River Floodplain Ramsar site provides an important nursery, breeding and feeding ground for at least 50 species of fish and a migratory route for 15 diadromous species.

There is sufficient evidence to suggest the sire regularly supports 20,000 birds in the site alone, although it should be acknowledged that there are difficulties associated with surveying the Ord River Floodplain. According to the 4th edition of Waterbird Population Estimates, the site regularly supports 1% of the population of Plumed Whistling Duck and Little Curlew (Hale, 2008). The Ramsar site is managed under the Ord River and Parry Lagoons Nature Reserves Management Plan (DEC, 2012c).

9.3 Wetlands of National Importance

9.3.1 Ashmore Reef

See the Ashmore Reef National Nature Reserve (**Section 9.2.3**) and Ashmore Reef Marine Park (**Section 12.3.12**).

9.3.2 Mermaid Reef

See the Mermaid Reef Marine Park (**Section 12.3.9**).

9.3.3 Vasse-Wonnerup Wetland System

See the Vasse-Wonnerup Wetland System (**Section 9.2.6**).

9.3.4 "The Dales", Christmas Island

See The Dales Ramsar site (**Section 9.2.8**).

9.3.5 Eighty Mile Beach System

See Eighty Mile Beach Ramsar site (**Section 9.2.1**).

9.3.6 Exmouth Gulf East

The Exmouth Gulf East wetlands are located in the eastern section of Exmouth Gulf from Giralia Bay to Urala Creek Locker Point. The wetland comprises of numerous tidal creeks, indentations and islands of dry land, mudflats, saline coastal flats and extensive mangroves (DAWE 2020a).

The site is one of the major population centres for dugongs in WA and its seagrass beds and extensive mangroves provide nursery and feeding areas for marine fishes and crustaceans in the Gulf. In addition, there are at least 29 species of birds which utilise the wetland, including 16 migratory shorebirds and several terns (DAWE 2020a).

9.3.7 Hosnies Spring, Christmas Island

See Hosnie's Spring Ramsar site (**Section 9.2.7**).

9.3.8 Hutt Lagoon System

The Hutt Lagoon System wetlands (3,000 ha) are located within the Geraldton Sandplains and comprises of Hutt Lagoon and the lakes and marshes immediately north-west and south-east of the lagoon, notably Utcha Swamp. The system is a coastal brine lake which runs parallel to the coast (DAWE 2020b).

Hutt Lagoon is a migratory stop-over for migratory waders, however numbers using the area vary greatly between years and are likely to be lower when northern and inland waterbodies are extensively flooded. Breeding shorebirds include the Australasian grebe (*Tachybaptus novaehollandiae*), grey teal (*Anas gibberifrons*) and eurasian coot (*Fulica atra*) at Utcha Swamp (DAWE 2020b).

9.3.9 Lake Macleod

The Lake Macleod wetland (150,000 ha) is located in the Carnarvon bioregion and includes distinct "inner wetlands" (sinkholes, channels, lakes, marshes) in the west and "floodout marshes" at river mouths in the north-east. The wetland also includes a lakebed that is infrequently inundated. The lake lies parallel to the Indian Ocean, north of the Gascoyne River and located 30 km away from Shark Bay East wetland (DAWE 2020c).

The Lake Macleod is a major migration stop-over and drought refuge area for shorebirds; it is one of the most important non-tidal stop-over sites in Australia. It also supports Australia's largest inland community of mangroves and associated fauna. Fifty-eight species have been identified within the wetland with 29 being shorebirds and eight gulls and terns, with seven species found breeding (DAWE 2020c).

9.3.10 Lake Thetis

The Lake Thetis wetland (7 ha) is located in the Swan bioregion and comprises of seasonal marshes that form in interdunal areas to the south of the lake. Lake Thetis is distinguished by the presence of both a variety of benthic microbial communities (mats) and stromatolites. No threatened species or migratory species have been observed to utilise this wetland (DAWE 2020d).

9.3.11 Learmonth Air Weapons Range – Saline Coastal Flats

The Learmonth Air Weapons Range – Saline Coastal Flats wetland (300 ha) represents typical saline coastal flats subject to inundation and ponding. The vegetation typically has a low species richness, but its floristic composition and structure is highly distinctive and supports habitat specific fauna (DAWE 2020e).

Species composition of the wetland has little information however it is likely to possess a relatively diverse community (DAWE 2020e).

9.3.12 Leslie (Port Hedland) Saltfields System

The Leslie (Port Hedland) Saltfields System (13,000 ha) comprises a large saltfield, fringing coastal flats, tidal creeks and mudflats between the saltfields and the Indian Ocean.

The wetland is likely a major migration stop-over area for shorebirds in the East Asia-Australasia Flyway. It is possibly the most important stop-over site in the Flyway for the broad-billed sandpiper (*Limicola falcinellus*) and an important site for oriental plover (*Charadrius veredus*). It is also likely to be the most important site in Australia for Asian dowitcher (*Limnodromus semipalmatus*) and red-necked phalarope (*Phalaropus lobatus*) (DAWE 2020f).

9.3.13 Prince Regent River System

The site comprises of the entire Prince Regent River system and large areas of mangrove on either side of the river mouth in Saint George Basin (14,300 ha). The site is a tropical estuary and river system incised in a plateau and is characterised by mangrove-fringed embayments (DAWE 2020g).

The site comprises of a diverse assemblage of flora and fauna, and includes mangroves, riverine vegetation, waterbirds, frogs, reptiles and fish. The site includes some of the most suitable and extensive breeding habitat for the saltwater crocodile in WA, well developed river banks with thick stands of reed and grasses (DAWE 2020g).

9.3.14 Roebuck Bay

See Roebuck Bay Ramsar site (**Section 9.2.2**).

9.3.15 Rottnest Island Lakes

The Rottnest Island Lakes wetland site comprises of a cluster of 18 lakes and swamps on the north-east part of Rottnest Island (180 ha). The site is a breeding area for Australian shelduck (*Tadorna tadornoides*) and major breeding area for Australian fairy tern (*Sterna nereis nereis*). The lakes are also a major migration stop-over area for shorebirds in south-western Australia and provide a significant drought refuge area for shorebirds, notably the banded stilt (*Cladorhynchus leucocephalus*) (DAWE 2020h).

9.3.16 Shark Bay East

The Shark Bay East wetland site extends along 250 km of coastline in the east arm of Shark Bay, from the mouth of the Gascoyne River (Carnarvon) south to latitude 26 S. The site comprises tidal wetlands and marine waters that are less than 6 m deep at low tide (up to approximately 10 km from shore). The wetland is a large, shallow marine embayment that support extensive seagrass beds and substantial areas of intertidal mud/sand-flats and mangrove swamp (DAWE 2020i).

The mangroves, algae and seagrasses present at the side are important for both dugongs and green turtles. A total of 69 species have been identified within the wetland including the threatened little tern (*Sterna albifrons*) and 33 shorebirds. A total of six species have been identified to be breeding within the wetland (Australian pelican, great egret, little egret, unidentified cormorants and striated herons). The site is also a stop-over for 24 species of migratory shorebirds (DAWE 2020i).

9.3.17 Cape Leeuwin System

The Cape Leeuwin System site is a small coastal valley, approximately 20 ha in size. Seepage from a series of freshwater springs feed an elongate swamp on the floor of the valley and moistens areas of the limestone and granite coastline to the west (DAWE 2020j). The site has been identified as the habitat for the largest known population of the rare aquatic gastropod mollusc; the Cape Leeuwin freshwater snail (*Austroassiminea letha* (Sr)) (DAWE 2020j).

9.3.18 Doggerup Creek System

The Doggerup Creek System site (2,500 ha) supports extensive flats subject to inundation in the north and east of its catchment. The site includes lakes (e.g. Doggerup, Samuel and Florence Lakes) and many small unnamed swamps. The site is an example of an `acid peat flat' with small permanent lakes and river (DAWE 2020k).

The wetland plant communities include 32 species at Doggerup Lake, 19 at Lake Samuel and 35 at Lake Florence. The site is a major habitat for two aestivating inland fishes, *Galaxiella nigrostriata* and *Lepidogalaxias salamandroides*, that are endemic to the far south coast of WA. No threatened species have been identified within the site and it is not considered to be an important wetland for migratory shorebirds (DAWE 2020k).

9.3.19 Cape Range Subterranean Waterways

The Cape Range Subterranean Waterways wetland site comprises of the subterranean waterways, sinkholes, general groundwater and artificial wells of the coastal plain and foothills of Cape Range north of a line between Norwegian Bay, at the foot of the peninsula on the west coast, and the Bay of Rest in Exmouth Gulf (DAWE 2020l).

The site is one of the only examples of subterranean karst wetland system (apart from Barrow Island) in arid north-western Australia. Two threatened species have been identified within the wetland and include the blind cave eel and the blind gudgeon (DAWE 2020l).

9.3.20 Yalgorup System

See Peel-Yalgorup System Ramsar site (**Section 9.2.5**).

9.3.21 Adelaide River Floodplain System

Several swamps, lakes, lagoons and dams are included in the 134,800-hectare site. Four principal plant structural formations are present consisting of mangal low closed-forest (mangroves) mainly in the far north-west but extending along the river to south of the site, scattered chenopod low shrubland (samphire) in the far north, patches of melaleuca open-forest near the floodplain edges and missed closed grassland/sedgeland (seasonal floodplain) over most of the site (Jaensch, 1993).

The site is of particular significance as it contains one of the largest blocks of mangroves associated with the Top End floodplain as well as near-permanent marsh (Fogg Dam and Melacca Swamp), a rare wetland type in the Northern Territory. A rare species of the wetland plant Goodenia quadrigida also occurs within the floodplain. Surface inflow from the Adelaide-Margaret River System as well as numerous creeks (e.g. Hollands, Sunday and Buffalo Creeks) and Manton River provides a water supply for the area. The total volume of inflow is moderately high. The area provides a good example of the major floodplain-tidal wetland system typical of the Top End Region with substantial area of each component wetland type (Jaensch, 1993).

Adelaide River Floodplain system is a major breeding area for multiple species such as the Magpie Goose (*Anseranas semipalmata*), Saltwater Crocodile (*Crocodylus porosus*) and herons and allies. It is also a major dry season refuge area for waterbirds and a significant migration stop-over area for shorebirds (Jaensch, 1993).

9.3.22 Kakadu National Park

See Kakadu National Park Ramsar site (**Section 9.2.10**).

9.3.23 Mary Floodplain System

Included in the 127,600hectare site is the entire floodplain of the Mary River, from near Bark Hit Inn downstream to Van Diemen Gulf (including intertidal mudflats) and including Swim Creek Plain. Three principal plant formations occur within the site. These include melaleuca open-forest (paperbark swamp), scattered chenopod low shrubland (samphire) in the north and centre-north; and the remainder, mixed closed-grassland/sedgeland (seasonal floodplain). Mangroves occur in the far north fringing the coast and at estuary mouths. The site includes some of the largest areas of wooded swamp in the Northern Territory. 21 of the 36 described floodplain flora communities occur in the Mary Floodplain system (Jaensch, 1993).

Water supply mainly occurs from the surface inflow form the Mary-McKinlay River system as well as many creeks. Mudflats, estuaries, and saline coastal flats are tidal. Tidal areas of mudflats and estuaries are inundated twice daily compared to the large parts of coastal flats that may be only periodically inundated. The floodplain water supply is seasonal, with near-permanent water in deeper channels and billabongs, as well as Eleocharis swamp. The site is a good example of a major floodplain-tidal wetland system typical of the Top End Region and features a complex network of channels and billabongs (Jaensch, 1993).

Mary Floodplain System provides a major breeding area for the Magpie Goose (*Anseranas semipalmata*) as well as refuge during dry season for waterbirds (geese, ducks and herons) and Saltwater Crocodiles (*Crocodylus porosus*). At least 75 species recorded within the area, of those 33 species were listed under treaties and 11 species were found breeding. The mudflat and coastal flats support at least several thousand migrant shorebirds at a time (Jaensch, 1993).

9.3.24 Cobourg Peninsula System

See Cobourg Peninsula Ramsar site (**Section 9.2.9**).

9.3.25 Daly-Reynolds Floodplain-Estuary System

The Daly-Reynold Floodplain-Estuary System includes the entire floodplain of the Daly River, entire floodplain of the Reynolds River and the tidal mudflats of north-east Anson Bay and is in the Darwin Coastal and Daly Basin biographical regions. Six principal plant formations exist within the 159,300-hectare site. This includes mixed closed-grassland/sedgeland (seasonal floodplain) over most of the site; Melaleuca open-forest (paperbark swamp) in patches throughout, Coolibah/Gutta-percha low woodland over grassland in the far south-east; closed-forest (monsoon vine-thicket) around the Daly River in the far south-east; mangal low closed-forest (mangroves), discontinuously along the Daly River estuary (to 1 km wide); and scattered chenopod low shrubland (samphire) at/near the coast and river mouth. The site provides a good example of a major floodplain-tidal wetlands system as it contains substantial areas of all the principal features of such a system in the Top End Region. It is also one of the largest floodplains in the Northern Territory (Jaensch, 1993).

31 of the 36 described floodplain flora communities occur on the Daly-Reynolds Floodplain. The Daly-Reynolds Floodplain-Estuary System plays an important ecological role by providing a top three breeding ground for Magpie goose (*Anseranas semipalmata*), as well as herons, allies and Saltwater Crocodiles. Additionally the site is a major dry season refuge area for waterbirds and a significant migration stop-over area for shorebirds. The site also contains more than 80 fauna species, 30 of which are listed under treaties. Up to 2100 shorebirds are known to frequent this site as a migratory stop over (Jaensch, 1993).

9.3.26 Finniss Floodplain and Fog Bay Systems

The floodplain and bay systems provide a good example of a beach-fringed, curved bay with intertidal mudflats and intact floodplain with extensive paperback swamps. Plant structural formations within the area include mixed closed grassland/sedgeland and melaleuca open forests. Small areas of mangal and samphire occur near the estuaries and the south-west part of the bay. Surface inflow from the Finniss River, and several creeks supply the site with water (Jaensch, 1993).

At least 70 species of fauna are recorded in the area, 20 of which are listed under treaties. Finnis Floodplain and Fog Bay Systems are major breeding areas for Magpie goose and Saltwater Crocodile, a significant dry season refuge area for water birds and a major migration stop-over for over 25’000 shorebirds. 24 of the described floodplain flora communities along with the best floating mats in the Northern territory occur within this site (Jaensch, 1993).

9.3.27 Moyle Floodplain and Hyland Bay System

Plant structural formations of the area consist of closed grassland/sledgeland latiform arrangements, some fringing and scattered patches of melaleuca open-forests, and mangal low closed forest (mangroves) along the lower river. Surface inflow to floodplain areas from multiple creeks and Moyle River is the main source of water supply.

The Moyle Floodplain and Hyland Bay System is one of the least distributed examples of a Top End floodplain system associated with a small river a mudflat-fringed bay. The site is a major breeding area for magpie goose, a refuge for waterbirds (whistling duck) in the dry season, migration stop over area for shorebirds and a major breeding area for Saltwater Crocodiles. 27 of the described floodplain flora communities occur at this site. 47 fauna species are known to occur on the floodplain and adjacent coast, 26 of which are listed under treaties (Jaensch, 1993).

9.3.28 Murgenella-Cooper Floodplain System

Murgenella-Cooper Floodplain System includes the entire contiguous floodplains and saline coastal flats, estuaries, and tidal mudflats of Murgenella, Cooper and Salt-Water Creeks within 81,500 hectares. Surface flow from Cooper Creek and several unnamed creeks provide water supply for the area. Plant structural formations that are present include mixed closed grassland/sedgeland over most of the site, scattered chenopod low shrubland and narrow areas of mangal closed-forest (mangroves) along tidal channels and at the coast. The site provides a good example of floodplain-tidal wetland system of the Top End Region, with relatively low volume of freshwater inflow (Jaensch, 1993).

13 of the 36 described floodplain flora communities occur within the site. The site is a major breeding ground for Magpie Goose, cormorants, herons and allies, a major dry season refuge area for waterbirds and a major migration stop-over area for more than 10’000 shorebirds. At least 71 species of fauna are recorded in the area, 26 of which are on treaties (Jaensch, 1993).

9.3.29 Ord Estuary System

See Ord River Flood Plains Ramsar site (**Section 9.2.11**).

9.3.30 Port Darwin

The entire Port Darwin site covers 48,800 hectares. The whole site is tidal with mangal low closed-forest (mangroves) plant structural formations present. The site provides a good example of a shallow branching embayment of the Top End Region, supporting one of the largest discrete areas of mangrove swamp in the Northern Territory (Jaensch, 1993).

36 flora species, 23 of them trees and tall shrubs are present within the mangrove communities. Including Northern territory endemic *Avicennia integra*. The mangrove communities of this site are the most extensive and species rich of any Northern Territory embayment. The site is a major nursery for estuarine and offshore fish and crustaceans in the Beagle Gulf area. 48 fauna species, with 25 listed under treaties existing within this site. Rare species such as Red-necked Phalarope have also been recorded within the site. Furthermore, Woods Inlet is frequented by the uncommon dolphin *Orcaella brevirostris*. At least 72 fish species occur within the site as well as there being an unusual richness in sponges (220 species), soft and hard coral as well as invertebrates (Jaensch, 1993).

9.3.31 Shoal Bay - Micket Creek

Shoal bay is approximately 10km immediately north-east of the City of Darwin and the site includes King Creek and Noogoo swamp within 1,600 hectares. The site contains wetland marshes, mangrove woodlands, beaches, mudflats, creeks and estuaries and is a good example of a spring fed coastal wetland system. Micket Creek is a tidal estuary flowing into Shoal Bay while King Creek and water from Noogoo Swamp all flow into Shoal Bay. All areas contain remnants of monsoon forest interspersed with open woodland bounded by grassed backsoil plain (Hodgson, 1995).

Within the site there are some notable species. It has a bird habitat of over 200 species and provides a dry season refuge for waterfowl and birds of prey. Migratory birds regularly use the areas of mudflats with more than 15,000 wader species and 25 of them listed on international agreements with Japan and China. The Nationally endangered Littler Tern and two other uncommon species, the Eastern Grass Owl and Peregrin Falcon have been recorded within Shoal Bay – Micker Creek (Hodgson, 1995).

9.4 National Heritage Places

Natural, historic and indigenous places that are of outstanding heritage value to the Australian nation are recorded as National Heritage Places. Eleven National Heritage Places are found in waters from the South Australian border to the NT, with ten of these occurring within the combined EMBA. Kakadu National Park, Shark Bay and The Ningaloo Coast are listed as both World Heritage Areas and National Heritage Places, and are discussed in **Section 9.1**.

9.4.1 HMAS Sydney II and HSK Kormoran Shipwreck Sites

The naval battle fought in 1941 between the Australian warship HMAS Sydney II and the German commerce raider HSK Kormoran off the Western Australian coast during World War II was a defining event in Australia’s cultural history. The loss of HMAS Sydney II, along with its entire crew of 645 following the battle with HSK Kormoran, remains Australia's worst naval disaster (DoE 2014d).

The shipwreck sites are comprised of two areas located approximately 290 km west-southwest of Carnarvon. The shipwrecks of the HMAS Sydney II and HSK Kormoran are located on the seabed approximately 22 km apart (DoE 2014d).

9.4.2 Batavia Shipwreck site and Survivor Camps Area 1629 - Houtman Abrolhos

The Batavia was included on the National Heritage List in 2006. This shipwreck is the oldest of the known Verenigde Oost-Indische Compagnie (VOC) wrecks on the WA coast and has a unique place in Australian shipwrecks. Because of its relatively undisturbed nature the archaeological investigation of the wreck itself has revealed a range of objects of considerable value to the artefact specialist and historian. The recovered sections of the hull of the Batavia that have been reconstructed in the Western Australian Maritime Museum and provides information on 17th century Dutch ship building techniques, while the remains of the cargo carried by the vessel have provided economic, and social evidence of the operation of the Dutch port at Batavia (now Jakarta) in the early 17th century (DoE 2014d).

9.4.3 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 (DoE 2014d). Of these values, the most relevant to the marine environment is Roebuck Bay as a migratory hub for shorebirds. These values are discussed in **Section 9.2.2**. The area is characterised by a diversity of landscapes and biological richness found in its cliffs, headlands, sandy beaches, rivers, waterfalls and islands.

9.4.4 The Ningaloo Coast

See the Ningaloo Coast World Heritage Area (**Section 9.1.2**).

9.4.5 Shark Bay

See Shark Bay World Heritage Area (**Section 9.1.1**).

9.4.6 Dirk Hartog Landing Site 1616 - Cape Inscription Area

Cape Inscription is the site of the oldest known landings of Europeans on the Western Australian coastline (from Dirk Hartog of the Dutch East India Company's ship the Eendracht in October 1616), and is associated with a series of landings and surveys by notable explorers over a 250-year period (DoEE 2019b). The landing site forms part of the Dirk Hartog Island and is about 1,110 ha located 100 km south west of Carnarvon (DoEE 2019b).

9.4.7 Dampier Archipelago (including Burrup Peninsula)

The Dampier Archipelago (including the Burrup Peninsula) contains one of the densest concentrations of rock engravings in Australia, with some sites containing thousands or tens of thousands of images. At a national level it has an exceptionally diverse and dynamic range of schematised human figures and provides an unusual and outstanding visual record of the Aboriginal responses to the rise of sea levels at the end of the last Ice Age (DoEE 2019c).

The site is about 36,860 ha at Dampier and comprises of nine distinct areas of the Burrup Peninsula Areas and part of the following surrounding islands: West Intercourse Island, West Mid Intercourse Island, Enderby Island, Goodwin Island, West Lewis Island and East Lewis Island, Rosemary Island, Brigadier Island, Miller Rocks, Lady Nora Island and Elphick Nob, Malus Islands, Angel Island, Gidley Island, Cohen Island, Keast Island and Collier Rocks, Tozer Island, Dolphin Island, and Unnamed Island (DoEE 2019c).

9.4.8 Fitzgerald River National Park

The Fitzgerald River National Park contains an exceptional concentration of plant species richness and endemism. At an international level it is recognised as a biodiversity hotspot of south western Australia and at a national level it has an exceptional endemism and diversity for plant species. The diversity is considered high due to a wide range of landforms, geology and soil types that supports a diverse community of shrublands and heath, often dominated by eucalypt mallee species (DoEE 2019d).

The national park is approximately 297,244 ha located between Bremer Bay and Hopetoun in the south west of Western Australia. The park contains extensive marine plain sediments deeply incised by several rivers, creating valleys and tablelands. The park's coastline is diverse, consisting of long beaches, quartzite cliffs, extensive sand drifts and inlets. Along the Hamersley and Fitzgerald River valleys are spongolite cliffs that were formed more than 36 million years ago (Eocene period) and consist of sea sponge fossils (DoEE 2019d)

9.4.9 Lesueur National Park

The Lesueur National Park contains an exceptional concentration of plant species richness and endemism. At an international level it is recognised as a biodiversity hotspot of south western Australia and at a national level it has an exceptional endemism and diversity for plant species. The diversity is considered high due to a wide range of landforms, geology and soil types that supports a diverse community of shrublands and heath (DoEE 2019e).

The national park is approximately 27,235 ha located near the towns of Green Head and Jurien Bay. Coastal areas consist of recent (Holocene) sand deposits and mobile dunes extending inland for approximately two kilometres. The dunes are bordered by a series of mainly saline lakes with some freshwater springs and swamps on the eastern margins. Further inland are older (Quaternary) dune systems that have been compacted in places to form limestone. The park supports approximately 122 birds, including a diverse range of honeyeaters, fairy wrens and thornbills (DoEE 2019e).

9.4.10 Kakadu National Park

See Kakadu National Park World Heritage Area (**Section 9.1.3**).

9.5 Commonwealth Heritage Places

The Commonwealth Heritage Places List comprises natural, indigenous and historic heritage places which are either entirely within a Commonwealth area, or outside the Australian jurisdiction and owned or leased by the Commonwealth or a Commonwealth Authority. Ten Commonwealth Heritage Places are found in or adjacent to the combined EMBA. Three of these places (Ashmore Reef, Mermaid Reef and the Ningaloo Marine Area – Commonwealth Waters) are found in Marine Parks and are discussed further in **Section 12**. The HMAS Sydney II and HSK Kormoran Shipwreck Sites is listed under both National and Commonwealth Heritage Lists and discussed in **Section 9.4.1**.

9.5.1 Scott Reef and Surrounds – Commonwealth Area

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 (DoE 2014d).

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 (DoE 2014d).

9.5.2 Mermaid Reef – Rowley Shoals

See the Mermaid Reef Marine Park (**Section 12.3.9**).

9.5.3 Ningaloo Marine Area – Commonwealth Waters

See the Ningaloo Coast World Heritage Area (**Section 9.1.2**).

9.5.4 Ashmore Reef National Nature Reserve

See the Ashmore Reef Marine Park (**Section 12.3.12**).

9.5.5 Garden Island

Garden Island is located to the south of Perth, 5 km northwest of Rockingham. It was registered in 2004 based on various fauna, geological, European and Aboriginal heritage and vegetation values. It was the original first site occupied by Governors Stirling's Party in 1829, with prior use by Aborigines and the French (being called Ile de Buache by the French in 1801). The island is virtually free from widespread feral animal colonisation, providing important habitat for various species that have reduced on the mainland. The island provides breeding habitat for bridled tern (*Onychoprion anaethetus*), rainbow bee-eaters (*Merops ornatus*) and osprey (*Pandion haliaetus*), which nest on the rocks surrounding the island. Important feeding habitat for the Sanderling (*Calidris alba*) is provided by sandy beaches on the west coast of the island.

The island provides nesting habitat on beaches for the breeding migrant fairy tern (*Sterna nereis*), which requires undisturbed nesting periods. The mature relatively undisturbed heath, scrub and low forest communities unburnt since the 1920's in the northern section of the island are especially important as a reference site for natural history. The least disturbed examples of calcaronite reef structures dune and tamate landscapes in the metropolitan region are present on the western side of the island (DoEE 2016b).

9.5.6 Christmas Island Natural Areas

Christmas Island is located is approximately 1,500 km from Exmouth and is approximately 2,200 ha above Low Water and 3,600 ha below Low Water in the Indian Ocean. The island is an uplifted coral atoll with its characteristic steep series of rainforest-covered terraces and sheer limestone cliffs. It was registered in 2004 based on various fauna, vegetation, geological and cultural heritage values. The evolutionary significance of Christmas Island is demonstrated both by its high level of endemism and by its unique assemblage of plant and animal species. The island hosts seventeen endemic plant species and rich endemic fauna includes three mammal species, ten bird species, five reptile species, one crab species, two insects, three marine fish species and several marine sponge species (DoEE 2019f).

The rainforests of Christmas Island are biogeographically significant; species have evolved from being either shoreline forest or early rainforest succession species to those that fill a tall climax rainforest role. The Island contains unique plant communities of high conservation and scientific interest including a variety of elevated and relict cycad and back-mangrove communities of international significance (DoEE 2019f).

The island is also one of the world's most significant seabird islands, both for the variety and numbers of sea-birds, with over 100 species of bird having been recorded, including eight species that breed on the island. The island rainforest provides significant habitat for two endemics the nationally endangered Abbott's booby and the nationally vulnerable Christmas Island frigate bird (DoEE 2019f).

The fringing simple reefs and adjacent waters of Christmas Island support provides habitat for two nationally vulnerable species of turtle, the green and hawksbill which nest on two of the Island's beaches and two nationally vulnerable shark species (DoEE 2019f).

9.5.7 Yampi Defence Area

The Yampi Defence Area is located at the confluence of the Dampierland, Central and Northern Kimberley biogeographic regions and has a diverse range of ecosystems of landforms, soils and vegetation representative of the transition from the sandstone plateaux of the wetter north-west Kimberley, to the broad plains and pindan scrub of the drier south-west Kimberley (DoEE 2019g).

The diversity of landforms in the place and the resultant high concentration of small refugial habitats support a regionally rich vertebrate fauna. The bird fauna is significant as it represents a suite of species which are at or near the southern edge of their range in the semi-humid zone of the Kimberley. The place is also an important zone of overlap between many northern and southern species and sub-species. The vertebrate fauna shows its closest similarity to those recorded from the wetter areas of the west Kimberley that lie further to the north. The place supports several fauna and flora species that are listed as specially protected, threatened or having priority status in Western Australia in addition to four fauna species that are nationally vulnerable and one nationally endangered (DoEE 2019g).

9.5.8 Learmonth Air Weapons Range Facility

The Learmonth Air Weapons Range Facility is located 30 km south west of Learmonth within Cape Range and Adjacent Coastal Plain, which is listed on the Register of the National Estate. As the Learmonth Air Weapons Range Facility is located within Cape Range it is of considerable importance of showing he sea level and landform changes for the past 1.8 million years (DoEE 2019h).

The area is important to a number of cave fauna of Cape Range and is considered of exceptional biogeographical importance. It hosts a high number of endemic aquatic stygofauna with ecosystems found within this area are considered rare within Western Australia and are considered to be of considerable scientific interest. The area also supports several species of terrestrial fauna that are isolated populations, populations at the extent of their range and a number of fauna and flora species that are endemic to southern WA and restricted to sandy coastal habitats along the western coast (DoEE 2019h).

9.5.9 Lancelin Defence Training Area

The Lancelin Defence Training Area is located approximately 11 k north of Lancelin township situated on the Swan Coastal Plain and consists of three main land systems that include Quindalup and Spearwood Dune Systems (together making up the Coastal Belt), and the Bassendean Dunes (DoEE 2019i).

The area supports a high diversity of vegetation types, flora species, fauna habitat types and a high diversity of terrestrial fauna.

9.5.10 Bradshaw Defence Area

The Bradshaw Defence Area is located in the Northern Territory and is bounded by the Fitzmaurice and Victoria Rivers on the shores of the Joseph Bonaparte Gulf and the Bradshaw Defence field training area.

The complex topography of the Bradshaw area results in a broad range of highly distinct environments and habitats that include lowland woodlands, heaths, grasslands, sandstone escarpments, monsoon rainforest patches and wetlands. Compared to surrounding areas, the vegetation within the Bradshaw area is more diverse and incorporates more than one fifth of the vegetation types that occur in the Top End of the Northern Territory and includes grassland, woodland flora that are restricted on a national level (DAWE, 2002).

The topological complexity that results in a broad range of environments also contributes to the unusually rich vertebrate fauna. The species richness of frogs, reptiles and mammals is considered significant at a national level. Furthermore, it is also worth noting that the Bradshaw area supports many species that have declined elsewhere in Australia (DAWE, 2002).

9.6 Coastal Terrestrial Conservations Reserves – bound by marine waters

Conservation reserves are created under the Land Administration Act 1997, and once reserved and set aside for conservation purposes are regulated under the *Conservation and Land Management Act (CALM) 1984*. Most conservation reserves in WA are vested in (owned) by the WA Conservation and Parks Commission, an independent statutory body established by the CALM Act 1984, and most are managed by the Department of Biodiversity, Conservation and Attractions – Parks and Wildlife Service. Most conservation areas in the NT are managed under the *Territory Parks and Wildlife Conservation Act*.

In WA there are three main types of terrestrial conservation reserves with legislative protection:

+ Nature reserves – established for wildlife and landscape conservation; scientific study; and preservation of features of archaeological, historic or scientific interest;
+ National parks – as above but also to be used for enjoyment by the public. Have national or international significance; and
+ Conservation parks – as above but have local or regional significance.

Nature reserves can have an extra classification applied to them and become ‘A class’ reserves, which generally require an Act of Parliament to alter.

In NT there are a number of types of terrestrial conservation reserves with legislative protection, those present within the combined EMBA include coastal reserves, national parks and conservation parks.

There are numerous terrestrial conservation reserves located adjacent to the coast in the combined EMBA. The oceanward boundary of the reserves varies. In some cases, the reserves extend to the low water mark, i.e. including the inter-tidal zone (particularly applicable to older gazetted reserves and terrestrial reserves not surrounded by a marine reserve). While in other cases, the terrestrial reserves extend to the high-water mark e.g. Lowendal Islands Nature Reserve (particularly applicable to terrestrial reserves adjacent to more recently gazetted marine parks). In other cases, the seaward boundary of the reserves is not defined. Management plans also contain the caveat for further consideration of the most appropriate tenure for intertidal areas and management arrangements.

Further information on coastal terrestrial reserves is provided below in **Section 9.6.1** (national parks) and **Section 9.6.2** (nature reserves and conservations parks).

9.6.1 Coastal National Parks

Protected coastal national parks managed under the CALM Act 1984 in the combined EMBA are listed in **Table 9-2**. The table also includes: any applicable management plan; whether the park includes the inter-tidal area; and the name of any adjacent state marine reserve. All WA National Parks are WA Class A reserves and IUCN Class 2.

Table 9-2: Coastal National Parks – coastal boundary in relation to inter-tidal zone

National Park	IBRA bioregion[9]	Management plan	Includes inter-tidal zone	Adjacent Marine Management Park (see Section 11)
Reserves of Northern WA (see Figure 9-6)				
Lawley River	Northern Kimberley	-	No [10]	Kimberley Marine Park
Mitchell River		-		
Prince Regent		-		
Reserves of North-West WA (see Figure 9-7)				
Murujuga	Pilbara	Murujuga National Park management plan 78 (DEC 2013)	Yes [11]	-
Cape Range	Carnarvon	Cape Range National Park Management Plan (DEC 2010a)	No	Ningaloo Marine Park
Reserves of Southern WA – (see Figure 9-8)				
Francois Peron	Carnarvon	Shark Bay Terrestrial Reserves and Proposed Reserve Additions Management Plan (2012)	No	Shark Bay Marine Park and Hamelin Pool Marine Nature Reserve
Dirk Hartog	Yalgoo		Yes – intertidal zone on western side of Dirk Hartog is included (as no marine park on western side of island)	

[9] IBRA classifies Australia’s landscapes into large geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information (DoEE 2012).

National Park	IBRA bioregion[9]	Management plan	Includes inter-tidal zone	Adjacent Marine Management Park (see Section 11)
Houtman Abrolhos Islands	Geraldton Sandplains	-	No - extends to the high water mark only.	Abrolhos Commonwealth Marine Park
Kalbarri	Geraldton Sandplains	Kalbarri National Park Management Plan (DPAW 2015)	Yes [11]	-
Namburg	Geraldton Sandplains	Namburg National Park Management Plan (1998)	Yes	-
Yalgorup	Swan Coastal Plain	Yalgorup National Park Management Plan (CALM 1995)	Yes [11]	-
Leeuwin - Naturaliste	Warren	Leeuwin-Naturaliste Capes Area Parks and Reserves Management Plan (DPAW 2015)	No	Ngari Capes Marine Park
Torndirrup	Warren	Albany coast draft management plan 2016 (DPaW 2016b)	Yes[11]	
Walpole-Nornalup	Warren	Walpole Wilderness and Adjacent Parks and Reserves Management Plan (DEC 2008) Walpole and Nornalup Inlets Marine Park Management Plan No 62 (DEC 2009b)	Yes[11]	Walpole and Nornalup Inlets Marine Park
Waychinicup	Southern Jarrah Forest and Fitzgerald	Albany coast draft management plan 2016 (DPAW 2016)	Yes[11]	
West Cape Howe	Warren	Albany coast draft management plan 2016 (DPaW 2016)	Yes[11]	
D'Entrecasteaux	Warren	Shannon and D'Entrecasteaux National Parks Management Plan No. 71 (DEC 2012b)	Yes[11]	
Fitzgerald River	Fitzgerald	Fitzgerald River National Park Management Plan 1991 – 2001 No. 15 (CALM 1991)	Yes[11]	
Reserves of the Northern Territory (NT) – (see Figure 9-5)				
Djukbinj National Park	Darwin Coastal and Pine Creek	-	Yes[11]	-

National Park	IBRA bioregion[9]	Management plan	Includes inter-tidal zone	Adjacent Marine Management Park (see Section 11)
Garig Gunak Barlu National Park	Tiwi Cobourg	Cobourg Marine Park Plan of Management (PAWCNT, 2011)	Yes[11]	Cobourg Marine Park
Mary River National Park	Darwin Coastal	Mary River National Park Joint Management Plan March 2015 (PAWCNT, 2015)	Yes[11]	-
Keep River National Park	Victoria Bonaparte	-	Yes[11]	-
Charles Darwin National Park	Darwin Coastal	Charles Darwin National Park Plan of Management (NT government, nd)	Yes[11]	-

9.6.2 Coastal Nature Reserves and Conservation Parks

Protected coastal nature reserves and conservation parks managed under the CALM Act 1984 in the combined EMBA are listed in **Table 9-3** and shown in **Figure 9-6**, **Figure 9-7** and **Figure 9-8** for the north, north-west and south of WA respectively. Protected lands in the NT are shown in Figure 9-5 as gazetted under the (NT) Crown Lands Act 1992. The table also includes reserve class; IUCN classification; any applicable management plan; whether the reserve includes the inter-tidal area; and the name of any adjacent state marine reserve (may also describe inter-tidal areas values).

The CALM Act does not require management plans to be in place for conservation reserves at all time, instead they are required to be made as is reasonably practicable regarding resources. This means some conservation reserves do not have a management plan, or do not have a recent management plan.

Table 9-3: Nature Reserves (NR) and Conservation Parks (CP) in EMBA

Reserve name and type	Reserve class	IUCN	Management Plan	Includes inter-tidal zone	Adjacent Marine Park (see Section 11)
Reserves of Northern WA (see Figure 9-6)					
Ord River NR	-	1a	-	No [10]	North Kimberley Marine Park
Pelican Island NR	-	1a			
Lesueur Island NR	A	1a			
Low Rocks NR	A	1a			
Browse Island NR	A	1a	-	Yes [11]	-
Scott Reef NR	-	1a	-	Yes [11]	-
Adele Island NR	A	1a	-	Yes [11]	-
Tanner Island NR	A	1a	-	Yes [11]	-
Lacepede Islands NR		1a	-	Yes [11]	-

[10] Inferred as adjacent marine park boundary is the high water mark and dual tenure cannot exist.

[11] Conservatively inferred as no adjacent Marine Park.

Reserve name and type	Reserve class	IUCN	Management Plan	Includes inter-tidal zone	Adjacent Marine Park (see Section 11)
Coulomb Point NR	A	1a	-	Yes [11]	-
Yawaru Birragun CP; Yawuru Northern Intertidal Area	- & A	2 & 6	Yawaru Birragun Conservation Park Management Plan (DPaW 2016). *Yawuru Intertidal Area management plan is not yet available*.	Yes	-
Jinmarnkur CP	C	-	Parks and reserves of the south-west Kimberley and north-west Pilbara Draft Management Plan (DPAW 2016). *Covers 80 Mile Beach coastal reserves*.	No	Eighty Mile Beach Marine Park
Jinmarnkur Kulja NR	A	-			
Kujungurru Warrarn NR	A	1a			
Kujungurru Warrarn CP	C	-			
Unnamed	A	-			
Jarrkunpungu NR	A				
Bedout Island NR	A	1a	-	Yes [11]	-
North Turtle Island NR	A	1a	-	Yes [11]	-
Reserves of North-West WA (see Figure 9-7)					
Unnamed (Dampier Archipelago) NR	A	1a	Dampier Achipelago Management Plan (CALM 1990). *Covers 25 of the islands*	Yes	-
Swan Island NR	A	1a	-	Yes[11]	Kimberly Marine Park
Unnamed NR		1a	-	Yes [11]	-
North Sandy Island NR	A	1a	-	Yes [11]	-
Montebello Islands CP	A	2	-	Partially [12]	Montebello Islands Marine Park
Lowendal Island NR		1a	-	No	Barrow Island Marine Management Area and Marine Park. Lowendal Island NR only partially bounded
Barrow Island NR	A	1a	Barrow Island Group Nature Reserves (DPAW 2015)	Yes	
Boodie, Double and Middle Islands NR	-	1a		Yes	
Great Sandy Island NR	B	1a	-	Yes	Barrow Island Marine Management Area
Weld Island NR	-	1a	-	Yes [11]	-
Little Rocky Island NR	A	1a	-	Yes [11]	-
Airlie Island NR	-	1a	-	Yes [11]	-

[12] Reserve R42197 includes the inter-tidal zone and reserve R42196 does not.

Reserve name and type	Reserve class	IUCN	Management Plan	Includes inter-tidal zone	Adjacent Marine Park (see Section 11)
Thevenard Island Nature	-	1a	-	Yes [11]	-
Bessieres Island NR	A	1a	-	Yes [11]	-
Serrurier Island NR	-	1a	-	Yes [11]	-
Round Island NR	-	1a	-	Yes [11]	-
Locker Island NR	A	1a	-	Yes [11]	-
Rocky Island NR	-	1a	-	Yes [11]	-
Gnandaroo Island NR	A	1a	-	Yes [11]	-
Victor Island NR	-	1a	-	Yes [11]	-
Y Island NR	-	1a	-	Yes [11]	-
Tent Island NR	-	1a	-	Yes [11]	-
Burnside and Simpson Island NR	-	1a	-	Yes [11]	-
Whalebone Island NR		1a	-	Yes [11]	-
Whitmore, Roberts, Doole Islands & Sandalwood Landing NR	-	1a	-	Yes [11]	-
Muiron Islands NR	-	1a	Jarabi and Bundegi Coastal Parks and Muiron Islands (CALM 1999)	No [10]	Muiron Islands Marine Management Area
OneTree Point NR	A	1a	-	Yes [11]	
Reserves of Southern WA – (see Figure 9-8)					
Koks Island NR	A	1a	Shark Bay Terrestrial Reserves and Proposed Reserve Additions Management Plan (DPAW 2012)	Yes [11]	-
Bernier and Dorre Islands NR	A	4			
Shell Beach CP	-	3		No	Shark Bay Marine Park
Freycinet, Double Islands etc NR	A	1a			Shark Bay Marine Park
Zuytdorp NR	-	1a		Yes [11]	-
Beekeepers NR	-	1a	-	Yes [11]	-
Beagle Islands NR	A	1a	Turquoise Coast Nature Reserve Management Plan (CALM 2004). *Covers chain of approximately 40 protected islands lying between Lancelin and Dongara.*	Yes	-
Lipfert, Milligan, etc Islands NR	A	1a			-
Fisherman Islands NR	A	1a			Jurien Bay Marine Park: extends from Greenhead south to Wedge Island
Sandland Islands NR	A	1a			
Boullanger, Whitlock, Favourite, Tern and Osprey Islands NR	A	1a			
Escape Island NR	A	1a			
Essex Rocks NR	A	1a			

Reserve name and type	Reserve class	IUCN	Management Plan	Includes inter-tidal zone	Adjacent Marine Park (see Section 11)
Outer Rocks NR	A	1a			
Ronsard Rocks NR	A	1a			
Cervantes Islands NR	A	1a			
Buller, Whittell and Green Islands NR	A	1a			
Wedge Island NR	A	1a			
Lancelin and Edwards Islands NR	A	1a			-
Southern Beekeepers NR	-	1a	Namburg National Park Management Plan (CALM 1998)	No	-
Wanagarren NR	-	1a		Yes	
Nilgen NR	-	1a		Yes	
Unnamed CP (R 49994) west of Wilbinga	-	2	-	Yes [11]	-
Unnamed CR (R 42469) at Woodman Point	-	-	Woodman Park Regional Park Management Plan (DEC 2010b)	No	-
Unnamed CP at Woodman Point (R 49220)	-	2		No	-
Carnac Island NR	A	1a	Carnac Island Nature Reserve Management Plan (CALM 2003)	Yes	-
Penguin Island CP	A	3	Shoalwater Islands Management Plan (CALM 2002)	No	Shoalwater Islands Marine Park
Shoalwater Islands NR	A	1a		Yes	
Port Kennedy Scientific Park	A	1a	Rockingham Lakes Regional Park (DEC 2015)	No	-
Leschenault Peninsula CP	A	2	Leschenault Peninsula Management Plan (CALM 1998)	Yes	-
Sugar Loaf Rock NR	A	1a	Leeuwin-Naturaliste Capes Area Parks and Reserves Management Plan (DPAW 2015)	Yes	Ngari Capes Marine Park
Hamelin Island NR	A	1a		Yes	
Seal Island NR	A	1a		Yes	
St Alouarn Island NR	A	1a		Yes	
Flinders Bay NR	A	1a		Yes	
Quagering NR	A	1a	-	Yes [11]	-
Doubtful Islands NR	A	1a	-	Yes	Bremer Marine Park
Quarram NR	A	1a	-	Yes	South-west corner Marine Park
Chatham Island NR	A	1a	-	Yes	
Two Peoples Bay NR	A	4		Yes [11]	-

Reserve name and type	Reserve class	IUCN	Management Plan	Includes inter-tidal zone	Adjacent Marine Park (see Section 11)
Breaksea Island NR	A	1a	Albany coast draft management plan 2016 (DPAW 2016b)	Yes[11]	-
Bald Island NR	A	1a		Yes[11]	-
Eclipse Island NR	A	1a		Yes[11]	-
Michaelmas Island NR	A	1a		Yes[11]	-
Glasse Island NR	A	1a	-	Yes[11]	-
Arpenteur NR	-	1a	-	No	-
Figure 9-5					
Channel Point Coastal Reserve	-	5	-	Yes[11]	-
Casuarina Coastal Reserve	1 and 3	5	Casuarina Coastal Reserve Management Plan (PAWCNT, 2016)	Yes[11]	-
Shoal Bay Coastal Reserve	-	6	-	Yes[11]	-
Tree Point Conservation Area	-	5	-	Yes[11]	-

Further information is provided below in relation to Varanus Island and Airlie Island Nature Reserves. Santos' Varanus Island Processing Hub and Airlie Island (operations ceased) co-exist with the reserves.

Lowendal Islands Nature Reserve - Varanus Island

Varanus Island is part of the Lowendal Islands group, a Nature Reserve (Class C). The Lowendal Islands comprise more than 40 limestone islands, islets and rocky stacks. There is not currently a DBCA Management Plan covering the Lowendal Islands Nature Reserve. Varanus Island is the largest island in the Lowendal Islands and is approximately 2.5 km long and 600m wide at its widest point. Its highest point is approximately 30m above sea level.

Described ecological conservation values of marine relevance include: Wedge-tailed Shearwater nesting (see **Section 8.1.6**); Loggerhead and Hawksbill Turtle nesting (see **Section 6.1.1** and **Section 6.1.3**), Flatback Turtle nesting (Section 6.1.4). The Lowendal Islands are described as particularly important for tern breeding (DEC 2002), further information on terns is provided in **Section 8.2.1**.

Airlie Island Nature Reserve

Airlie Island Nature Reserve is an ungazetted 'C' class nature (Reserve identifier: 40323, Crown Lease 1901/100) located on Airlie Island. Airlie Island is a small sand cay (26 Ha) located 35 km NNE of Onslow. It is part of the Pilbara Inshore Islands chain. A management plan for the nature reserves of the Pilbara Inshore Islands is currently under development (DBCA 2019) i.e. there is not currently a DBCA Management Plan covering Airlie Island Nature Reserve.

Described ecological conservation values of marine relevance include: a wedge-tailed shearwater nesting (see **Section 8.1.6**); silver gull nesting (see **Section 8.1.6**) and low levels of green turtle and hawksbill turtle nesting (see **Section 6.1.2** and **6.1.3**).

9.7 Threatened Ecological Communities

An ecological community is a naturally occurring group of plants, animals and other organisms interacting in a unique habitat. Ecological communities are listed under the EPBC Act as threatened if the community is at risk of extinction.

Similarly, ecological communities can be listed under the WA BC Act as threatened if facing a risk of becoming a collapsed ecological community. To date no ecological communities are listed as threatened under the WA Act, however several ecological communities are currently endorsed by the WA Minister of Environment as Threatened Ecological Communities (TECs) through the previous non-statutory process.

TECs of relevance (likely to exist in marine water inter-tidal areas) in the combined EMBA are listed in **Table 9-1** and further described below.

Table 9-4: Relevant TEC in the marine EMBA

Species	Conservation Status		
	EPBC Act 1999 (Cwth)	BC Act 2016 (WA)	Otherwise endorsed by the WA Minister for Environment
Monsoon Vine Thicket on the Ridge on the Coastal Sand Dunes of Dampier	Endangered	-	Vulnerable
Roebuck Bay mudflats	-	-	Vulnerable
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	-	-

9.7.1 Monsoon Vine Thicket on the Ridge on the Coastal Sand Dunes of Dampier

Monsoon vine thicket occurs as semi - deciduous and evergreen vine thicket communities on and behind landward slopes of coastal sand dunes on the Dampier Peninsula in the Kimberley Region. This community is closely associated with coastal dunes elsewhere on the Dampier Peninsula and is listed as Endangered under the EPBC Act (Government of Western Australia 2010; DoEE 2016b). The community is also endorsed by the WA Minister for Environment as a threatened ecological community (non-statutory process).

9.7.2 Roebuck Bay Mudflats

Roebuck Bay mudflats (Kimberley region) have been endorsed by the WA Minister for Environment as a threatened ecological community (non-statutory process). The TEC is not listed under the EPBC Act.

Roebuck Bay mudflats (Kimberley region) are described as a 'species rich faunal community of the intertidal mudflats of Roebuck Bay' in the Kimberley region. Classed as Vulnerable (B). Roebuck Bay is a tropical marine embayment with extensive, biologically diverse, intertidal mudflats.

Roebuck Bay is protected as a designated Ramsar Wetland of International Importance (**Section 9.2.2**) and Marine Park (see **Sections 11.1.17** and **12.3.10**).

9.7.3 Subtropical and Temperate Coastal Saltmarsh

Subtropical and Temperate Coastal Saltmarsh occurs within the subtropical and temperate climatic zones and is present in coastal areas under regular or intermittent tidal influences and occurs over six State jurisdictions (Queensland, New South Wales, Victoria, Tasmania and WA). In WA it occurs from the south coast up to the southern part of Shark Bay. The community is made up of mainly salt tolerant vegetation which include halophytes as well as a number of non-vascular plant species. The community is listed as vulnerable under the EPBC Act (DoE 2014k).

9.7.4 Thrombolite (microbialite) Community of a Coastal Brackish Lake (Lake Clifton)

The Lake Clifton thrombolite community is restricted to Lake Clifton, which occurs on the Swan Coastal Plain region of WA. Lake Clifton is situated within the Yalgorup National Park and is the northernmost lake in the Peel-Yalgorup Lakes System, which consists of several hypersaline and brackish lakes (Moore 1990). The Lake Clifton thrombolite community occurs on a relict foredune plain of Holocene age sands. The main known occurrence of the ecological community is a stretch, approximately 15 km long and up to 15 m wide, along the north-eastern shoreline of Lake Clifton. There are other small clusters of thrombolites within the Lake, also at the northern end. The thrombolites cover a total area of approximately four square kilometres (Moore 1990).

This structure is the largest known example of a living, non-marine microbialite reef in the southern hemisphere.

The Thrombolite (microbialite) Community of a Coastal Brackish Lake (Lake Clifton) is listed as critically endangered under the EPBC Act because it has a very restricted distribution and recent investigations indicate that *Scytonema*, a key cyanobacterium for thrombolite formation has gone from being a dominant species to no longer being found in Lake Clifton thrombolites.

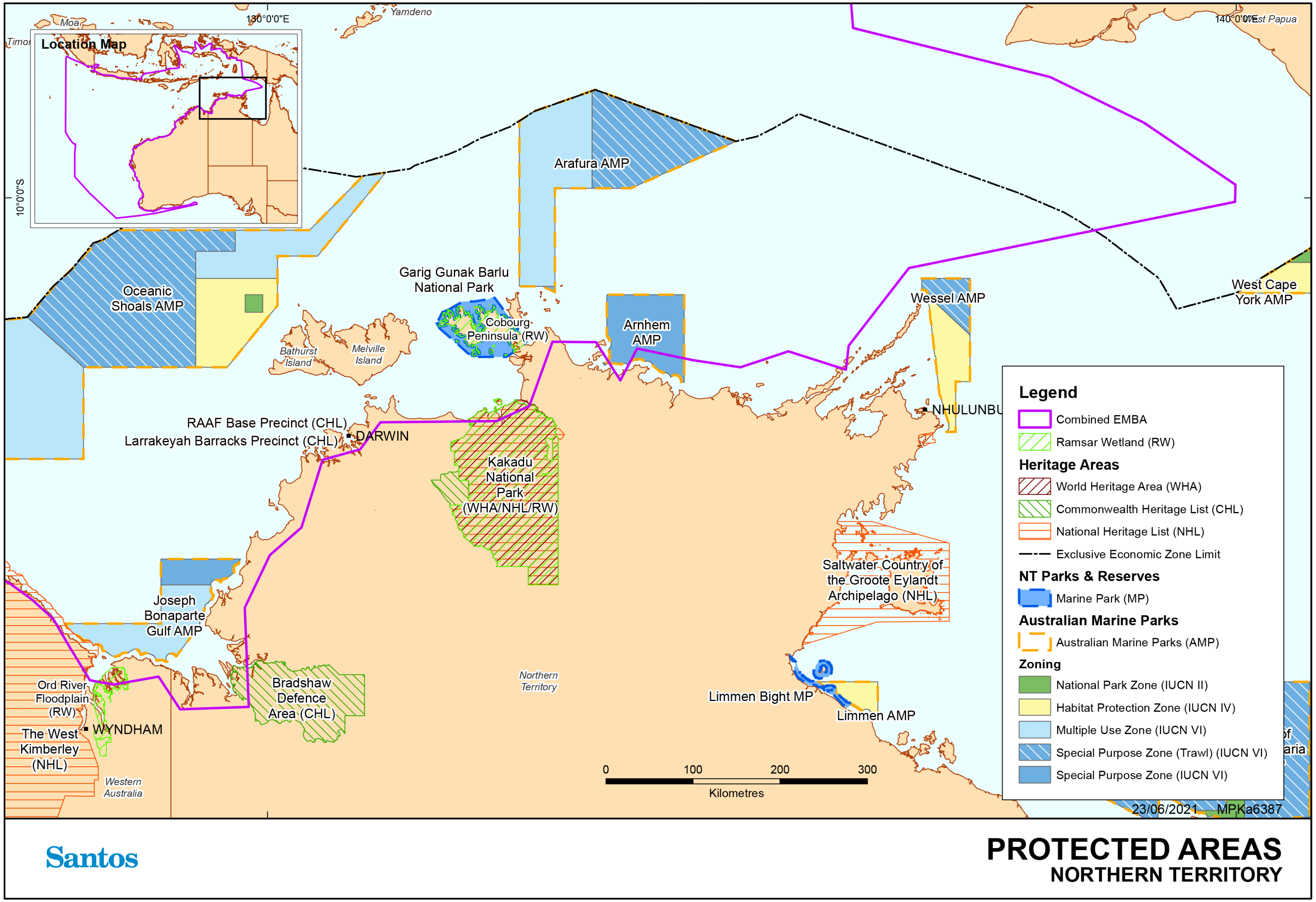

Figure 9-1: Protected areas in NT

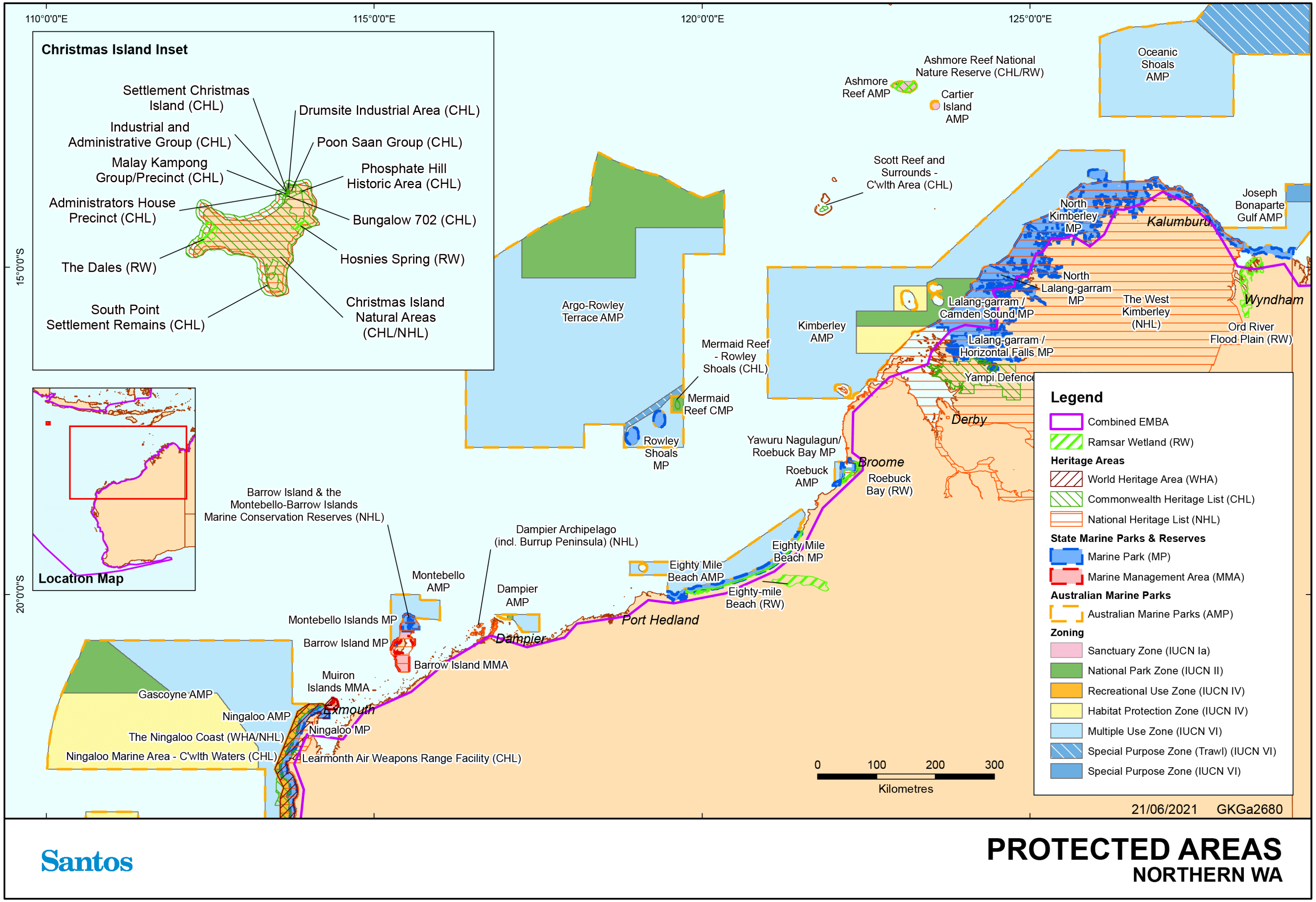

Figure 9-2: Protected areas in Northern WA

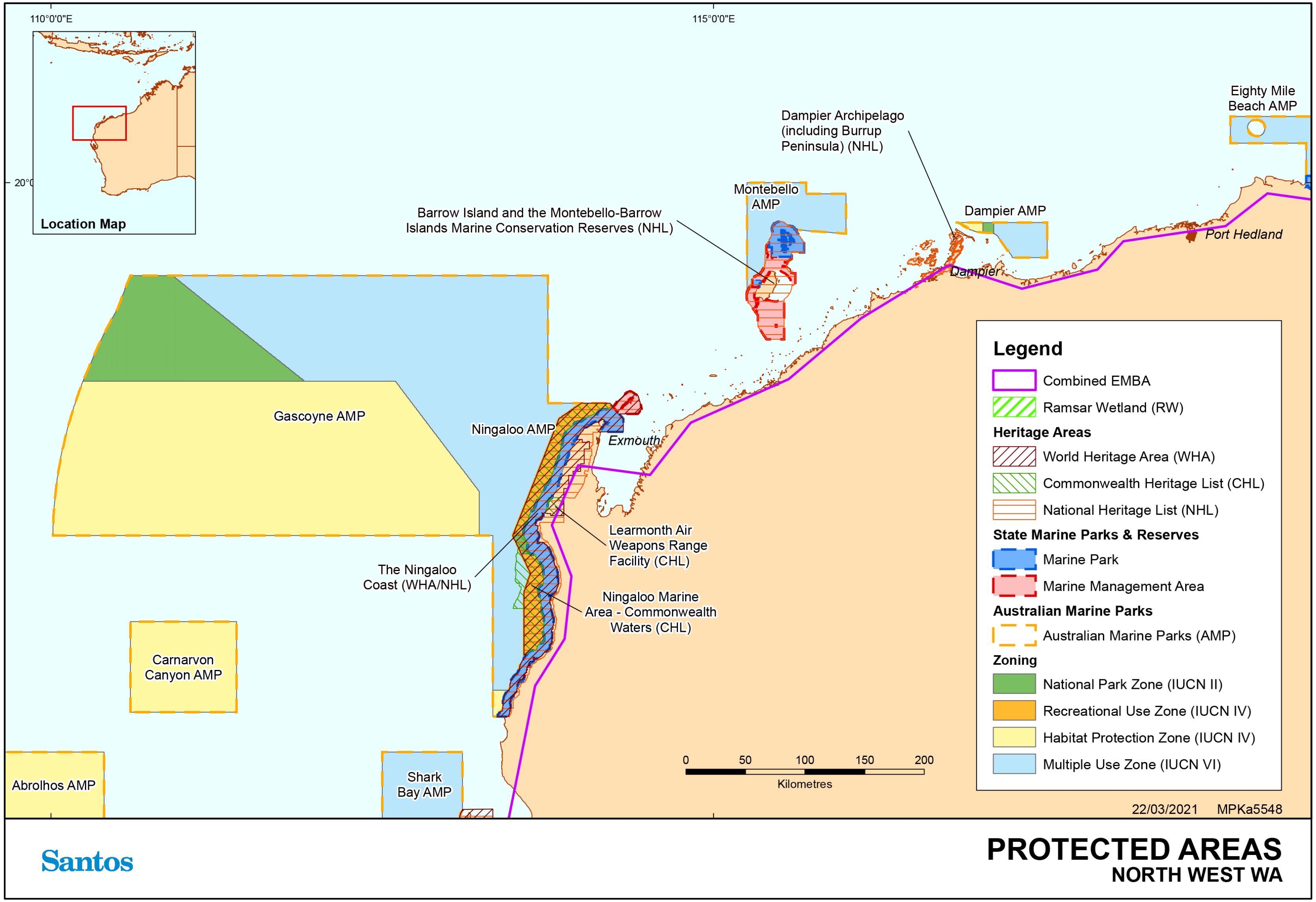

Figure 9-3: Protected areas in North West WA

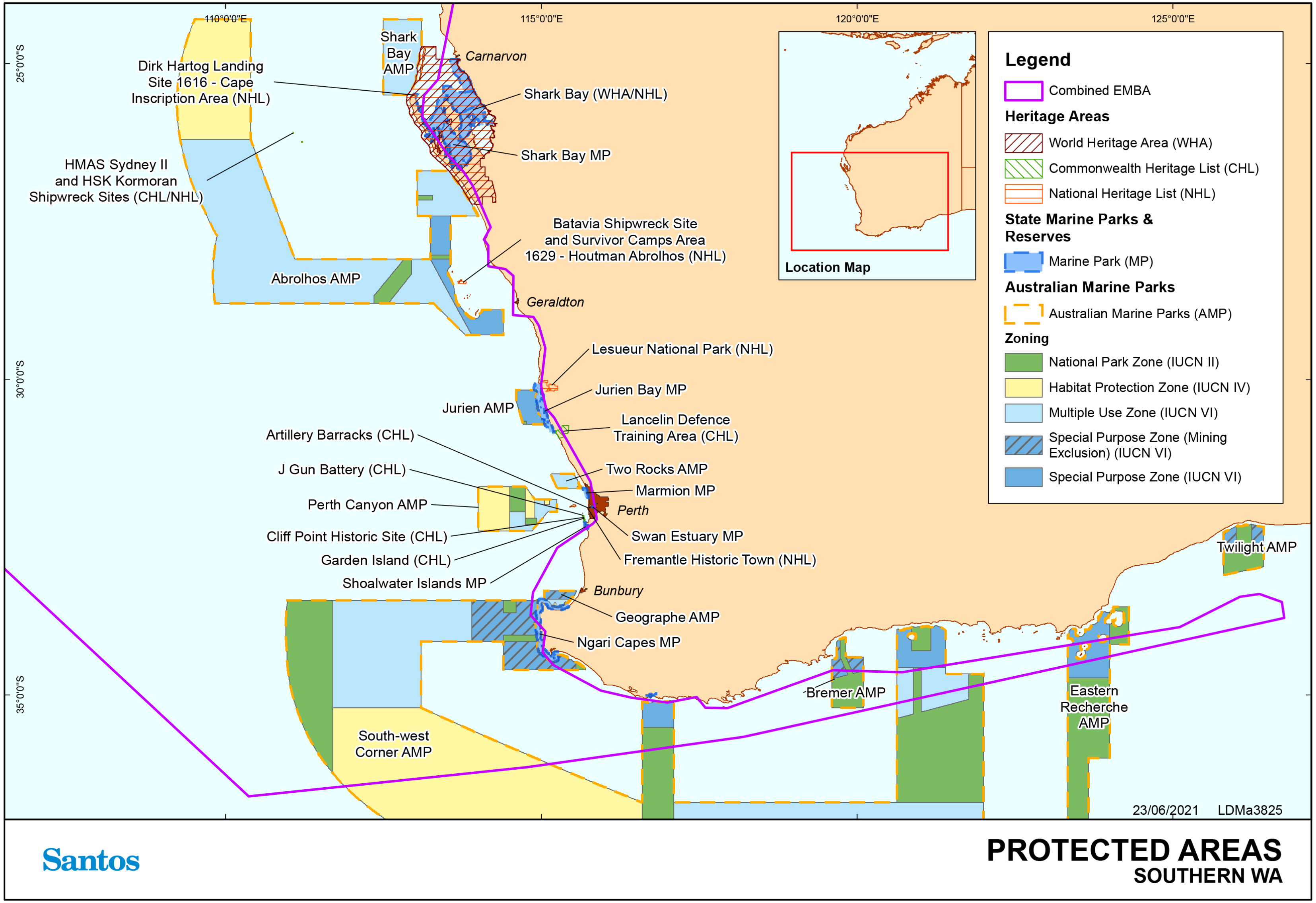

Figure 9-4: Protected areas in Southern WA

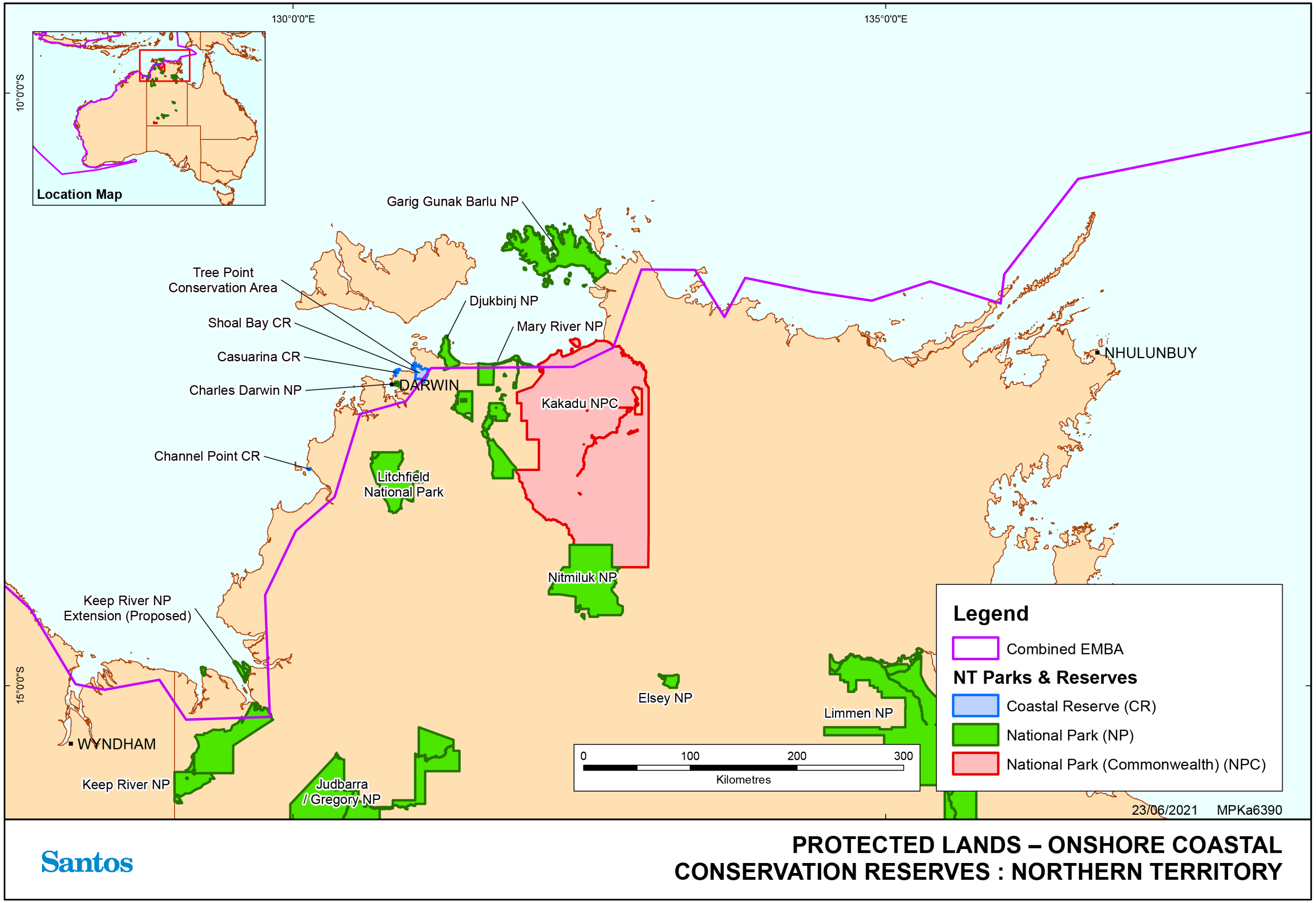

Figure 9-5: Protected Lands (CALM Act 1984) – terrestrial coastal reserves bounding marine waters in NT

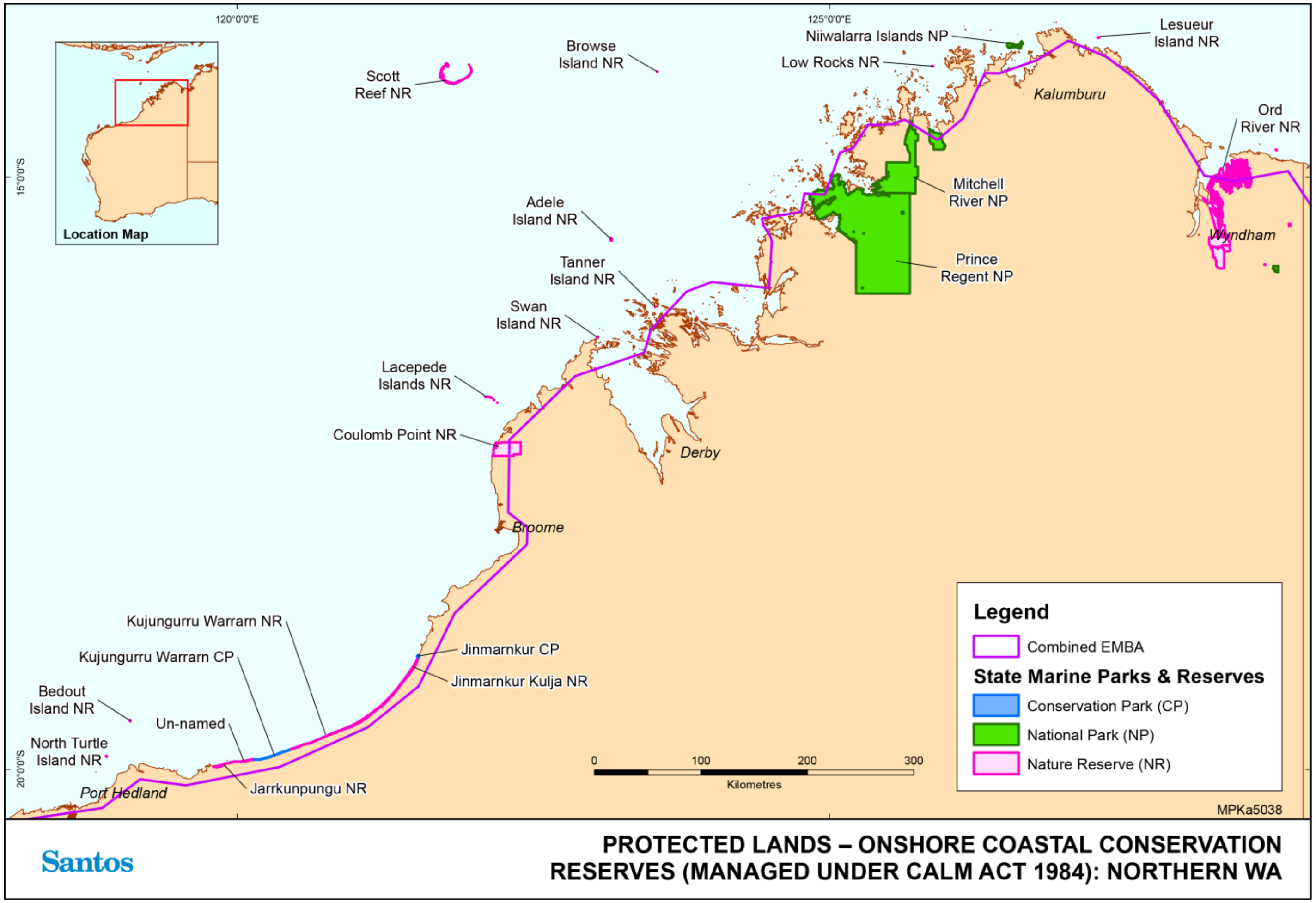

Figure 9-6: Protected Lands (CALM Act 1984) – terrestrial conservation reserves bounding marine waters in northern WA[13]

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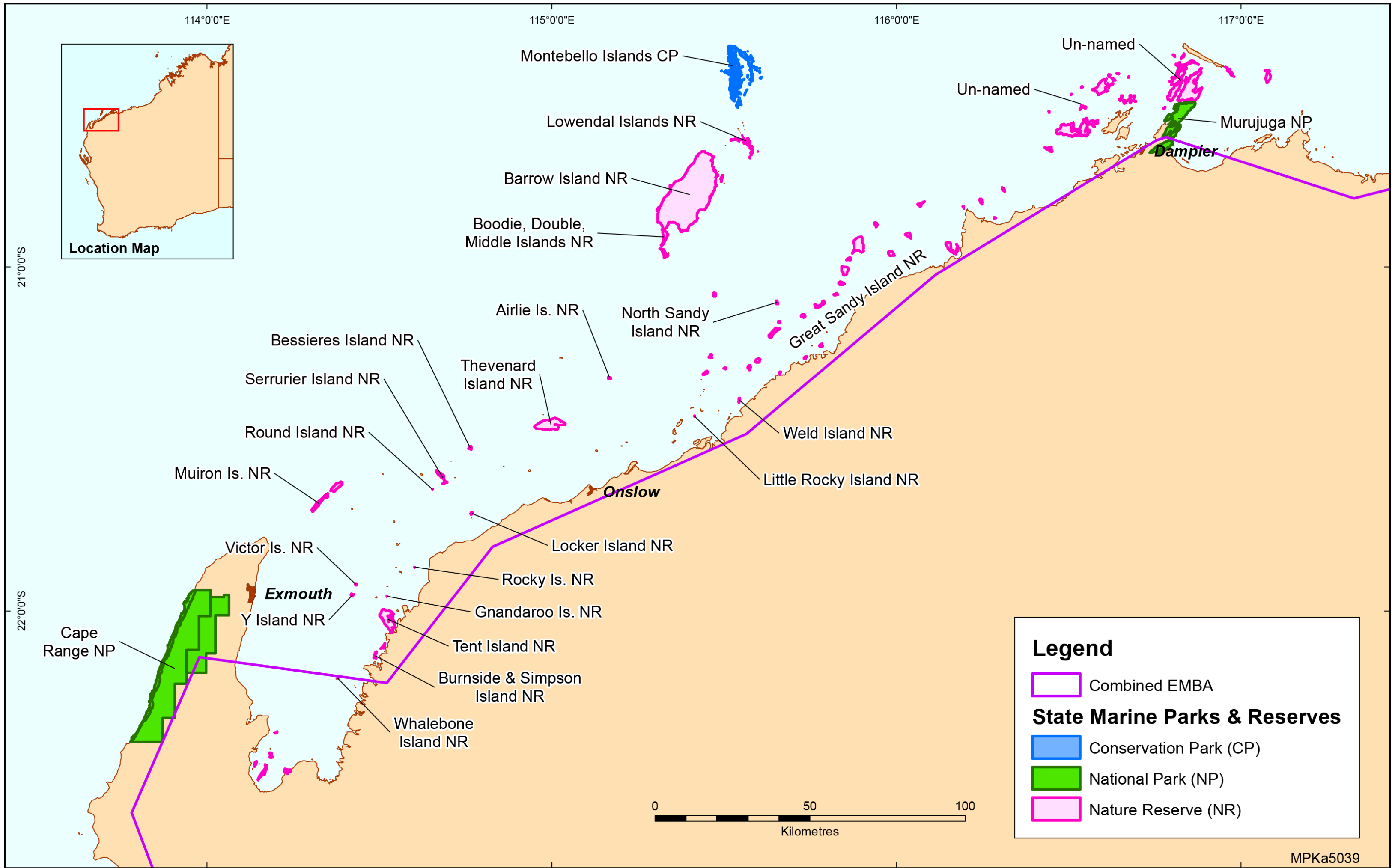
[13] Yawaru Minyirr Buru Conservation Reserve (adjacent to Roebuck Bay) not shown as exact spatial extent unavailable, however the adjacent inter-tidal waters are managed under adjacent Roebuck Bay Marine Park (described in **Section 11.1.17**).

Santos



Santos

PROTECTED LANDS – ONSHORE COASTAL CONSERVATION RESERVES (MANAGED UNDER CALM ACT 1984): NORTH-WEST WA

Figure 9-7: Protected Lands (CALM Act 1984) – terrestrial conservation reserves bounding marine waters in North-West WA

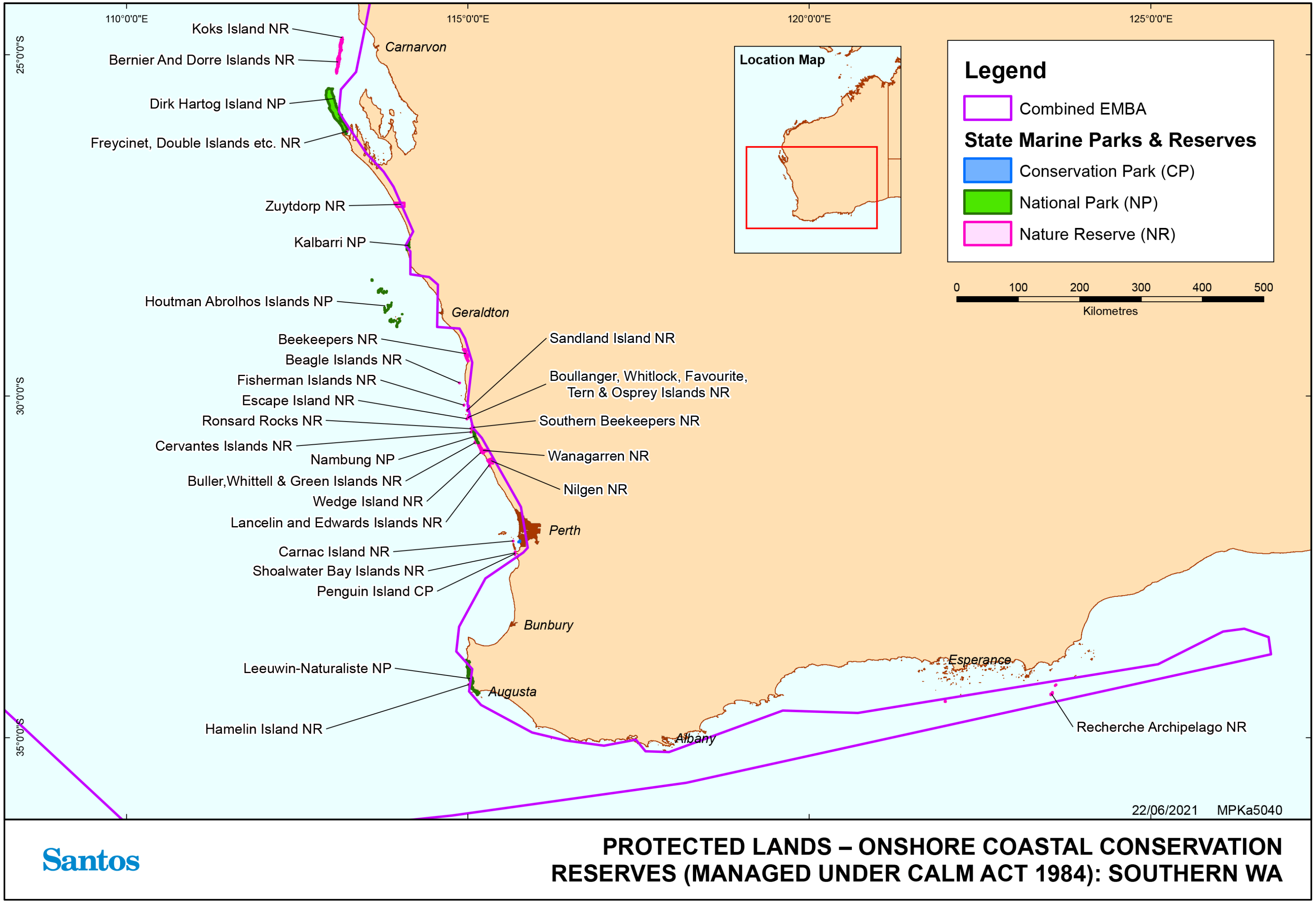


Figure 9-8: Protected Lands (CALM Act 1984) – terrestrial conservation reserves bounding marine waters in Southern WA[14]

9.8 International Protected Areas

There are 54 National Parks in Indonesia, six are World Heritage Sites, nine are part of the World Network of Biosphere Reserves and five are wetlands of international importance under the Ramsar convention. A total of nine parks are largely marine (ADB 2014). the combined EMBAA number of marine national parks, nature reserves and protected areas are overlapped by the combined EMBA. A summary of these is provided below. The waters and islands of these protected areas are frequented by tourists undertaking diving, snorkelling, sailing and other marine nature based tourism with many attractions such as shipwrecks and whale sharks as well as the extensive terrestrial ecosystems. Traditional fishing also occurs throughout the parks where allowed.

9.8.1 World Heritage and Protected Sites

9.8.1.1 Komodo

Komodo National park is located within the lesser Sunda Island between the provinces of East Nusa Tenggara and West Nusa Tenggara. Within the 1733km^2 site, three larger island (Komodo, Padar and Rincach) and 26 smaller ones are included. The marine fauna and flora are generally the same as that found throughout the Indo Pacific area, though species richness is very high, notable marine mammals include blue whale (*Balaenoptera musculus*) and sperm whale (*Physeter catodon*) as well as 10 species of dolphin, dugong (*Dugong dugon*) and five species of sea turtles (WHC, 2021). Fringing and patch coral reefs are extensive and most developed on the north-east side of Komodo (Indahnesia, 2011). The property is identified as a global conservation priority area, comprising unparalleled terrestrial and marine ecosystems (WHC, 2021).

The islands have an irregular coastline characterized by bays, beaches and inlets separated by headlands, often with sheer cliffs falling vertically into the surrounding seas.

9.8.1.2 Siberut

Siberut is located about 155km off the coast of West Sumatra across the Mentawaian strait and covers an area of 4050km^2. Sand beaches, lagoons, mangroves, and coral sea gardens create ecosystems within the site (Indahnesia, 2011).

9.8.1.3 Ujung Kulon

Ujung Kulon covers 1230km^2 of area. The coastline features various ecosystems such as sandy beaches, lagoons, rocky outcrops, as well as mangrove swamps. The water is an unusually warm 29 to 30 degrees Celsius and is home to multiple species of coral and fish (Indahnesia, 2011). The property includes the Ujung Kulon peninsula and several offshore islands that demonstrate on-going evolutionary processes (WHC, 2021).

9.8.2 Marine National Parks

9.8.2.1 Laut Sawu

The Laut Sawu Marine National Park located within the Lesser Sunda Ecoregion in the Savu Sea and covers a reported 35,211 km^2 (Protected Planet 2017). It was established in 2009 and has an IUCN Category II status (Protected Planet 2017). The marine park area is a known migration route for several cetacean species, including the blue whale and sperm whale. Other cetacean species such as pygmy killer whales, melon-head whale, short-finned pilot whales and numerous dolphin species (including Risso's dolphin, Fraser's dolphin, common dolphin, bottlenose dolphin and spinner dolphin) are known to frequent the marine park area. Several species of marine turtle, including the green turtle, hawksbill turtle and leatherback turtle have also been recorded in the marine park area.

The marine park area covers a range of habitats and species diversity, including:

+ 532 corals species which include 11 endemic and sub endemic species;
+ 350 reef fish species;

- fifteen mangrove species are recorded that represented 9 families of mangrove;
- ten seagrass species;
- deep-water habitats such as seamounts, deep-water canyons, straits (migratory corridors);
- large persistent pelagic habitats;
- main migratory corridors and habitats for 14 whale species, seven dolphin's species, and dugong; and
- habitats for five sea turtle species (green, leatherback, olive ridley, loggerhead, and flatback) as well as for large marine fauna such as sharks, napoleon, parrotfish and groupers (Savu Sea National Marine Conservation Area undated).

9.8.2.2 Kepulauan Seribu

Kepulauan Seribu, also known as Thousand Islands National Park, consists of a string of 105 islands within a reported area of 1074.89km^2. It is designated with an IUCN category II status. The closest island lies in Jakarta Bay, only a few kilometres from off mainland Jakarta with islands stretching as far as 45km north into the Java Sea (Indahnesia, 2011). Some islands are uninhabited, others have resorts or are privately owned. The coastlines are dominated by sandy beaches with some of the islands declared as protected historical sites to protect the artifacts and ruins on the islands dating back to the 19th century. Extensive coral reefs surround the islands. A Hawksbill turtle preservation program is in places in the park to protect the species that are found in the waters and nest on sandy beaches there (UNDP Indonesia, 2017). Mangroves are also found in the park, including plantations to increase the mangrove coverage.

9.8.2.3 Teluk Cenderawasih

Teluk Cenderawasih National Park is the largest marine park in Indonesia, with the reported area being 14535 km^2. It is designated with an IUCN category II status. The National Park is in Cenderawasih Bay, south-east of Bird's Head Peninsula, and includes the Islands of Misowaar, Nusrowi, Roon, Rumberpon and Yoop. The Park protects a rich marine ecosystem where over 150 coral species have been recorded. It is therefore considered to be a potential World Heritage Site (Indahnesia, 2011).

3.8% of the site consists of island tropical forest ecosystems, where some 46 species of plant have been recorded on the islands. 0.9% of the site is specifically mangrove ecosystems. Although only 5.5% of the site consists of coral reef ecosystems, 150 species of coral have been recorded. This coral reef ecosystem forms part of the Coral Triangle region. Within the remaining area of the site, over 200 fish species, various species of molluscs, whale sharks, four species of turtle as well as mammals such as the dugong, blue whale and dolphins inhabit the 89.8% of marine water ecosystems.

9.8.2.4 Taka Bonerate

Taka Bonerate National Park includes the Takabonerate Atoll Islands within a 5307 km^2 area within the Flores Sea. Taka Bone Rate consists of separate table reefs, enclosing a lagoon filled with massive reefs and is a site of major ecological importance (Indahnesia, 2011). According to the Indonesian Department of Forestry, the site has 261 species of coral, 295 species of coral fish, 244 species of molluscs as well as many other species such as turtles including green turtles that are known to nest on sandy beaches within the park (UNDP Indonesia, 2017).

9.8.2.5 Bunaken

Bunaken National Park is located in the north of the Sulawesi Islands, located near the centre of the Coral Triangle, it is designated with an IUCN category II status. This site typifies Indonesian tropical water ecosystems, consisting of seagrass plains, coral reefs and coastal ecosystems. 97% of the site is classified as marine habitat with the remaining being terrestrial, including 5 islands (Indahnesia, 2011). 390 species of coral, 90 fish species as well as mollusc, reptile, marine and mammal species have all been recorded.

9.8.2.6 Kapulauan Wakatobi

Kapulauan Wakatobi is located south of Sulawesi Island of Indonesia within a 13900km^2 area. It is designated with an IUCN category II status. Types of vegetation found in the National Park include mangrove forests, coastal forests, lowland swamp forests, riverbank vegetation, lowland rainforests, mountain rainforests and coral reefs (Indahnesia, 2011). There are 25 groups of coral reefs, including fringing reefs, barrier reefs and atolls. 396 species of coral belonging to 68 genera and 15 families populate the coral reef. Turtles are found nesting on the beaches and in the waters of the marine park.

9.8.2.7 Meru Betiri

Meru Betiri National Park lies within the province of East Java and extends over 580km^2. Of that area, 8.45 km^2 is marine (Indahnesia, 2011). The beaches of the park provide nesting grounds for endangered turtle species such as leatherback turtles, hawksbill turtles, green turtles, and olive ridley turtles (ADB 2014). The coastal vegetation is mostly found around Sukamade Bay and Meru Bay. Mangrove vegetation is largely found at the eastern side of the Rajegwesi Bay. The dominant genera are *Rhizophora, Avicennia* and *Bruguiera*. At the outlet of the Sukamade River, there is *Nypa fruticans*.

9.8.2.8 Togian Islands

The Togian Islands National Park, otherwise known as Kepulauan Togean, is a largely marine national park and provides habitat and breeding areas for hawksbill and green turtles and dugongs (Indahnesia, 2011). Mangroves forests are found within the marine park and extensive coral reefs.

9.8.3 Marine Nature Reserves and Conservation Areas

9.8.3.1 Karimunjawa

Karimunjawa is a national marine park in the Karimumjawa archipelago, 80km north of Jepara in the Java sea. The national park was formally declared a marine protected area in 2001 and has an IUCN category Ia status.

Karimunja has five types of ecosystems; coral reef, seagrass and seaweed, mangrove forest, coastal forest and low land tropical rainforest. The coral reefs of Karimunja are composed of fringing and barrier reefs along with several patch reefs. More than 90 species of coral biota is known to make up these ecosystems that creates a habitat for over 242 species of ornamental fish. Protected coral biota such as black coral, hornet helmet, titron trumpet, green shell and organ pipe coral, can be found here.

The 300 hectares of mangrove forests contain 32 species of mangroves and habitat many endemic species such as the dewadaru tree (*Fragraea elliptica*), setgi (*Pemphis acidula*) and kalimsada (*Cordia Subcordata*). Around 40 species of bird habitat this area as well as other terrestrial animals. Several species of turtles are known to use this national park as a breeding ground. Marine species within the area are particularly diverse, and in more abundance than the terrestrial populations.

9.8.3.2 Savu Sea National Marine Conservation Area

Savu Sea National Marine Conservation Area is located between the islands Sumba and Timor encompassing Pulau Roti and Sawu. The park includes coral reefs, mangroves, seagrass and deepwater habitats such as seamounts and deepwater canyons. Savu Sea NMCA is located within the Lesser Sunda seascape which is regarded as a high priority seascape for marine biodiversity conservation (Huffard et al. 2012). The Lesser Sundas is the main corridor between the Indian and Pacific Oceans including for migrating whales and commercially-important pelagic fishes (Huffard et al. 2012). Savu Sea NMCA covers ranges of species diversities and habitats within its region which includes:

- 532 corals species, 11 endemic and sub endemic species;
- 350 reef fish species;
- 15 mangrove species are recorded that represented nine families of mangrove;
- 10 sea grass species in two families;

- Deep-water habitats such as seamounts, deep-water canyons, straits (migratory corridors) and large persistent pelagic habitats were covered within Savu Sea NMP boundaries;
- Main migratory corridors and habitats for 14 whales species, seven dolphins species and one dugong species;
- Habitats for five sea turtles species (green, leatherback, olive ridley, loggerhead, and flat back), as well as for large marine fauna such as sharks, napoleon, parrotfish and groupers (Savu Sea Management Plan 2014).

10. Key Ecological Features

10.1 Introduction

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. KEFs meet one or more of the following criteria (DSEWPaC 2012a):

- A species, group of species or a community with a regionally important ecological role;
- A species, group of species or a community that is nationally or regionally important for biodiversity;
- An area or habitat that is nationally or regionally important for:
  - Enhanced or high biological productivity;
  - Aggregations of marine life; or
  - Biodiversity and/or endemism
- A unique seafloor feature with ecological properties of regional significance.

Twenty eight key ecological features of the Commonwealth waters in the combined EMBA (covering the NMR, the NWMR and the SWMR) have been identified in the protected matters search (**Figure 10-2,Figure 10-3** and **Figure 10-1**) and are discussed in this section.

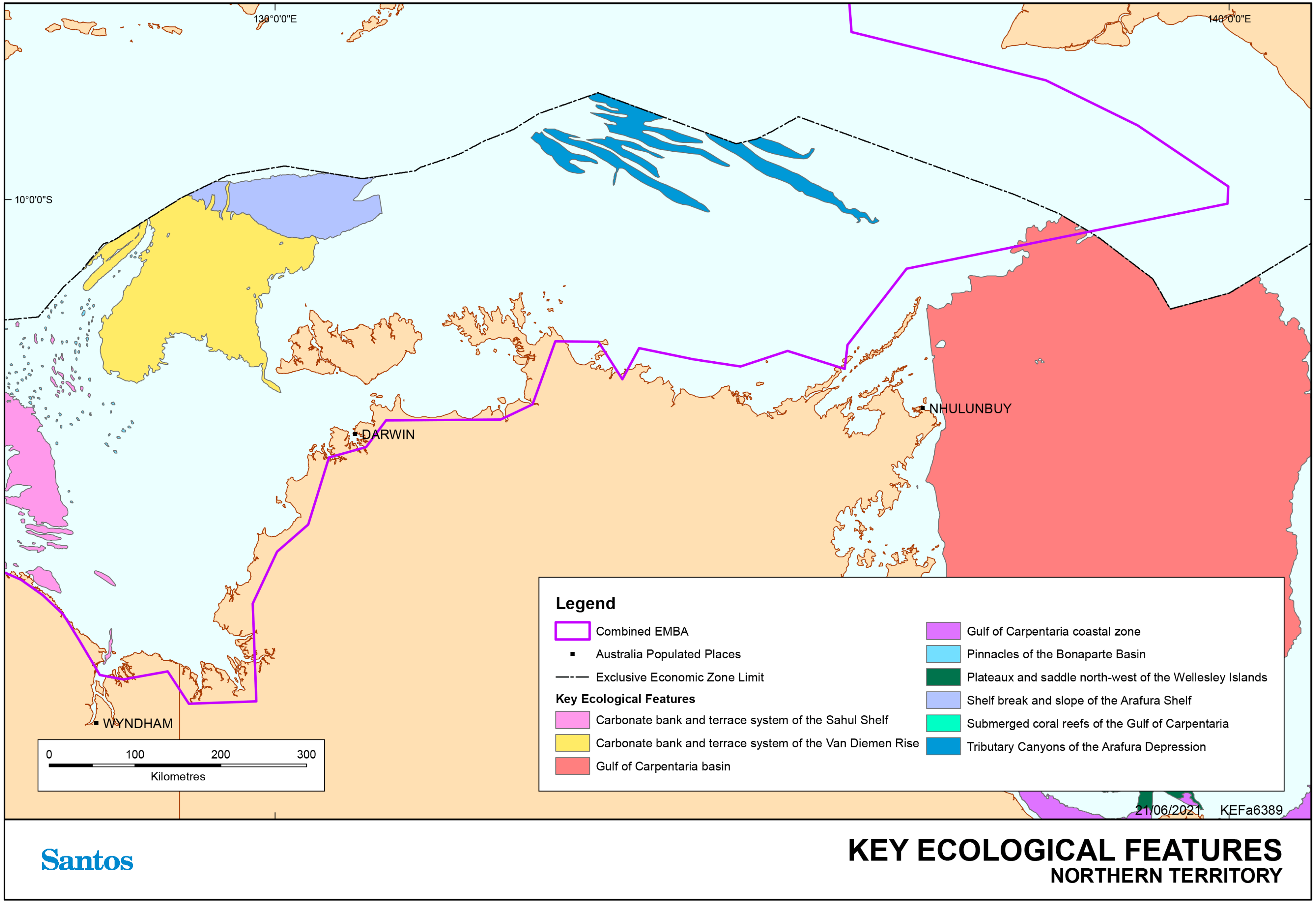


Figure 10-1: Key ecological features of NT

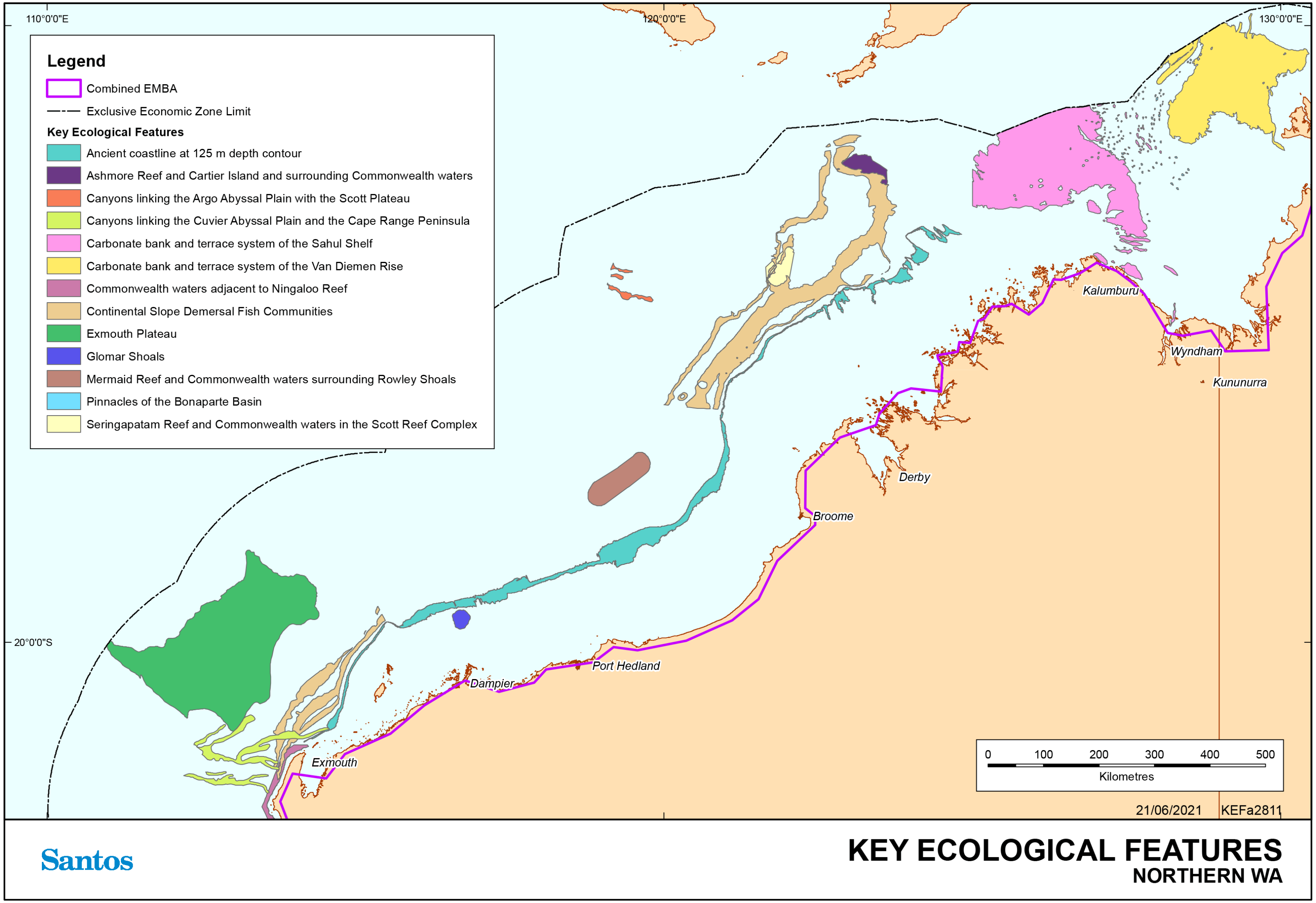


Figure 10-2: Key ecological features of Northern WA

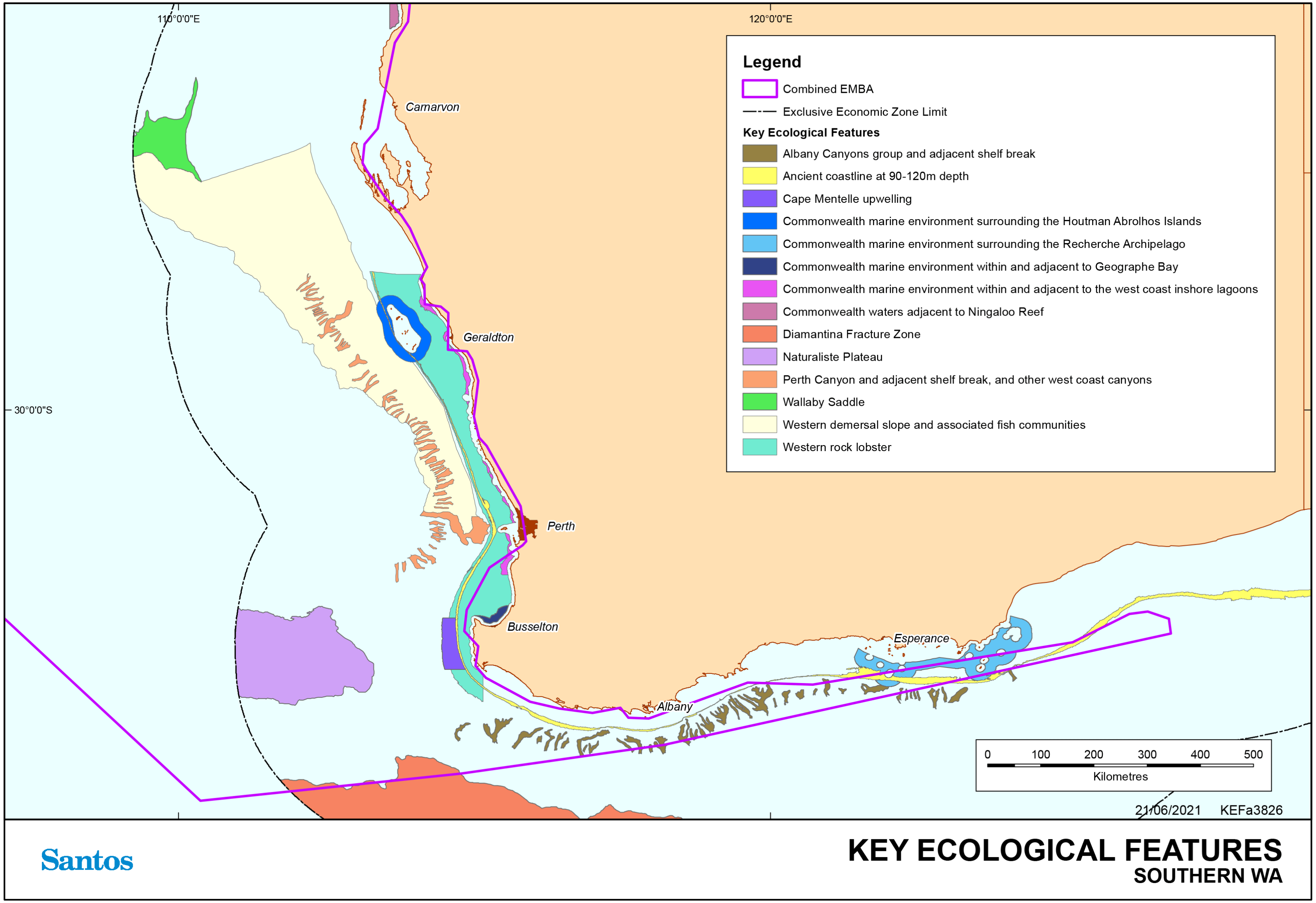


Figure 10-3: Key ecological features of Southern WA

10.1.1 Commonwealth Marine Environment Surrounding the Houtman Abrolhos Islands (and Adjacent Shelf Break)

The Commonwealth marine environment surrounding the Houtman Abrolhos Islands (and adjacent shelf break) is defined as a KEF for its high levels of biodiversity and endemism in benthic and pelagic habitats. The Houtman Abrolhos Islands and surrounding reefs support a unique mix of temperate and tropical species, resulting from the southward transport of species by the Leeuwin Current over thousands of years. The reefs are composed of 184 known species of corals that support about 400 known species of demersal fish, 492 known species of molluscs, 110 known species of sponges, 172 known species of echinoderms and 234 known species of benthic algae (DEWHA 2008b). The Houtman Abrolhos Islands are the largest seabird breeding station in the eastern Indian Ocean (DSEWPaC 2012a). They support more than one million pairs of breeding seabirds. The Houtman Abrolhos Islands and surround waters are also BIAs for Australian sea lions for foraging and breeding (DEWHA 2010b).

10.1.2 Commonwealth Marine environment surrounding the Recherche Archipelago

The Recherche Archipelago is a chain of approximately 105 islands and 1 500 islets extending over 470 km of coastline near Esperance, Western Australia. This area is defined as a KEF as it is a region of high biodiversity, The Recherche Archipelago is the most extensive area of reef in the South-west Marine Region. Its reef and seagrass habitat support a high species diversity of warm temperate species, including 263 known species of fish, 347 known species of molluscs, 300 known species of sponges, and 242 known species of macroalgae. The islands also provide haul-out (resting areas) and breeding sites for Australian sea lions and New Zealand fur seals (DSEWPaC 2012)

10.1.3 Perth Canyon and Adjacent Shelf Break, and other West-Coast Canyons

The Perth Canyon is defined as a KEF for its high biological productivity and aggregations of marine life and unique seafloor features with ecological properties of regional significance. The Perth Canyon is the largest known undersea canyon in Australian waters. In the Perth Canyon, interactions between the Leeuwin Current and the Canyon topography induce clockwise-rotating eddies that transport nutrients upwards in the water column from greater depths (DoEE 2019a). Due to the Canyon's depth and Leeuwin Current's barrier effect, this remains a subsurface upwelling which supports ecological complexity that is typically absent from canyon systems in other areas (Pattiaratchi 2007). This nutrient-rich cold-water habitat attracts feeding aggregations of deep-diving mammals, such as pygmy blue whales and large predatory fish that feed on aggregations of small fish, krill and squid (DSEWPaC 2012a). The Perth Canyon also marks the southern boundary for numerous tropical species groups on the shelf, including sponges, corals, decapods and xanthid crabs (DoEE 2017a).

10.1.4 Commonwealth Marine Environment within and adjacent to the West-Coast Inshore Lagoons

This key ecological feature is composed by a chain of inshore lagoons of limestone reef (as deep as 30 m) extending along the Western Australian coast from south of Mandurah to Kalbarri. The mix of sheltered and exposed seabeds form a complex mosaic of habitats. The lagoons are dominated by seagrass and epiphytic algae (Dambacher et al. 2009). Although macroalgae (principally Ecklonia spp.) and seagrass appear to be the primary source of production, scientists suggest that groundwater enrichment may supplement the supply of nutrients to the lagoons. The lagoons are associated with high biodiversity and endemism, containing a mix of tropical, subtropical and temperate flora and fauna.

The inshore lagoons are important areas for the recruitment of the commercially and recreationally important western rock lobster, dhufish, pink snapper, breaksea cod, baldchin and blue gropers, abalone and many other reef species. The area includes breeding and nursery aggregations for many temperate and tropical marine species (Goldberg & Collings 2006 in McClatchie et al. 2006). Extensive schools of migratory fish visit the area annually, including herring, garfish, tailor and Australian salmon.

10.1.5 Commonwealth Marine Environment within and Adjacent to Geographe Bay

The Commonwealth marine environment within and adjacent to Geographe Bay is defined as a KEF for its high productivity and aggregations of marine life and high levels of biodiversity and endemism. Geographe Bay is known for its extensive beds of tropical and temperate seagrass that account for about 80 % of benthic primary production in the area (DEH 2006). This habitat supports a diversity of species, many of them not found anywhere else (DSEWPaC 2012a). The bay provides important nursery habitat for many species, including juvenile dusky whaler sharks. It is also an important resting area for migrating for humpback whales (McCauley *et al.* 2000).

10.1.6 Cape Mentelle Upwelling

The Cape Mentelle upwelling is defined as a KEF for its high productivity and aggregation soft marine life. The Cape Mentelle upwelling draws relatively nutrient-rich water from the base of the Leeuwin Current, up the continental slope and onto the inner continental shelf, where it results in phytoplankton blooms at the surface. The phytoplankton blooms provide the basis for an extended food chain characterised by feeding aggregations of small pelagic fish, larger predatory fish, seabirds, dolphins and sharks (DSEWPaC 2012a). The Cape Mentelle upwelling has a disproportionate influence on the overall-nutrient poor nature of the region’s water.

10.1.7 Naturaliste Plateau

The Naturaliste Plateau is defined as a KEF for its unique seafloor feature with ecological properties of regional significance. The Naturaliste Plateau is Australia’s deepest temperate marginal plateau and occurs an area where numerous water bodies and currents converge. It is also the only seafloor feature in the region that interacts with the subtropical convergence front (DoEE 2019b). Although there is very little known about the marine life of the plateau, it is speculated that the combination of its structural complexity, mixed water dynamics and relative isolation indicate that it supports deep-water communities with high species diversity and endemism (DEWHA 2008b; DSEWPaC 2012a). The Plateau acts as an underwater ‘biogeographical island’ on the edge of the abyssal plain, providing habitat for fauna unique to these depths (Richardson et al. 2005). The Plateau is also within a deep eddy field that is thought to be associated with high productivity and aggregations of marine life (Pattiaratchi 2007). Proximity to the nearby subtropical convergence front is thought to have a significant influence on the biodiversity of the Plateau (DEWHA 2008b).

10.1.8 Western Demersal Slope and associated Fish Communities

The Western Demersal Slope and associated Fish Communities, also known as the Demersal Slope and associated Fish Communities of the Central Western Province, is defined as a key ecological community for its high levels of biodiversity and endemism. It is located on the edge of the shelf to the limit of the exclusive economic zone from Perth to the northern boundary of the SWMR. The western demersal slope provides important habitat for demersal fish communities, with a high level of diversity and endemism. A diverse assemblage of demersal fish species below a depth of 400 m is dominated by relatively small benthic species such as grenadiers, dogfish and cucumber fish. Unlike other slope fish communities in Australia, many of these species display unique physical adaptations to feed on the sea floor (such as a mouth position adapted to bottom feeding), and many do not appear to migrate vertically in their daily feeding habits (DSEWPaC 2012a, Williams *et al.* 2001). A total of 480 fish species have been described that inhabit the slope of this bioregion with 31 considered to be endemic to the bioregion (DoEE 2019a). Demersal fish communities within the area have recorded higher diversity when compared to other oceanic regions which have been more intensively sampled. The increased diversity within the area has been attributed to the overlap of ancient and extensive Indo-west Pacific and temperate Australasian fauna (Williams et al. 2001).

10.1.9 Western Rock Lobster

The Western Rock Lobster KEF is defined due to its presumed ecological role on the West Coast Continental Shelf. This species is the dominant large benthic invertebrate in the region. The lobster plays an important trophic role in many of the inshore ecosystems of the South-west Marine Region. Western rock lobsters are an important part of the food web on the inner shelf, particularly as juveniles as they are preyed upon by octopus, cuttlefish, baldchin groper, dhufish, pink snapper, wirrah cod and breaksea cod (DEWHA 2008b, DSEWPaC 2012a). The high biomass of western rock lobsters and their vulnerability to predation suggest that they are an important trophic pathway for a range of inshore species that prey upon juvenile lobsters (DEWHA 2008b).

10.1.10 Wallaby Saddle

The Wallaby Saddle is defined as a KEF for its high productivity and aggregations of marine life. The Wallaby Saddle is an abyssal geomorphic feature located on the upper continental slope at a depth of 4,000–4,700 m (DSEWPaC 2012a). The feature connects the north-west margin of the Wallaby Plateau with the margin of the Carnarvon Terrace (Falkner *et al*. 2009 in DSEWPaC 2012a). The Wallaby Saddle is situated within the Indian Ocean water mass and is thus differentiated from systems to the north that are dominated by transitional fronts or the Indonesian Throughflow (DSEWPaC 2012a). Little is known about the Wallaby Saddle; however, the area is considered one of enhanced productivity and low habitat diversity (Brewer *et al*. 2007). The Wallaby Saddle is associated with historical aggregations of sperm whales (DEWHA 2008c).

10.1.11 Commonwealth Waters Adjacent to Ningaloo Reef

The Commonwealth Waters adjacent to Ningaloo Reef KEF is 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. Commonwealth waters adjacent to the reef are thought to support the rich aggregations of marine species at Ningaloo Reef through upwellings associated with canyons on the adjacent continental slope and interactions between the Ningaloo and Leeuwin currents (Brewer *et al*. 2007, DEWHA 2008d, DSEWPaC 2012a). 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. Terrestrial nutrient input is low, hence this deep-water source is a major source of nutrients for Ningaloo Reef and therefore very important in maintaining this system (DEWHA 2008c).

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. The Commonwealth waters around Ningaloo include areas of potentially high and unique sponge biodiversity (DEWHA 2008c). Upwellings on the seaward side support aggregations such as whale sharks and manta rays (these waters are the main known aggregation area for whale sharks in Australian waters). 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.

The Ningaloo Marine Park includes this Key Ecological Feature and is discussed in **Section 12.3.4**.

10.1.12 Canyons Linking the Cuvier Abyssal Plain with the Cape Range Peninsula

The Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula are defined as a KEF as they are unique seafloor features with ecological properties of regional significance.

Cape Range Peninsula and the Cuvier Abyssal Plain are linked by canyons, the largest of which are the Cape Range Canyon and Cloates Canyon. These two canyons are located along the southerly edge of Exmouth Plateau adjacent to Ningaloo Reef and are unique due to their close proximity to the North West Cape (DSEWPaC 2012a). The Leeuwin Current interacts with the heads of the canyons to produce eddies resulting in delivery of higher nutrient, cool waters from the Antarctic intermediate water mass to the shelf (Brewer *et al*. 2007). Strong internal tides also create upwelling at the canyon heads (Brewer *et al*. 2007). Thus the canyons, the Exmouth Plateau and the Commonwealth waters adjacent to Ningaloo Reef interact to create the conditions for enhanced productivity seen in this region (Sleeman *et al*. 2007 in DSEWPaC 2012a). The canyons are also repositories for particulate matter deposited from the shelf and sides of the canyons and serve as conduits for organic matter between the surface, shelf and abyssal plains (DSEWPaC 2012a).

The soft bottom habitats within the canyons themselves are likely to support important assemblages of epibenthic species. Biological productivity at the head of Cape Range Canyon in particular, is known to support species aggregations, including whale sharks, manta rays, humpback whales, sea snakes, sharks, large predatory fish and seabirds. 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).

10.1.13 Exmouth Plateau

The Exmouth Plateau is defined as a KEF as it is a unique seafloor feature with ecological properties of regional significance. The Exmouth Plateau covers an area of 49,310 km^2 and is located approximately 150 km northwest of Exmouth. The plateau ranges in water depths from 800 to 4,000 m (Heap & Harris 2008 in DSEWPaC 2012a). The plateau's surface is rough and undulating at 800–1,000 m depth. The northern margin is steep and intersected by large canyons (e.g. Montebello and Swan canyons) with relief greater than 50 m. The western margin is moderately steep and smooth and the southern margin is gently sloping and virtually free of canyons (Falkner *et al*. 2009 in DSEWPaC 2012a).

The Exmouth Plateau is a regionally and nationally unique tropical deep sea plateau. It that may serve 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 from the 19th century 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).

10.1.14 Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals

Mermaid Reef and Commonwealth waters surrounding Rowley Shoals is defined as a KEF for its enhanced productivity and high species richness. The Rowley Shoals are a group of three atoll reefs—Clerke, Imperieuse and Mermaid reefs—located about 300 km north-west of Broome. Mermaid Reef lies 29 km north of Clerke and Imperieuse reefs and is totally submerged at high tide. Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals are regionally important in supporting high species richness, higher productivity and aggregations of marine life associated with the adjoining reefs themselves (Done et al. 1994). Rowley shoals contain 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).

Mermaid Reef falls under Commonwealth jurisdiction and forms the Mermaid Reef Commonwealth Marine Park. Clerke and Imperieuse reefs constitute the Rowley Shoals Marine Park, which falls under Western Australian Government jurisdiction (EA 2000). The Rowley Shoals are discussed with the Commonwealth and State Marine Park (**Sections 11.1.9** and **12.3.9**).

10.1.15 Glomar Shoals

The Glomar Shoals are a 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). They 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).

The Glomar Shoals are 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).

10.1.16 Ancient Coastline at 125 m Depth Contour

The shelf of the North-west Marine Region contains several terraces and steps which reflect changes in sea level that occurred over the last 100,000 years. The most prominent of these features occurs at a depth of 125m as an escarpment along the North West Shelf and Sahul Shelf (DSEWPaC 2012a). Where the ancient submerged coastline provides areas of hard substrate it may contribute to higher biological diversity. Little detailed knowledge is available, but the hard substrate of the escarpment is likely to support sponges, crinoids, molluscs, echinoderms (DSEWPaC 2012a). It is understood that changes in topography at these depths are critical points for the generation of internal waves (Holloway *et al.* 2001 cited in DEWHA 2008c), playing a minor role in aiding localised upwelling or at least regional mixing associated with the seasonal changes in currents and winds. It is also believed that this prominent floor feature could be important as a migratory pathway for cetaceans and pelagic species such as the whale shark and humpback whale, as they move north and south between feeding and breeding grounds (DEWHA 2008c).

Parts of the ancient coastline are thought to provide biologically important habitats in areas otherwise dominated by soft sediments. The topographic complexity of these escarpments may also facilitate vertical mixing of the water column providing a relatively nutrient-rich environment for species present on the escarpment (DSEWPaC 2012a). This enhanced productivity could potentially be attracting baitfish, which in turn provide food for the migratory species. The pressures of potential concern on the biodiversity value of this feature generally include ocean acidification as a result of climate change (DoEE 2019a).

10.1.17 Ancient Coastline at 90-120 m Depth

This coastline is found in the South-west Marine Region and contains several terraces and steps reflecting a gradual increase in sea level across the shelf that occurred during the Holocene. Some of these features create escarpments of distinct elevation, creating topographic complexity through the exposure of rocky substrates. The most prominent of these occurs close to the middle of the continental shelf off the Great Australian Bight at a depth of 90-120 m, which provides a complex habitat for a number of species (DSEWPaC 2012c). The area has important conservation value due to its potential for high productivity, biodiversity and aggregations of marine life. Benthic biodiversity and productivity occur where the ancient coastline forms a prominent escarpment of exposed hard substrates, where it is dominated by sponge communities of significant biodiversity and structural complexity (DSEWPaC 2012c). These sponge communities have been recorded to contain sponges up to one metre across, which implies that some of the sponges in this region are likely to be many decades old (DSEWPC 2012c). It has been suggested that in certain places, the area may support some demersal fish species, travelling to the upper continental slope from across the continental shelf. The transportation of fine grained sediments off shelf occurs as a physical process down to depths of approximately 120 m, and influence the benthic invertebrate communities of the Great Australian Bight (DSEWPaC 2012c). Both species richness and biomass in the area, has been associated as declining with increasing depth and percentage of fines in sediment (Ward *et al.* 2006 cited in DSEWPaC 2012c).

10.1.18 Canyons Linking the Argo Abyssal Plain with Scott Plateau

The 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). The canyons are believed to be up to 50 million years old and excavated during the evolution of the region through sediment and water movements (DEWHA 2008d). The canyons cut deeply into the south-west margin of the Scott Plateau and act as conduits for transport of sediments from an approximate depth of 2,000–3,000 m to depths of more than 5,500 m (DSEWPaC 2012a). The water masses at these depths are deep Indian Ocean water on the Scott Plateau and Antarctic bottom water on the Argo Abyssal Plain. Both water masses are cold, dense and nutrient-rich (Lyne *et al*. 2006 in DSEWPaC 2012a). The 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. The canyons are therefore thought to be linked to small and periodic upwellings that enhance this biological productivity (DEWHA 2008d).

The Canyons linking the Argo Abyssal Plain and Scott Plateau are likely to be important features due to their historical association with sperm whale aggregations (DSEWPaC 2012a). Historical records of whaling in the Timor region indicate that the number of sperm whales was high in the region in the past. Though current numbers are unknown, it is possible that they congregate around the canyon heads adjacent to the Scott Plateau, encouraged by the high biological productivity, supporting stocks of their prey (DEWHA 2008d). There is anecdotal evidence that supports the idea that the Scott Plateau itself may be a breeding ground for sperm and beaked whales. It is also likely that important demersal communities occur in the canyons, as they do in the Scott Plateau supported by the localised upwelling, which in turn attract larger predatory fish, sharks and cetaceans (DEWHA 2008d).

10.1.19 Continental Slope Demersal Fish Communities

The Australian Continental Slope provides important habitat for demersal fish communities, characterised by high endemism and species diversity. Specifically, the continental slope between North West Cape and the Montebello Trough is the most diverse slope bioregion in Australia with more than 500 fish species, 76 of which are endemic (Last *et al*. 2005 in DSEWPaC 2012).

The Continental Slope consists of two distinct community types, associated with the upper and mid slope, 225 – 500 m and 750 – 1000 m respectively. The Timor Province and Northwest Transition bioregions are the second-richest areas for demersal fish across the entire continental slope (DSEWPaC 2012). The bacteria and fauna that is present in the system on the Continental Slope are the basis for the food web for demersal fish and higher order consumers in the system. Further information of this system has been poorly researched, though it has been suggested that it is a detritus-based system, where infauna and epifauna become prey for a range of teleost fish, molluscs and crustaceans (Brewer *et al.* 2007). The higher order consumers supported by this system are likely to be carnivorous fish, deep water sharks, large squid and toothed whales (Brewer *et al.* 2007). The pelagic production is known to be phytoplankton based, with hotspots located around oceanic reefs and islands (Brewer *et al.* 2007).

It is believed that the loss of the benthic habitat along this continental shelf region would likely lead to a decline in the species diversity and endemism that this feature is associated with (DoEE 2019a). The endemism of the region is not supported by large data sets and is scarce. It is consequently not well understood what interactions exist between the physical processes and trophic structures that lead to this high diversity of fish and the suggested presence of endemic species in the region (DoEE 2019a).

10.1.20 Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex

Scott and Seringapatam reefs are part of a series of submerged reef platforms that rise steeply from the sea floor between the 300–700 m contours on the north-west continental slope and lie in the Timor Province (Falkner et al. 2009). Scott Reef consists of two separate reef formations, North Reef and South Reef. The total area of the key ecological feature is approximately 2,418 km². As two of the few offshore reefs in the north-west, they provide an important biophysical environment in the region.

Scott and Seringapatam reefs and the waters surrounding them attract aggregations of marine life including humpback whales on their northerly migration, Bryde's whales, pygmy blue whales, Antarctic minke whales, dwarf minke whales, minke whales, dwarf sperm whales and spinner dolphins (Jenner et al. 2008; Woodside 2009). Whale sharks and several species of sea snakes have also been recorded in this area (Donovan et al. 2008). Green and hawksbill turtles nest during the summer months on Sandy Islet on South Scott Reef. These species also internest and forage in the surrounding waters (Guinea 2006). Scott Reef is a particularly biologically diverse system and includes more than 300 species of reef-building corals, approximately 400 mollusc species, 118 crustacean species, 117 echinoderm species and around 720 fish species (Woodside 2009). Corals and fish at Scott Reef have higher species diversity than the Rowley Shoals (Done et al. 1994).

Scott Reef is listed as Commonwealth Heritage Places and is discussed in **Section 9.5.1**.

10.1.21 Ashmore Reef and Cartier Island and Surrounding Commonwealth Waters

Ashmore Reef and Cartier Island are situated on the shallow upper slope of the Sahul Shelf, north of Scott and Seringapatam reefs. Rising from a depth of more than 100 m, the reef platform is at the edge of the North West Shelf and covers an area of 239 km². Ashmore Reef Commonwealth Marine Reserve encloses an area of about 583 km² of seabed (EA 2002). Cartier Island lays about 350 km off Australia's Kimberley coast, 115 km south of the Indonesian island of Roti and 45 km south-east of Ashmore Reef Commonwealth Marine Reserve. Cartier Island Commonwealth Marine Reserve covers 167 km² (EA 2002). Species at Ashmore Reef and

Cartier Island include more than 225 reef-building corals, 433 molluscs, 286 crustaceans, 192 echinoderms, and the most diverse variety of fish of any region in Western Australia with 709 species (EA 2002).

Sandy beaches provide important habitat for nesting green and hawksbill turtles throughout the year. Seagrass present at Ashmore Reef provides critical breeding (April–May) and foraging (throughout the year) habitat for a genetically distinct population of dugong with their range probably extending to other submerged shoals within the area (Brown & Skewes 2005; Whiting 1999). The emergent habitat at Ashmore also provides important nesting sites for seabirds, many of which are migratory. Ashmore's islands are regarded as supporting some of the most important seabird rookeries on the North West Shelf seasonally supporting up to 50,000 seabirds (26 species) and up to 2,000 waders (30 species, representing almost 70% of wader species that regularly migrate to Australia) (Milton 2005). Large colonies of sooty terns, crested terns, bridled terns and common noddies breed on the east and middle islands. Smaller breeding colonies of little egrets, eastern reef egrets, black noddies and possibly lesser noddies also occur. Migratory wading birds include eastern curlews, ruddy turnstones, whimbrels, bar-tailed godwits, common sandpipers, Mongolian plovers, red-necked stints and tattlers, during October–November and March–April as part of the migration between Australia and the Northern Hemisphere (Milton 2005).

10.1.22 Carbonate Bank and Terrace System of the Sahul Shelf

The Carbonate Banks and Terrace System of the Sahul Shelf are located in the western Joseph Bonaparte Gulf and to the north of Cape Bougainville and Cape Londonderry. The banks consist of a hard substrate and flat tops at depths of 150–300 m. Each bank occupies an area generally less than 10 km^2 and is separated from the next bank by narrow sinuous channels with depths up to 150 m. The origin of the banks is uncertain, though the area contains predictably high levels of productivity, in comparison to the generally low productivity of the region (DSEWPaC 2012).

The banks are foraging areas for loggerhead, olive ridley and flatback turtles and provide habitat for humpback whales, and green and freshwater sawfish (Donovan *et al*. 2008 in DSEWPaC 2012). The hard substrate of the banks is thought to support diverse organisms including sessile benthic invertebrates such as sponges, soft and hard corals, gorgonians, bryozoans, ascidians and associated reef fish and elasmobranchs (Brewer *et al*. 2007). Cetaceans, green and fresh sawfish are also likely to occur in the area, as well as possibly the Australian snubfin dolphin, a migratory species occurring mostly on the northern extent of the Sahul Shelf (DSEWPaC 2012).

According to DSEWPaC (2012) the carbonate banks and terrace system of the Sahul Shelf are regionally important because of their role in enhancing productivity relative to their surrounds. Little is known about the banks, terraces and associated channels but they are believed to be areas of enhanced productivity and biodiversity due to the upwellings of cold nutrient-rich water at the heads of the channels and the availability of hard substrate (Brewer *et al*. 2007).

10.1.23 Pinnacles of the Bonaparte Basin

The limestone Pinnacles of the Bonaparte Basin are located in the mid-outer shelf of the western Joseph Bonaparte Gulf and comprise of 61% of the limestone pinnacles in the Northwest Marine Region and 8% of the total limestone pinnacles found within the Australian Exclusive Economic Zone (Baker *et al.* 2008). The pinnacles range from water depths of 30 to 80 m providing hard substrate in a relatively sparse soft sediment habitat for sessile species. The pinnacles are thought to be remnants of the calcareous shelf and coastal features from previous low sea level stands, and have been recorded to be up to 50 m in height and range from 50 to 100 km long (Baker *et al.* 2008, Heyward *et al.* 1997).

Diverse communities of sessile benthic invertebrates including hard and soft corals, sponges, whips, fans, bryozoans and aggregations of demersal fish species such as snappers, emperors and groupers have been recorded (Brewer *et al.* 2007, Nichol *et al.* 2013). Foraging and general use has been recorded within the pinnacles by marine turtles and the area has also been suggested to be used by freshwater and green sawfish as well as humpback whales (Donovan *et al.* 2008). The pinnacles have been recognised as a sponge biodiversity hotspot which has recorded greater diversity and communities than that of the surrounding seafloor (NERP MBH 2014).

According to DSEWPaC (2012) the Pinnacles of the Bonaparte Basin are regionally important because of its biodiversity values (unique sea-floor feature with ecological properties of regional significance), which apply to both the benthic and pelagic habitats. The hard substrate of the pinnacles are likely to support a high number of species, although a better understanding of the species richness and diversity associated with these structures is required.

10.1.24 Diamantina Fracture Zone

The Diamantina Fracture Zone is located south of the Naturaliste Plateau covering a range of more than 100,000 km^2 in water depths greater than 3,000 m. The ridge, troughs and seamounts that form the fracture zone have been recorded to have a relief up to 4,000 m which has resulted in highly variable environmental conditions (Stow 2006, Richardson *et al.* 2005). The Diamantina Fracture Zone encompasses the deepest known points in Australia's exclusive economic zone, reaching depths of more than 6,000 metres.

Limited information is available for the Diamantina Fracture Zone, however it is likely that due to the highly variable environmental conditions within the distinctive community structures and unique habitats have the potential to form. The presence of seamounts and ridges has the potential to increase local primary and secondary productivity, which may in turn promote phytoplankton growth. Increased phytoplankton has been recorded to increase the diversity and abundance of marine life (e.g. whales, dolphins, fish and benthic species) (Rowden *et al.* 2010). The area is expected to sustain similar habitats to that of and around the Tasmanian Seamounts due to similar depths in the South-east Marine Region (Richardson et al. 2005).

According to DSEWPaC (2012) the Diamantina Fracture Zone is regionally important because of to enhance productivity and assist with dispersal and migration of species across the region and wider abyssal plain (Wilson & Kaufman 1987, in Richardson *et al.* 2005). While research on the Diamantina Fracture Zone is limited, its size, physical complexity and isolation indicate that it is likely to support deepwater communities characterised by high species diversity and endemism.

10.1.25 Demersal Slope and Associated Fish Communities of the Central Western Province

The demersal slope and associated fish communities of the Central Western Province is located on the edge of the shelf to the limit of the exclusive economic zone from Perth to the northern boundary of the SWMR. The area supports a diverse demersal fish species assemblage of relatively small benthic species (e.g. grenadier, dogfish and cucumber fish) at depths greater than 400 m. Fish species within this area have adapted physically to feed on the seafloor and do not appear to migrate vertically to feed (Williams et al. 2001).

According to DSEWPaC (2012), the demersal slope and associated fish communities of the Central Western Province are recognised as a KEF for their high levels of biodiversity and endemism. A total of 480 fish species have been described that inhabit the slope of this bioregion with 31 considered to be endemic to the bioregion. Demersal fish communities within the area have recorded higher diversity when compared to other oceanic regions which have been more intensively sampled. The increased diversity within the area has been attributed to the overlap of ancient and extensive Indo-west Pacific and temperate Australasian fauna (Williams et al. 2001).

10.1.26 Albany Canyons Group and Adjacent Shelf Break

The Albany Canyons group and adjacent shelf break is located along a 700 km extent ranging from Cape Leeuwin to the east of Esperance and consists of 32 deep canyons which cut into the continental slope. Sonar surveys have indicated that individual canyons can extent up to 90 km long at water depths of 2,000 m. The canyons can start at the uppermost continental slope and reach the lowermost slope and extend onto the abyssal plain (Exon *et al.* 2005).

Due to close spacing of the numerous canyons, a wide range of depth dependent benthic habitats are connected increasing the habitat heterogeneity along the south western Australian continental margin. Offshore transport increases the sediment load and organic material is received from productive shelf waters. The closely spaced canyons have the potential to allow increased amounts of organic matter to reach the abyssal plain which may increase biodiversity in comparison to other areas within the south west Marine Region. (Richardson e*t al.* 2005).

According to DSEWPaC (2012), the Albany Canyons group and adjacent shelf break is regionally important and recognised as a key ecological feature for its high productivity, aggregations of marine life, and as a unique seafloor feature with ecological properties of regional significance (Pattiaratchi 2007). Both benthic and demersal habitats within the feature are of conservation value. The canyons are known to be a feeding area for the sperm whale (Bannister *et al.* 1996) and sites of orange roughy aggregations (Caton & McLoughlin 2004).

10.1.27 Carbonate Bank and Terrace System of the Van Diemen Rise

The bank and terrace system of the Van Diemen Rise covers approximately 31,278 km^2 and forms part of the larger system associated with the Sahul Banks to the north and Londonderry Rise to the east. The feature is characterised by carbonate terrace, banks, channels and valleys, with variability in water depth and substrate composition considered to contribute to the presence of unique ecosystems in the channels. The variability in water depth and substrate composition across the feature may contribute to the presence of unique ecosystems in the channels. The carbonate banks and shoals found within the Van Diemen Rise make up 80% of the banks and shoals, 79% of the cannels and valleys, and 63% of the terrace found across the North Marine Region. The carbonate banks and shoals rise from depths of 100 m- 200 m to withing 10 m -40 m of the sea surface (Anderson et al. 2011).

The feature provides habitat for a high diversity of sponges, soft corals and other sessile filter feeders; epifauna and infauna; and olive ridley turtles, sea snakes and sharks. Rich sponge gardens and octocorals have been identified on the eastern Joseph Bonaparte Gulf along the banks, ridges and some terraces. Plains in deep hole/valleys are characterised by scattered epifauna and infauna that include polychaetes and ascidians. Epibenthic communities such as the sponges found in the channels are likely to support fish and second-order consumers. Pelagic fish such as mackerel, red snapper and a distinct gene pool of gold band snapper are found in the Van Diemen Rise.

10.1.28 Gulf of Carpentaria Basin

The Gulf of Carpentaria basin is defined as a key ecological feature for its regional importance for biodiversity, endemism and aggregations of marine life. These values apply to both the benthic and the pelagic habitats within the feature.

The Gulf of Carpentaria is believed to be one of the few remaining near-pristine marine environments in the world (Wightman et al. 2004). Primary productivity in the basin is mainly driven by cyanobacteria that fix nitrogen (Burford et al. 2009), but is also strongly influenced by seasonal processes. The soft sediments of the basin are characterised by moderately abundant and diverse communities of infauna and mobile epifauna dominated by polychaetes, crustaceans, molluscs and echinoderms.

The Gulf of Carpentaria basin also supports assemblages of pelagic fish species including planktivorous and schooling fish, and top predators such as shark, snapper, tuna and mackerel (Smith et al. 2006). The Gulf is also an important migratory route for seabirds, shore birds and marine turtles.

10.1.29 Shelf Break and Slope of the Arafura Shelf

The Shelf Break and Slope of the Arafura Shelf is an important ecological feature that creates a unique seafloor which enhances biological productivity on the edge of the shelf and attracts feeding aggregations of pelagic marine organisms. The productivity of this area has been recognised as nationally and/or regionally important (Last et al. 2005).

Although the ecosystem processes in this area are largely unknown it is thought that the oceanographic processes associated with the Indonesian Throughflow current and monsoonal winds are strong influence (DEWHA, 2007).

The physical characteristics of the Shelf Break and Slope of the Arafura Shelf comprise of continental slope, patch reefs and hard substrate pinnacles (Harris et al. 2005).

Phytoplankton and invertebrates have been sampled at this KEF and the primary production of phytoplankton is thought to be the basis for offshore food webs in the area (DEWHA, 2007). Records show approximately 284 demersal fish species in the area (Last et al. 2005) and other marine species that have been recorded include marine turtles, whale sharks and predatory fish species including sharks (DEWHA, 2008a).

10.1.30 Tributary Canyons of the Arafura Depression

The Tributary Canyons of the Arafura Depression is an important ecological feature characterised by high nutrients from upwellings of deep ocean water, which enhance productivity of the area (DEWHA, 2008a). This is thought to occur as a result of movements of water through the canyons and surface water circulating as a result of monsoonal winds (Wilson, 2005).

Surveys of the area identified around 245 macroscopic species including a variety of invertebrates and six small fish species (Wilson, 2005). The area also contains coral communities and attract aggregations of marine life (DEWHA, 2008a). Larger species found at this key ecological feature include predatory fish, whale sharks, sawfish and marine turtles (mostly olive ridley) (DEWHA, 2008a).

The national and/or regional importance of the Tributary Canyons of the Arafura Depression is associated with its high productivity, high levels of biodiversity and endemism.

11. State Marine Conservation Reserves

11.1 Introduction

Marine parks and reserves have been progressively established in Western Australia since 1987 and the Northern Territory since 1983. The Conservation and Parks Commission (CPC) is the vesting authority for marine parks and reserves under the provisions of the *Conservation and Land Management Act 1984*. Parks and Wildlife, within the Department of Biodiversity, Conservation and Attractions (DBCA), is responsible for day to day management of the parks.

There are three categories of state marine conservation reserves: marine parks; marine management areas; and marine nature reserves.

Marine parks are created to protect natural features and aesthetic values while allowing recreational and commercial uses that do not compromise conservation values. There are currently 25 marine parks within the combined EMBA (refer **Figure 9-2**, **Figure 9-3** **Figure 9-4** and **Figure 9-4**).

Marine parks are multiple-use reserves that cater for a wide range of activities. Within marine parks there may be four types of management zones: recreation zones: general use zones; no-take areas known as sanctuary zones; and special purpose zones.

Each marine park has a ‘management plan’ that contains strategies to protect the high value assets in the park, as well as permitted activities tables. These tables provide explicit regulatory management.

Sanctuary zones are ‘no-take' areas created primarily for conservation and scientific research and are designed to protect a particular significant ecosystem or habitat. Low-impact tourism may be permitted, but no recreational or commercial fishing, aquaculture, pearling, petroleum drilling or production is allowed.

Marine management areas provide an integrated management structure over areas that have high conservation value and intensive multiple-use. There are two marine management areas within the combined EMBA (described below).

There is currently only one state marine nature reserve: Hamelin Pool Nature Reserve part of the Shark Bay World Heritage Area (**Section 9.1.1**).

Within the NT component of the combined EMBA, there are no marine based conservation reserves. There were three coastal reserves (Channel Point Coastal Reserve, Casuarina Coastal Reserve and Shoal Bay Coastal Reserve), one conservation area (Tree Point Conservation Area) and two national parks (Djukbinj National Park Garig Gunak Barlu National Park) identified in the PMST report as being situated adjacent to the combined EMBA. Three more were identified as being present (Mary River National Park, Keep River National Park, Charles Darwin National Park) in the combined EMBA from mapping. However, these are all terrestrial based reserves and have not been discussed in further detail.

11.1.1 Ngari Capes Marine Park

The Ngari Capes Marine Park is gazetted as a Class A Marine Park. The park is located off the southwest coast of Western Australia, approximately 250 km south of Perth, covering approximately 123,790 ha. The seaward boundary of the marine park is congruent with the seaward limit of Western Australian waters (three nautical miles from the territorial baseline). The north-eastern boundary in Geographe Bay is located near the intersection of the Shire of Busselton boundary with the coastline. The Shire of Busselton–Shire of Capel boundary is approximately 30 m north-east of the marine park boundary, while the south-eastern boundary in Flinders Bay is located at 115˚17’00” E. The marine park consists of four areas that are representative of the Leeuwin–Naturaliste marine bioregion: Geographe Bay; Cape Naturaliste to Cape Mentelle coast; the Cape Mentelle to Cape Leeuwin coast; and Flinders Bay. These areas show distinct differences in geomorphology, oceanography, habitats and flora and fauna.

The Ngari Capes Marine Park was identified as one of the most diverse temperate marine environments in Australia. Warm, tropical waters of the Leeuwin Current mix with the cool waters of the Capes Current, resulting in high finfish diversity, including tropical and temperate species (see fish in **Section 5.1.1**) and internationally significant seagrass diversity with seagrasses occurring at depths greater than 40 m (see seagrasses in **Section 3.2**). The marine park also surrounds a number of islands that are important seabird nesting habitat and pinniped haul-outs (places where seals and sea lions leave the water and come onto land), including Hamelin Island, Sugarloaf Rock and the Saint Alouarn Islands which include Flinders Island, Seal Island and Square Rock (DEC 2013). These islands are vested with the Conservation Commission as nature reserve and are managed by DBCA for the purpose of conservation. The marine park is also adjacent to the Leeuwin Naturaliste National Park which extends to the high water mark (DEC 2013).

The Ngari Capes marine park was also created for its high social values. The unique geographical location of this region exposes it to large, uninterrupted ocean swells and results in the South West capes area being recognised as one of the world's premier surfing regions. Many activities occurring in the region are marine based, including commercial and recreational fishing, swimming, surfing, diving, snorkelling, boating, and marine nature-based tourism.

11.1.2 Jurien Bay Marine Park

The Jurien Bay Marine Park is a Class A marine park located on the central west coast of Western Australia about 200 km north of Perth and covers an area of 82,375 ha (CALM 2005b). Its western boundary is the seaward limit of Western Australian coastal waters. Its northern boundary is the northern point of Dynamite Bay at Green Head (30° 4' 7.9" South), and its southern boundary is located just south of Wedge (30° 50' 20" South) and is contiguous with the southern boundary of the Wanagarren Nature Reserve.

Jurien Bay Marine Park is considered to be broadly representative of the Central West Coast limestone reef system, which is a major marine ecosystem within this bioregion. The marine biota of the area consists of an unusual mix of tropical and temperate species as well as many endemic species (Larkum & Hartog, 1989). The Marine Park is dominated by five major marine habitat types: seagrass meadows; bare or sparsely vegetated mobile sand; shoreline and offshore intertidal reef platforms; subtidal limestone reefs; and reef pavement (CALM 2005b). Marine wildlife includes 14 species of cetaceans, a variety of sea and shorebirds which nest on the islands and the Australian sea lion (North Fisherman Island to the north of Jurien Bay is one of the main breeding sites for sea lions in the Central West Coast region and it is believed this breeding population is genetically distinct from the southern coast population – Gales et al. 1992). Commercial fishing for western rock lobster as well commercial wetlining, abalone, shark netting, beach seining for mullet and collecting of specimen shells and aquarium fish are carried out within the marine park.

11.1.3 Shark Bay Marine Park and Hamelin Pool Marine Nature Reserve

The Shark Bay Marine Reserves comprise the Shark Bay Marine Park and the Hamelin Pool Marine Nature Reserve. The Shark Bay Marine Park was gazetted on 30 November 1990 as A Class Marine Park Reserve No. 7 and vested in the National Park and Nature Conservation Authority (NPNCA) under the CALM Act. The marine park encompasses an area of 748,725 ha (CALM 1996).

The Bay is located near the northern limit of a transition region between temperate and tropical marine fauna. Of the 323 fish species recorded from Shark Bay, 83% are tropical species with 11% warm temperate and 6% cool temperate species. Similarly, of the 218 species of bivalves recorded in Shark Bay, 75% have a tropical range and 10% a southern Australian range, with 15% being endemic to the west coast (CALM 1996).

Key features of Shark Bay Marine Park include (CALM 1996, DSEWPaC 2013b):

+ 12 species of seagrass making it one of the most diverse seagrass assemblages in the world;
+ Seagrass that covers over 4,000 km^2 of the bay. The 1,030 km^2 Wooramel Seagrass Bank is the largest structure of its type in the world;
+ An estimated population of about 11,000 dugongs, one of the largest populations in the world;
+ Humpback and southern right whales use the bay as a migratory staging post;
+ Bottlenose dolphins occur in the bay, and green turtle and loggerhead turtle nest on the beaches;

+ Large numbers of sharks including whaler, tiger shark and hammerhead are present as well as an abundant population of rays, including the manta ray;
+ Hamelin Pool in Shark Bay contains the most diverse and abundant examples of stromatolite forms in the world, representative of life-forms which lived some 3,500 million years ago; and
+ Shark Bay Marine Park does not cover Bernier and Dorre Islands and only coastal waters inshore of Dirk Hartog Island (east of eastern shoreline).

Shark Bay was included on the World Heritage List in 1991 primarily on the basis of three natural features: vast seagrass beds; dugong population; and stromatolites (microbial colonies that form hard, dome-shaped deposits and are among the oldest forms of life on Earth) (DSEWPaC 2013b; see **Section 9.1**).

There is no zoning within the Hamelin Pool Marine Nature Reserve. This area is a 'look but don't take' area managed solely for the conservation of globally outstanding marine life. Hamelin Pool is one of only two known places in the world with living examples of marine stromatolites (DEC 2010). The shores of Hamelin Pool are also important for the formation of extensive marine algal mats formed by microbial algae. If damaged, the mats and stromatolites can take many hundreds of years to recover (DEC 2010).

11.1.4 Ningaloo Marine Park

The Ningaloo Marine Park was declared in May 1987 under the National Parks and Wildlife Conservation Act 1975 (Commonwealth). The Ningaloo Coast, incorporating both key marine and terrestrial values was later granted World Heritage Status in June 2011. In November 2012, the Ningaloo Marine Park (Commonwealth Waters) was renamed to be incorporated in the North-west Commonwealth Marine Reserves Network. The park covers an area of 263,343 km^2, including both State and Commonwealth waters, extending 25 km offshore.

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

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

+ Over 217 species of coral (representing 54 genera);
+ Over 600 species of mollusc (clams, oysters, octopus, cuttlefish, snails);
+ Over 460 species of fish;
+ Ninety-seven species of echinoderms (sea stars, sea urchins, sea cucumbers);
+ Habitat for numerous threatened species, including whales, dugong, whale sharks and turtles; and
+ Habitat for over 25 species of migratory wading birds listed in CAMBA and JAMBA.

11.1.5 Muiron Islands Marine Management Area

The Ningaloo Marine Park Management Plan (CALM 2005) created a MMA for the Muiron Islands, immediately adjacent to the northern end of the Park. This 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.

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 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).

11.1.6 Barrow Island Marine Park

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

11.1.7 Barrow Island Marine Management Area

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

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

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

11.1.8 Montebello Islands Marine Park

Montebello/ Barrow/ Lowendal Islands are part of a shallow submarine ridge, which extends north from the mainland near Onslow. The ridge contains extensive areas of intertidal and shallow subtidal limestone pavement surrounding the numerous, mostly small islands which are found in the region. The seabed is generally less than 5 m deep and consists of sand veneered limestone pavement with patches of fringing coral reef (DEC 2007).

The island chain lies entirely within WA State waters, with the State-Commonwealth boundary extending out to encompass the islands and waters 3 nm west of Barrow Island and north of the Montebello Islands. These islands are protected within as marine conservation reserves: Montebello Islands Marine Park, Barrow Islands Marine Park and Barrow Island Marine Management Area.

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.

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Socio-economic values of the Montebello and Barrow Islands MCR include hydrocarbon exploration and production, pearling, nature-based tourism, commercial and recreational fishing, water sports, European history and maritime heritage and scientific research (DEC 2007)

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

11.1.9 Rowley Shoals Marine Park

The Rowley Shoals (including the Commonwealth-managed Mermaid Reef Marine National Nature Reserve) are located approximately 300 km west-northwest of Broome, lying between 17°07'S, 119°36'E and 17°35'S, 118°56'E and encompassing approximately 87,674 ha (DEC 2007b).

The Rowley Shoals is ecologically significant in that the reefs form part of a series of important ecological "stepping stones" for a range of reef biota originating in Indonesian/west Pacific waters. Their position off the north-west Australian coast, an area of few offshore reef systems, provides an important upstream source for recruitment to reefs further south (DEC 2007b). Marine wildlife includes 184 species of corals, primarily Indo-West Pacific species, indicating the strong affinity of the Rowley Shoals communities with Indonesia. In terms of other species, at least 264 species of molluscs, 82 species of echinoderms and 389 species of finfish were also identified (DEC 2007b). The faunal assemblages of the Rowley Shoals Marine Park are regionally significant as they contain large numbers of species not found in the more turbid coastal environments of tropical Western Australia (DEC 2007b). There is a relatively low level of recreational and commercial activity, mostly atribuated to the remoteness of the Shoals with access difficult from both Indonesia and mainland Australia (DEC 2007b).

11.1.10 Lalang-garram/Camden Sound Marine Parks

The Lalang-garram/Camden Sound Marine Park was created on 19 June 2012 under Section 13 of the Conservation and Land Management Act 1984 (CALM Act). It is a multiple zone marine park that includes; Sanctuary, Special Purpose, and General Use zones (DPaW 2013). The marine park falls within the west Kimberley, which was recently added to the Australian National Heritage List because of its natural, indigenous and historic values to the nation.

The marine park is located about 150 km north of Derby (or 300 km north of Broome) and lies within the traditional country of three Aboriginal native title groups. The Dambimangari people's determination overlies the majority of the marine park. A section of the Wunambal Gaambera people's Uunguu determination includes a small portion of St George Basin, while a small section of the Mayala people's claim (native title not determined at the time of writing of Management Plan) overlies the southwest corner of the marine park (DPaW 2013).

The marine park covers an area of approximately 705,000 ha. It recognises and provides special management arrangements for this area of the Kimberley, which is a principal calving habitat of the humpback whale (*Megaptera novaeangliae*) population that migrates annually along Western Australia's coast. The marine park also conserves a range of species listed as having special conservation status including marine turtles, snubfin and Indo-Pacific humpback dolphins, dugong, saltwater crocodiles, and several species of sawfish. The park also includes a 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).

11.1.11 Marmion Marine Park

Marmion Marine Park was Western Australia's first marine park, declared in 1987 and is a multi-use reserve (CALM 2002). Marmion Marine Park is located offshore from Perth's northern suburbs, between Trigg Island and Burns Beach.

Habitats in the area include intertidal reef platforms, coastal sand beaches, a high limestone reef about 1 km from shore, Little Island and the Three Mile Reef system. Of note are complex assemblages of sea floor communities, including seagrass meadows, algal limestone pavement communities and crevice animal associations (CALM 2002).

The marine park provides an important habitat for marine mammals, such as sea lions, dolphins and whales. The island nature reserves within Marmion Marine Park provide an important habitat for several species of seabirds and haul-out areas for Australian sea lions, especially at Little Island and Burns Rocks (CALM 2002).

11.1.12 Swan Estuary Marine Park

The Swan Estuary Marine Park (A Class marine reserve number 4) was gazetted on 25 May 1990. The Swan Estuary Marine Park and Adjacent Nature Reserves Management Plan 1999-2009 was gazetted 7 April 2000 (CALM 1999).

The Swan Estuary Marine Park encompasses Alfred Cove, 200 ha adjacent to the suburbs of Attadale and Applecross; Pelican Point, a 45 ha area in Crawley; and Milyu, 95 ha adjacent to the Como foreshore (CALM 1999). All three localities are within 20 minutes of the Perth CBD.

These areas encompass mudflats, seagrass beds and intertidal vegetation such as sedges and saltmarsh, which provide many different habitats for a host of animals. The most important of these, due to their international significance, are the migratory wading birds. They come from as far afield as Asia, Mongolia and Siberia. About 33 of these species are protected, including the red-necked stint (CALM 1999).

11.1.13 Shoalwater Islands Marine Park

The Shoalwater Islands Marine Park is located within the Perth metropolitan area, adjacent to the city of Rockingham and was gazetted in 1990 (DEC 2007). There are three sanctuary zones, two special purpose zones and a large general use zone in the park.

The Shoalwater Island region is dominated by beach and rocky shore shoreline habitats. The many jagged edged islands and rocky islets of the marine park provide important roosting and nesting areas for numerous bird species. The marine park has some of the healthiest seagrass meadows in the Perth metropolitan area, consisting of long lived species such as *Posidonia* spp. and *Amphibolis* spp. Seagrass meadows provide an important habitat and nursery area for a large number of marine species such as fish, rock lobsters, worms, shellfish, crustaceans, fish sharks and rays (DEC 2007).

The habitats of the marine park are important for the feeding, resting and breeding of little penguins and other sea and shore birds. Penguin Island which is found within the marine park has the largest breeding colony of little penguin on the west coast of Australia (DEC 2007). The bottlenose dolphin is the most common marine mammal, and Australian sea lions are commonly seen throughout the park.

11.1.14 Eighty Mile Beach Marine Park

The Eighty Mile Beach Marine Park, located between Port Hedland and Broome, was gazetted on 29 January 2013. It covers an area of approximately 200,000 ha stretching for some 220 km from Cape Missiessy to Cape Keraudren, and includes sanctuary, recreation, general use and special purpose zones. The park is managed under the Eighty Mile Beach Marine Park Management Plan 2014-20124 (DPaW, 2014).

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

+ The intertidal sand and mudflat communities supporting a high abundance and diversity of invertebrate life and providing a valuable food source for shorebirds (including migratory species) and other fauna;
+ The diverse subtidal filter-feeding communities;
+ Macroalgal and seagrass communities providing habitat and feeding opportunities for fish, invertebrates and dugongs;

- High diversity intertidal and subtidal coral reef communities; and
- Mangrove communities and adjacent saltmarshes provide nutrients to the surrounding waters and habitat for fish and invertebrates.

The listed marine and coastal fauna values are as follows:

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

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

The marine park contains vast intertidal sand and mudflats that extend up to 4 km wide at low tide and provide a rich source of food for many species. Eighty Mile Beach Marine Park is one of the world's most important feeding grounds for small wading birds that migrate to the area each summer, travelling from countries thousands of kilometres away (DPaW 2014) (see **Section 9.2.1**).

11.1.15 Lalang-garram/ Horizontal Falls and North Lalang-garram Marine Parks

The Lalang-garram/ Horizontal Falls and North Lalang-garram Marine Parks were established in 2016 under the State Government's *Kimberley Science and Conservation Strategy* and are jointly managed by Dambimangari Traditional Owners and the Department of Parks and Wildlife (DPaW 2016). The marine parks fall within the west Kimberly region, included in the Australian National Heritage List for its nationally significant natural, indigenous and historic values (DoEE 2019c).

The Lalang-garram/ Horizontal Falls Marine Park extends from Talbot Bay (*Ganbadba*) in the west to Walcott Inlet (*Iledda*) and Glenelg River (*Molor Moloiyn*) in the east and covers approximately 353,000 ha (DPaW 2016). The marine park protects the internationally recognised Horizontal Falls and is important for the region's tourism. The North Lalang-garram Marine Park lies between the Lalang-garram / Camden Sound and North Kimberley Marine Parks and covers approximately 110,000 ha (DPaW 2016).

The area's large tidal range results in extensive intertidal areas with diverse ecosystems such as fringing coral reefs, mangroves and mudflat communities. Subtidal habitats and communities common to the marine parks include filter feeding communities of sponges and hard and soft corals. These intertidal and subtidal habitats provide critical foraging and nursery areas for dugong, marine turtles, estuarine crocodiles, snubfin and Indo-Pacific humpback dolphins, several species of sawfish and migratory seabirds. The marine parks are also a principal calving habitat for humpback whales (DPaW 2016).

11.1.16 North Kimberley Marine Park

The North Kimberley Marine Park was established in December 2016 as a Class A marine park under the CPC (DPaW 2016a). The marine park comprises four separate management areas including, Uunguu, Balanggarra, Miriuwung Gajerrong, and Wilinggin. It is a multiple zone marine park that includes: eight sanctuary zones, nine special purpose zones (recreation and conservation), two special use zone (cultural heritage), and general use areas (DPaW 2016a). The marine park is managed in accordance with the provisions of the CALM Act with joint management between the Department of Parks and Wildlife and Traditional Owners of the area.

The area within the marine park is recognised for its Aboriginal cultural and heritage values, natural values including coral reefs, marine turtle species, dugongs, seagrass and macroalgal communities, mangroves and saltmarshes, finfish, and water and sediment quality, as well as for its social values (i.e. recreation, tourism and community values) and commercial values and resource use (e.g. commercial fishing). The marine park lies within the Indian Ocean and Timor Sea of Western Australia's Kimberley region, covering an area of approximately 1,845,000 hectares (DPaW 2016a). The south-western boundary is approximately 270 km northeast of Derby.

11.1.17 Yawuru Nagulagun/ Roebuck Bay Marine Park

The Yawuru Nagulagun/Roebuck Bay Marine Park was approved by the State Minister for Environment in October 2016 and declared as a Class A reserve over the subtidal and intertidal areas of Roebuck Bay (excluding the Kimberley Ports Authority waters), (DBCA, 2017a). The Marine Park is managed with a joint management framework between Parks and Wildlife and Yawuru Registered Native Title Body Corporation (RNTBC). The intent is to manage the areas from the offshore waters around Roebuck and Broome, collectively referred to as the Yawuru conservation estate, as one ecological system (DPaW 2016b). The development of the joint management plan is in accordance with the Conservation and Land Management Act 1984 (Yawuru Organisation 2017) as well as contributes to the State Governments commitment under the Kimberly Science and Conservation Strategy, released in June 2011.

The Yawuru people have lived along the foreshores of Roebuck Bay for thousands of years, the Bay is part of the Yawuru traditional estate (DPaW 2016b). Roebuck Bay is an internationally significant Ramsar wetland, declared in 1990, and an important feeding ground for many species of migratory shorebirds. It hosts possibly the greatest diversity of shorebird species at any site across the globe (DBCA 2017b). The Bay has some of the most productive tropical intertidal flats in the world, and is consequently an important ground for Yawuru fishing, hunting and gathering of sea food. The Bay hosts communities of seagrass and macroalgae, providing food for protected species such as the dugong and flatback turtle. Marine mammals also pass through the waters of the Bay such as the Australian snubfin dolphin and the humpback dolphin, the humpback whale can also be found during annual migration (DPaW 2016b).

12. Australian Marine Parks

12.1 Introduction

In agreement with the States and NT governments, the Australian Commonwealth government was committed to establish Commonwealth marine parks as a component of the National Representative System of Marine Protected Areas (DoE 2014) (See **Figure 9-2, Figure 9-3** and **Figure 9-4**). In November 2012, the Commonwealth Marine Reserves Network was proclaimed with the purpose of protecting the biological diversity and sustainable use of the marine environment (Director of National Parks 2012a). Commonwealth Marine Reserves were renamed as Australian Marine Parks in October 2017. Six marine regions are included in the Australian Marine Parks Network, including the Coral Sea, the South-west, the Temperate East, the South-east, the North and the North-west. The South-east network 10-year Management Plan came into effect on 1 July 2013. The remaining networks 10-year Management Plans were approved and came into effect on 1 July 2018.

The new management plans establish the management and zoning of the designated marine parks. The marine park networks pertinent to the combined EMBA include:

+ The South-West Marine Parks Network;
+ The North-West Marine Parks Network; and
+ The North Marine Parks Network.

The South-West Marine Parks Network comprises 14 marine parks. Seven of these occur in West Australian waters in the combined EMBA, including:

+ Abrolhos Commonwealth Marine Park;
+ Jurien Marine Park;
+ Two Rocks Marine Park;
+ Perth Canyon Marine Park;
+ Geographe Marine Park;
+ South-west Corner Marine Park; and
+ Bremer Marine Park
+ Eastern Recherche Marine Park

The North-West Marine Parks Network comprises 13 marine parks which all occur in West Australian waters pertinent to the combined EMBA:

+ Carnarvon Canyon Marine Park;
+ Shark Bay Marine Park;
+ Gascoyne Marine Park;
+ Ningaloo Marine Park;
+ Montebello Marine Park;
+ Dampier Marine Park;
+ Eighty Mile Beach Marine Park;
+ Argo-Rowley Terrace Marine Park;
+ Mermaid Reef Marine Park;

+ Roebuck Marine Park;
+ Kimberley Marine Park;
+ Ashmore Reef Marine Park; and
+ Cartier Island Marine Park.

The Northern Marine Parks Network comprises eight marine parks. Four of these occur in Western Australian or Northern Territory waters within the combined EMBA:

+ Oceanic Shoals Marine Park;
+ Arafura Marine Park;
+ Arnhem Marine Park; and
+ Joseph Bonaparte Gulf Marine Park.

the combined EMBAThe sizes of these marine parks range from 300—152,000 km^2, and the water depths within the marine parks vary from approximately 15—1,500 m deep. The EPBC Act requires that each management plan assign an International Union for the Conservation of Nature (IUCN) category to each marine park. Additionally, the Act also allows for the management plan to divide a marine park into zones and to assign a category to each zone, which may differ from the overall category of the marine park. Zoning considers the purposes for which the marine parks were declared, the objectives of the relevant management plans, the values of the marine park and requirements of the EPBC Act and EPBC Regulations.

the combined EMBAThe North-West Marine Parks Network includes six different types of zoning:

+ Sanctuary Zone (IUCN Category Ia);
+ National Park Zone (IUCN Category II);
+ Recreational Use Zone (IUCN Category IV);
+ Habitat Protection Zone (IUCN Category IV);
+ Multiple Use Zone (IUCN Category VI); and
+ Special Purpose Zone (Trawl) (VI).

The South-west Marin Parks Network includes six different types of zoning:

+ National Park Zone (IUCN Category II);
+ Habitat Protection Zone (IUCN Category IV);
+ Multiple Use Zone (IUCN Category VI);
+ Special Purpose Zone (Mining Exclusion) (IUCN Category VI);
+ Special Purpose Zone (IUCN Category VI); and
+ Special Purpose Zone (Trawl) (IUCN Category VI).

Five types of zones are represented within the North Marine Parks Network:

+ National Park Zone (IUCN Category II)
+ Habitat protection zone (IUCN Category IV)
+ Multiple use zone (IUCN Category VI)
+ Special Purpose Zone (Trawl) (IUCN Category VI)
+ Special Purpose Zone (IUCN Category VI)

A summary of the South-West, North-West and North Marine Parks Networks is provided in **Table 12-1**.

12.2 South-West Marine Parks Network

The South-West Commonwealth Marine Parks Network is aligned to the South-West Marine Region. The network covers 508,371 km^2 and includes 14 marine parks (Director of National Parks, 2018a). Broad values of the South-west Australian Marine Parks include:

+ Natural values;
+ Cultural values;
+ Heritage values; and
+ Socio-economic values.

Further detail on each of the relevant marine parks those that fall within the combined EMBA is provided below.

12.2.1 Abrolhos Marine Park

The Abrolhos Marine Park (including zones within the combined EMBA: Marine National Park Zone – IUCN Category II-2,548 km^2; Habitat Protection Zone – IUCN Category VI-23,239 km^2; Multiple Use Zone – IUCN Category VI-56,545 km^2; Special Purpose Zone – IUCN Category VI-5,729 km^2) covers an area of approximately 88,060 km^2 and protects the following conservation values (Director of National Parks, 2018a):

+ Important foraging areas for the:
  – Threatened Australian lesser noddy;
  – Northernmost breeding colony of the threatened Australian sea lion;
  – Great white sharks; and
  – Migratory common noddy, wedge-tailed shearwater, bridled tern, Caspian tern and roseate tern.
+ Important migration habitat for the protected humpback whale and pygmy blue whales;
+ The second largest canyon on the west coast, the Houtman Canyon;
+ Examples of the northernmost ecosystems of the Central Western Province and South-west Shelf Transition (including the Central West Coast meso-scale bioregion);
+ Examples of the deeper ecosystems of the Abrolhos Islands meso-scale bioregion;
+ Examples of the shallower, southernmost ecosystems of the Central Western Shelf Province provincial bioregion including the Zuytdorp meso-scale bioregion;
+ Examples of the deeper ecosystems of the Central Western Transition provincial bioregion;
+ Examples of diversity of seafloor features including: southern most banks and shoals of the North-west region; deep holes and valleys; slope habitats; terrace and shelf environments; and
+ Seven KEFs.

The Abrolhos Marine Park is adjacent to the Shark Bay World Heritage Property. The marine park does not contain any Commonwealth or National Heritage listings (Director of National Parks 2018a). The marine park contains 11 known shipwrecks listed under the *Underwater Culture Heritage Act 2018*. Commercial tourism, fishing, recreation and mining are important supported socio-economic activities in the park.

12.2.2 Jurien Marine Park

The Jurien Marine Park (including zones within the combined EMBA): Marine National Park Zone -IUCN Category II – 31 km^2 Special Purpose Zone -IUCN Category VI – 1,820 km^2) covers an area of approximately 1,851 km^2 and protects the following conservation values (Director of National Parks 2018a):

+ Important foraging areas for the:
  – Threatened soft-plumaged petrel;

- Threatened Australian sea lion;
- Threatened white shark; and
- Migratory roseate tern, bridled tern, wedge-tailed shearwater, and common noddy.

+ Important migration habitat for the protected humpback whale;
+ Examples of the ecosystems of two provincial bioregions: the central part of the South-west Shelf Transition (which includes the Central West Coast meso-scale bioregion) and small parts of the Central Western Province;
+ Three KEFs; and
+ Heritage values represented by the SS Cambewarra and Oleander historic shipwreck.

The Jurien Marine Park does not contain any international, Commonwealth or National Heritage listings (Director of National Parks 2018a). Commercial tourism, fishing, recreation and mining are important supported socio-economic activities in the park.

12.2.3 Two Rocks Marine Park

The Two Rocks Marine Park (including zones within the combined EMBA): Multiple Use Zone - IUCN Category VI – 867 km^2; Marine National Park Zone - IUCN Category II – 15 km^2) covers an area of approximately 882 km^2 and protects the following conservation values (Director of National Parks 2018a):

+ Important foraging areas for the:

- Threatened soft-plumaged petrel;
- Threatened Australian sea lion; and
- Migratory roseate tern, bridled tern, Caspian tern, wedge-tailed shearwater, and common noddy.

+ Important migratory areas for protected humpback whales and pygmy blue whales;
+ Seasonal calving habitat for the threatened southern right whale;
+ Examples of the ecosystem of the southernmost parts of the South-west Shelf Transition (including the Central West Coast meso-scale bioregion); and
+ Three KEFs.

The Two Rocks Marine Park does not contain any international, Commonwealth or National Heritage listings (Director of National Parks 2018a). Commercial tourism, fishing, recreation and scientific research are important supported socio-economic activities in the park.

12.2.4 Perth Canyon Marine Park

Perth Canyon Marine Park (including zones within the combined EMBA): Marine National Park Zone – IUCN Category II – 1,241 km^2; Habitat Protection Zone – IUCN Category IV –4,352 km^2; Multiple Use Zone – IUCN Category VI – 1,816 km^2) covers an area of approximately 7,409 km^2 and protects the following conservation values (Director of National Parks 2018a):

+ Globally important seasonal feeding aggregation for the threatened blue whale;
+ Important foraging areas for the:

- Threatened soft-plumaged petrel;
- Migratory sperm whale; and
- Migratory wedge-tailed shearwater.

+ Important migratory areas for protected humpback whales and blue whales;
+ Seasonal calving habitat for the threatened southern right whale;

- Examples of the ecosystems of the southernmost parts of the Central Western Province and South-west Shelf Transition (including the Central West Coast meso-scale bioregion), and the northernmost parts of the South-west Transition and Southwest Shelf Province (including the Leeuwin-Naturaliste meso-scale bioregion); and
- Four KEFs.

The Perth Canyon Marine Park does not contain any international, Commonwealth or National Heritage listings (Director of National Parks 2018a). Commercial tourism, fishing, shipping, recreation and defence training are important supported socio-economic activities in the park.

12.2.5 Geographe Marine Park

Geographe Marine Park (including zones within the combined EMBA): Marine National Park Zone - IUCN Category II – 15 km^2; Special Purpose Zone - IUCN VI – 650 km^2; Multiple Use Zone - IUCN Category VI – 291 km^2; Habitat Protection Zone (IV) 21 km^2) covers an area of approximately 977 km^2 and protects the following conservation values (Director of National Parks 2018a):

- Important foraging areas for the:
  - Threatened soft-plumaged petrel; and
  - Migratory wedge-tailed shearwater.
- Important pre-migration aggregation area for the migratory flesh-footed shearwater;
- Important migratory habitat for the protected humpback whale and blue whale;
- Seasonal calving habitat for the threatened southern right whale.
- Seasonal calving habitat for the threatened southern right whale.
- Representation of the South-west Shelf Province on the continental shelf as well as the Leeuwin-Naturaliste meso-scale bioregion;
- Two KEFs; and
- Representation of the seagrass habitats of the Geographe Bay key ecological feature, which in this location extend the furthest into Commonwealth waters.

The Geographe Marine Park does not contain any international, Commonwealth or National Heritage listings (Director of National Parks 2018a). The marine park contains eight known shipwrecks listed under the *Underwater Culture Heritage Act 2018.* Commercial tourism, fishing and recreation are important supported socio-economic activities in the park.

12.2.6 South-west Corner Marine Park

The South-west Corner Marine Park (including zones within the combined EMBA: Marine National Park Zone - IUCN II – 54,841 km^2; Multiple Use Zone - IUCN VI –106,602 km^2; Special Purpose Zone (Mining exclusion) - IUCN VI – 9,550 km^2, Special Purpose Zone – IUCN VI – 5753 km^2; Habitat Protection Zone - IUCN IV – 95,088 km2) covers an area of approximately 271,833 km2 within the combined EMBA and protects the following conservation values (Director of National Parks 2018a):

- Important migratory area for protected humpback whales and blue whales;
- Important foraging areas for the:
  - Threatened white shark;
  - Threatened Australian sea lion;
  - Threatened Indian yellow-nosed albatross and soft-plumaged petrel;
  - Sperm whale;

- – Migratory flesh-footed shearwater, short-tailed shearwater and Caspian tern; and
- – Seasonal calving habitat for the threatened southern right whale.
+ Representation of three provincial bioregions (the South-west Transition and Southern Province in the off-shelf area, and the South-west Shelf Province on the continental shelf) and two meso-scale bioregions (southern end of the Leeuwin-Naturaliste meso-scale bioregion and western and central parts of the Western Australia South Coast meso-scale bioregion);
+ Representation of the Donnelly Banks, east of Augusta, characterised by higher productivity and including nursery habitats; and
+ Six KEFs.

The South-west Corner Marine Park does not contain any international, Commonwealth or National Heritage listings (Director of National Parks 2018a). The marine park contains ten known shipwrecks listed under the *Underwater Culture Heritage Act 2018*. Commercial tourism, fishing, shipping and recreation are important supported socio-economic activities in the park.

12.2.7 Bremer Marine Park

The Bremer Marine Park: National Park Zone – IUCN II – 3,172 km^2; Special Purpose Zone (Mining exclusion) - IUCN VI – 1,300 km^2, which covers an area of approximately 4,472 km^2 and protects the following conservation values (Director of National Parks 2018a):

+ Contains habitats, species and ecological communities associated with two bioregions: Southern Province and South-west Shelf Province;
+ Two key ecological features (Albany Canyon group and adjacent shelf break and ancient coastline between 90 m and 120 m depth);
+ Important foraging areas for:
+ Threatened white shark;
+ Threatened Australian sea lion;
+ Threatened Indian yellow-nosed albatross, Australian fairy tern and soft-plumaged petrel; and
+ Migratory flesh-footed shearwater, short-tailed shearwater, bridled tern and Caspian tern.
+ Important migratory pathway for humpback whales;
+ Significant calving habitat for the threatened southern right whale; and
+ Important aggregation area for killer whales

The marine park does not contain any international, Commonwealth or National Heritage listings (Director of National Parks 2018a). Commercial tourism, fishing, shipping and recreation are important supported socio-economic activities in the park.

12.2.8 Eastern Recherche Marine Park

The Eastern Recherche Marine Park (Special Use Zone – IUCN Category V) is part of the South-West Marine Park Network. It lies adjacent to the Recherche Archipelago about 135km east of Esperance and includesimportant foraging areas for:

+ Threatened white shark;
+ Threatened Australian sea lion
+ Pygmy blue whales are distributed across the marine park
+ Southern right whales migrate through the region to important nursery areas in coastal waters.

The marine park does not contain any international, Commonwealth or National heritage listings (Director of National Parks 2018a) but it is adjacent to the Recherche Archipelago which is home to the only breeding population of great-winged petrels in Australia.

12.3 North-West Marine Park Network

The North-West Marine Parks Network is aligned to the North-west Marine Region. The network covers 335, 341 km^2 and includes 13 marine parks (Director of National Parks, 2018b). Broad values of the North-west Commonwealth Marine Reserves Network include:

+ Natural values;
+ Cultural values;
+ Heritage values; and
+ Socio-economic values.

Further detail on each of the relevant marine parks within the combined EMBA is provided below.

12.3.1 Carnarvon Canyon Marine Park

The Carnarvon Canyon Marine Park (Habitat Protection Zone – IUCN Category IV) covers an area of approximately 6,177 km^2 and protects the following conservation values (Director of National Parks 2018b):

+ The Carnarvon Canyon a single channel canyon with seabed features that include slope, continental rise and deep holes and valleys;
+ The Carnarvon Canyon ranges in depth from 1500 m to over 5,000 m, thereby providing habitat diversity for benthic and demersal species; and
+ Central Western Transition provincial bioregion ecosystem examples are found here, which are characteristic of the biogeographic faunal transition between tropical and temperate species.

There is limited information about species' use of this Marine Park (Director of National Parks 2018b). The marine park does not contain any international, Commonwealth or National Heritage listings (Director of National Parks 2018b). Commercial fishing, tourism, shipping and mining are important supported socio-economic activities in the marine park.

12.3.2 Shark Bay Marine Park

The Shark Bay Marine Park (Multiple Use Zone – IUCN Category VI) covers an area of approximately 7,443 km^2 and protects the following conservation values (Director of National Parks 2018b):

+ Foraging areas adjacent to important breeding areas for several species of migratory seabirds;
+ Part of the migratory pathway of protected humpback whales;
+ Internesting habitat for marine turtles;
+ Waters that are adjacent to the largest nesting area for loggerhead turtles in Australia;
+ Marine park and adjacent coastal areas important for shallow-water snapper;
+ Protection to shelf and slope habitats as well as a terrace feature;
+ Examples of the shallower ecosystems of the Central Western Shelf Province and Central Western Transition provincial bioregions including the Zuytdorp meso-scale bioregion; and
+ Connectivity between the inshore waters of the Shark Bay World Heritage Area and the deeper waters of the area.

Whilst no listed international, Commonwealth or National Heritage places are within the marine park, the park is adjacent to Shark Bay World Heritage Area (Director of National Parks 2018b). Commercial tourism, fishing, mining and recreation are important socio-economic values of the park.

12.3.3 Gascoyne Marine Park

The Gascoyne Marine Park (Multiple Use Zone – IUCN Category VI-33,652 km^2; Habitat Protection Zone – IUCN Category IV-38,982 km^2; Marine National Park Zone – IUCN Category II-9,132 km^2) covers an area of approximately 81,766 km^2 and protects the following conservation values (Director of National Parks 2018a):

+ 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 for the region:
  - Canyons on the slope between the Cuvier Abyssal Plain and the Cape Range Peninsula (enhanced productivity, aggregations of marine life and unique sea-floor feature);
  - Exmouth Plateau (unique sea-floor feature associated with internal wave generation);
  - Continental slope demersal fish communities (high species diversity and endemism – the most diverse slope bioregion in Australia with over 500 species found with over 64 of those species occurring nowhere else); 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.

The park is also adjacent to World Heritage listings associated with the Ningaloo Coast. Commercial tourism, commercial fishing, mining and recreation are important socio-economic values of the park (Director of National Parks 2018b).

12.3.4 Ningaloo Marine Park

Ningaloo Marine Park stretches approximately 300 km along the west coast of the Cape Range Peninsula and is adjacent to the Western Australian Ningaloo Marine Park and Gascoyne Marine Park (Director of National Parks, 2018b). Ningaloo Reef is the longest fringing barrier reef in Australia forming a discontinuous barrier that encloses a lagoon that varies in width from 200 m to 7 km. Gaps that regularly intercept the main reef line provide channels for water exchange with deeper, cooler waters (CALM 2005). It is the only example in the world of extensive fringing coral reef on the west coast of a continent.

The Ningaloo Marine Park (Recreational Use Zone – IUCN Category II) covers an area of approximately 2,435 km^2 and protects the following conservation values (Director of National Parks 2018a):

+ 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
- The Ningaloo Coast World Heritage Property, the Ningaloo Coast National Heritage listing and Ningaloo Marine Area Commonwealth Heritage Listing.

Commercial tourism and recreation are important socio-economic values of the marine park (Director of National Parks 2018b).

12.3.5 Montebello Marine Park

The Montebello Marine Park is located offshore of Barrow Island and 80 km west of Dampier extending from the Western Australian state water boundary and is adjacent to the Western Australian Barrow Island and Montebello Islands Marine Parks. The Montebello Marine Park (Multiple Use Zone – IUCN Category VI) covers an area of approximately 3,413 km^2 and protects the following conservation values (Director of National Parks 2018b):

- 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 (a unique seafloor feature that provides areas of enhanced biological productivity).

Commercial tourism, commercial fishing, mining and recreation are important socio-economic values for the park.

12.3.6 Dampier Marine Park

The Dampier Marine Park (Marine National Park Zone – IUCN Category I-73 km^2; Habitat Protection Zone – IUCN Category IV-104 km^2; Multiple Purpose Zone – IUCN Category VI-1,074 km^2) covers an area of approximately 1,252 km^2 and protects the following conservation values (Director of National Parks 2018b):

- Foraging areas for migratory seabirds that are adjacent to important breeding grounds;
- Important foraging areas for marine turtles adjacent to significant nesting sites;
- Part of the migratory pathway of the protected humpback whale;
- Protection for offshore shelf habitats and shallow shelf habitats adjacent to the Dampier Archipelago; and

- Communities and seafloor habitats of the Northwest Shelf Province provincial bioregion as well as the Pilbara (nearshore) and Pilbara (offshore) meso-scale bioregions are included.

Port activities, commercial fishing and recreation are important activities in the marine park (Director of National Parks 2018b). No heritage listings apply to the marine park.

12.3.7 Eighty Mile Beach Marine Park

The Eighty Mile Beach Marine Park (Multiple Use Zone – IUCN Category VI) is adjacent to the Western Australia Eighty Mile Beach Marine Park, 74 km north-east of Port Hedland and covers an area of approximately 10,785 km^2 and protects the following conservation values (Director of National Parks 2018b):

- 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 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).

Tourism, commercial fishing, pearling and recreation are important activities in the Marine Park (Director of National Parks 2018b).

12.3.8 Argo-Rowley Terrace Marine Park

The Argo-Rowley Marine Park is located approximately 270 km north-west of Broome, Western Australia, and extends to the limit of Australia's exclusive economic zone. The Marine Park (Multiple Use Zone – IUCN Category VI-108,812 km^2; Marine National Park Zone – IUCN Category II-36,050 km^2; Special Purpose Zone – IUCN Category VI-1,141 km^2) covers an area of approximately 146,003 km^2 and protects the following conservation values (Director of National Parks 2018b):

- Foraging areas that are important for migratory seabirds as well as the endangered loggerhead turtle;
- Important habitat and foraging for sharks;
- Migratory pathway for pygmy blue whales (Director of National Parks 2018b);
- Protection for communities and habitats of the deeper offshore waters (220 m to over 5,000 m) of the region;
- Seafloor features including aprons and fans, canyons, continental rise, knolls/abyssal hills and the terrace and continental slope;
- Communities and seafloor habitats of the Northwest Transition and Timor Province provincial bioregions;
- Connectivity between the existing Mermaid Reef Marine National Nature Reserve and reefs of the Western Australian Rowley Shoals Marine Park and the deeper waters of the region;
- Two KEFs in the reserve include:
  - The canyons linking the Argo Abyssal Plain with the Scott Plateau (unique seafloor feature with enhanced productivity and feeding aggregations of species); and

- Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals (an area of high biodiversity with enhanced productivity and feeding and breeding aggregations).

No heritage listings apply to this marine park (Director of National Parks 2018b). Commercial fishing, mining and recreation are important socio-economic values for the park.

12.3.9 Mermaid Reef Marine Park

The Mermaid Reef Marine Park (Multiple Use Zone – IUCN Category VI) lays approximately 280 km north-west of Broome, Western Australia, adjacent to the Argo–Rowley Terrace Marine Park and approximately 13 km from the Western Australian Rowley Shoals Marine Park. It covers an area of 540 km² and protects the following conservation values (Director of National Parks 2018b):

+ Mermaid Reef and Commonwealth waters surrounding Rowley Shoals are valued for its high productivity, aggregations of marine life and high species richness;
+ Mermaid Reef, Clerke Reef and Imperieuse Reef are biodiversity hotspot and key topographic feature of the Argo Abyssal Plain;
+ Rowley Shoals present some of the best geological examples of shelf atolls in Australian waters, and are ecologically significant in that they are considered ecological steppingstones for reef species originating in Indonesian/Western Pacific waters, are one of a few offshore reef systems on the north-west shelf, and may also provide an upstream source for recruitment to reefs further south;
+ Breeding habitat for seabirds;
+ Migratory pathway for the pygmy blue whale; and
+ One known shipwreck listed under the *Underwater Cultural Heritage Act 2018*: Lively (wrecked in 1810).

Tourism, recreation, and scientific research are important activities in the Marine Park (Director of National Parks 2018b).

12.3.10 Roebuck Marine Park

The Roebuck Marine Park (Multiple Use Zone – IUCN Category VI) covers an area of approximately 304 km^2 and protects the following conservation values (Director of National Parks 2018b):

+ Foraging habitat area for migratory seabirds adjacent to important breeding areas;
+ Foraging area adjacent to important nesting sites for flatback turtles;
+ Parts of the migratory pathway of the protected humpback whale;
+ Habitat adjacent to important foraging, nursing and pupping areas for freshwater, green and dwarf sawfish;
+ Foraging and calving areas for Australian snubfin, Indo-Pacific humpback and Indo-Pacific bottlenose dolphins;
+ Foraging habitat for dugong;
+ Protection for shallow shelf habitats ranging in depth from 15–70 m;
+ Ecosystems example of the Northwest Shelf Province provincial bioregion and the Canning meso-scale bioregion; and
+ Sea country valued for indigenous cultural identity, health and well-being for the Yawuru people (Director of National Parks 2018b).

No heritage listings apply to the marine park. Commercial tourism, fishing, pearling and recreation are important socio-economic values of the marine park (Director of National Parks 2018b).

12.3.11 Kimberley Marine Park

The Kimberley Marine Park (Multiple Use Zone – IUCN Category VI) is located approximately 100 km north of Broome, Western Australia, and extends from the Western Australian state water boundary north from the Lacepede Islands to the Holothuria Banks offshore from Cape Bougainville. It is adjacent to the Western Australian Lalanggarram / Camden Sound Marine Park and the North Kimberley Marine Park. It covers an area of 74,469 km^2, and protects the following conservation values (Director of National Parks 2018b):

+ Northwest Shelf Province;
  - Diverse benthic and pelagic fish communities
  - Ancient coastline thought to be an important seafloor feature
  - Migratory pathway for humpback whales
+ Northwest Shelf Transition;
  - High levels of species diversity
  - Endemism occur among demersal fish communities on the continental slope
+ Timor Province;
  - Reefs and islands of the bioregion are regarded as biodiversity hotspots
  - Endemism in demersal fish communities of the continental slope is high (two distinct communities have been identified on the upper and mid slopes)
  - Ancient coastline at the 125 m depth contour where rocky escarpments are thought to provide biologically important habitats in areas otherwise dominated by soft sediments;
  - Continental slope demersal fish communities characterised by high diversity of demersal fish assemblages;
  - 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 and whale sharks;
  - The Wunambal Gaambera, Dambimangari, Mayala, Bardi Jawi and the Nyul Nyul people's sea country extends into the Kimberley Marine Park. Access to sea country by families is important for cultural traditions, livelihoods and future socio-economic development opportunities; and
  - More than 40 known shipwrecks listed under the *Underwater Cultural Heritage Act 2018*.

Tourism, commercial fishing, mining, recreation, including fishing, and traditional use are important activities in the Marine Park (Director of National Parks 2018b).

12.3.12 Ashmore Reef Marine Park

The Ashmore Reef Marine Park (Sanctuary Zone – IUCN Category Ia; Recreational Use Zone – IUCN Category II) covers an area of approximately 583 km^2 (Director of National Parks 2018b). It forms part of the North-west Park Network. As the only oceanic reef in the north-east Indian Ocean with vegetated islands (East, Middle and West Islands), Ashmore is also the largest of three emergent, oceanic reefs in the region (DSEWPaC 2012). Both the Ashmore and Cartier Islands fall under the legal memorandum of understanding between Indonesia and Australia, as both areas are located within Australia's external territory (DSEWPaC 2012).

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Ashmore Reef Marine Park is located on Australia's North West Shelf in the Indian Ocean, about 450 nautical miles (840 km) west of Darwin and 330 nautical miles (610 km) north of Broome. The reserve covers 583 km^2 and includes two extensive lagoons, shifting sand flats and cays, seagrass meadows, a large reef flat covering an area of 239 km^2. Within the reserve are three small islands known as East, Middle and West Islands (DoE, 2002).

Ashmore was designated a Ramsar Wetland of International Importance in 2003 due to the importance of its islands providing a resting place for migratory shorebirds and supporting large seabird breeding colonies.

The proclaimed marine park will protect the following conservation values (DoE 2014):

- Ecosystems, habitats and communities associated with; the North West Shelf; Timor Province; and emergent oceanic reefs;
- The island and reef habitats:
  - Contains critical nesting and internesting habitat for green turtles (including one of three genetically distinct breeding populations in the North-west Marine Region). Low level nesting activity by loggerhead turtles has also been recorded;
  - Large and significant feeding populations of green, hawksbill and loggerhead turtles occur around the reefs (it is estimated that approximately 11,000 marine turtles feed in the area throughout the year);
  - Supports a small dugong population of less than 50 individuals that breed and feed around the reef. This population is thought to be genetically distinct from other Australian populations;
  - Migratory pathway for pygmy blue whales (Director of National Parks 2018b);
  - 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;
  - Is an important staging points/feeding areas for many migratory seabirds; and
  - Is internationally significant for its abundance and diversity of sea snakes.
- Two KEFs:
- Ashmore Reef and Cartier Island and surrounding Commonwealth waters; and
- Continental slope demersal fish communities (Director of National Parks 2018b);
- Cultural and heritage sites, including;

- Ashmore lagoon as a rest/staging area for traditional Indonesian fishers
- Indonesian artefacts; and
- Grave sites.
- Commonwealth heritage listing – Ashmore Reef

Ashmore Reef and nearby islands and reefs are associated with benthic communities consisting predominantly of sand and coral rubble, with noteworthy hard coral, soft coral, algae and seagrasses (Heyward *et al.* 2012; Skewes et al., 1999a, 1999b). The reefs host similar benthic communities, with areas of relatively high live coral cover, although episodes of coral bleaching have been recorded (Heyward *et al.* 2012). Benthic organisms that depend on photosynthesis such as seagrasses, macroalgae and zooxanthellate corals are typically restricted to shallower waters around the reefs, although in the clear tropical waters may be found at considerable depths. Given the shallowest sampling location is greater than 60 m, and that most sampling locations are greater than 100 m deep, diverse benthic communities driven by primary producers such as seagrasses, algae and zooxanthellate corals are not expected to occur at the sampling locations. Data collected in the vicinity of Ashmore Reef indicates that corals are likely to spawn during March and April (Heyward *et al.* 2010).

Soft sediments are widespread in the region, with sediment infauna communities in the region dominated by polychaetes and crustaceans. These taxa accounted for over 80% of benthic infauna sampled, both in terms of numbers of species and individual organisms (Smith *et al.* 1997).

Commercial tourism, recreation and scientific research are important socio-economic values of the marine park (Director of National Parks 2018b).

12.3.13 Cartier Island Marine Park

The Cartier Island Marine Park (Sanctuary Zone – IUCN Category Ia) is located approximately 45 km south-east of Ashmore Reef Marine Park and 610 km north of Broome, Western Australia. Both Marine Parks are in Australia's External Territory of Ashmore and Cartier Islands and are also within an area subject to a Memorandum of Understanding (MoU) between Indonesia and Australia, known as the MoU Box. The Marine Park covers an area of 172 km^2 and protects the following conservation values (Director of National Parks 2018b):

+ Ashmore Reef and Cartier Island and surrounding Commonwealth waters;
+ Areas of enhanced productivity in an otherwise low-nutrient environment;
+ Regional importance for feeding and breeding aggregations of birds and marine life;
+ Continental slope demersal fish communities;
+ Area of high diversity in demersal fish assemblages;
+ Area of high diversity and abundance of hard and soft corals, gorgonians (sea fans), sponges and a range of encrusting organisms;
+ Breeding and foraging habitat for seabirds;
+ Internesting, nesting and foraging habitat for marine turtles;
+ Foraging habitat for whale sharks;
+ Internationally significant for its abundance and diversity of sea snakes;
+ One known shipwreck listed under the *Underwater Cultural Heritage Act 2018*: the Ann Millicent (wrecked in 1888).

Scientific research is an important activity in the Marine Park (Director of National Parks 2018b).

12.4 North Marine Park Network

The North Marine Parks Network is aligned to the North Marine Region. The network covers 157,480 km^2 (Director of National Parks 2018c). Broad values of the North Network include:

+ Natural values;
+ Cultural values;
+ Heritage values; and
+ Socio-economic values.

Further detail on the applicable Oceanic Shoals Marine Park is provided below.

12.4.1 Oceanic Shoals Marine Park

The Oceanic Shoals Marine Park (zones within EMBA: Multiple Use Zone - IUCN Category VI- 32,488 km^2; Special Purpose Zone – IUCN VI-24,443 km^2) and is wholly contained within the combined EMBA.

The marine park protects the following conservation values (DoE 2014):

+ Important resting area for turtles between egg laying (internesting area) for the threatened flatback turtle and olive ridley turtle;

+ Important foraging area for the threatened loggerhead turtle and olive ridley turtle;
+ Examples of the ecosystems of two provincial bioregions: the Northwest Shelf Transition Province (which includes the Bonaparte, Oceanic Shoals, and Tiwi meso-scale bioregions) and the Timor Transition Province;
+ KEFs represented in the park are (Director of National Parks 2018c):
  - Carbonate bank and terrace system of the Van Diemen Rise (unique sea-floor feature);
  - Carbonate banks and terrace system of the Sahul Shelf (unique sea-floor feature);
  - Pinnacles of the Bonaparte Basin (enhanced productivity, unique sea-floor feature); and
  - Shelf break and slope of the Arafura Shelf (unique sea-floor feature).

No heritage listings apply to the marine park. Commercial fishing and mining are important socio-economic values for the park (Director of National Parks 2018c).

A spatial predictive benthic habitat model of the Oceanic Shoals Marine Park has been developed by AIMS, as part of the Australian National Environmental Science Programme, to determine the spatial heterogeneity of the benthic environment and key classes of organisms within the reserve. The benthic habitat model maps the 10 broad classes of benthic organisms; alcyons, gorgonians, soft corals, hard corals, halimeda, macroalgae, seagrass, filterers (e.g. sponges), burrowers (e.g. sea urchins) and no biota detected (Radford and Puotinen 2016).

12.4.2 Arafura Marine Park

The Arafura marine park covers 22,924 km^2 and is comprised of a Multiple Use Zone and Special Purpose Zone (Trawl). The marine park is wholly contained within the combined EMBA. It is located approximately 256 km from Darwin and extends to the outer edge of the Exclusive Economic Zone and the water depth ranges from 15 m to 500 m (Director of National Parks 2018c).

The Arafura Marine Park has been deemed significant because “*it contains habitats, species and ecological communities associated with the Northern Shelf Province and Timor Transition. It includes one key ecological feature: the tributary canyons of the Arafura Depression (valued as a unique seafloor feature with ecological properties of regional significance). It is near to important wetland systems including the Cobourg Peninsula Ramsar site, and provides important foraging habitat for seabirds”* (Director of National Parks, 2018c)

The Arafura Marine Park has both cultural and natural values.

The marine park protects the following natural values (Director of National Parks, 2018c):

+ Ecosystems representative of the Northern Shelf Province
+ Ecosystems representative of the Timor Transition
+ BIAs for Marine Turtles
+ BIAs for Seabirds
+ Tributary canyons of the Arafura Depression key ecological features.

The sea country of the marine park is part of the responsibility of the Yuwurrumu members of the Mandilarri-Ilduji, the Mangalara, the Murran, the Gadura-Minaga and the Ngaynjaharr clans. Sea country is valued for Indigenous cultural identity and Indigenous people have been sustainably using and managing their sea country, including the sea country within the Arafura Marine Park for tens of thousands of years (Director of National Parks, 2018c).

12.4.3 Arnhem Marine Park

The Arnhem Marine Park covers an area of 7125 km^2 and water depth ranges from less than 15 m to 70 m. The marine park is entirely comprised of a Special Purpose Zone (VI) and the majorityof the marine park is contained within the combined EMBA. It is located approximately 100 km south-east of Croker Island and 60 km south-east of the Arafura Marine Park. It extends from Northern Territory waters surrounding the Goulburn Islands, to the waters north of Maningrida (Director of National Parks 2018c).

The Arnhem Marine Park has been deemed significant because "*it contains habitats, species and ecological communities associated with the Northern Shelf Province. It includes dynamic habitats due to gently sloping shelf topped with a number of pinnacles, at depths ranging from 5 m to 30 m. It is near to important wetland systems including the Blyth-Cadell Floodplain and Boucaut Bay Nationally Important Wetland and provides important foraging habitat for seabirds*" (Director of National Parks 2018c).

The Arnhem Marine Park has both cultural and natural values.

The marine park protects the following natural values (Director of National Parks, 2018c):

+ Ecosystems representative of the Northern Shelf Province
+ Nutrient-rich coastal water contributing to high biological biodiversity
+ BIAs for Marine Turtles
+ BIAs for Seabirds

The sea country of the marine park is part of the responsibility of the coastal Aboriginal people of West Arnhem land. Sea country is valued for Indigenous cultural identity and Indigenous people have been sustainably using and managing their sea country, including the sea country within the Arnhem Marine Park for tens of thousands of years (Director of National Parks, 2018c).

No heritage listings apply to the marine park. Commercial fishing, tourism and recreation are important socio-economic values for the park (Director of National Parks 2018c).

12.4.4 Joseph Bonaparte Marine Park

The Joseph Bonaparte Gulf Marine Park is located approximately 15 km west of Wadeye, Northern Territory, and approximately 90 km north of Wyndham, Western Australia, in the Joseph Bonaparte Gulf. It is adjacent to the Western Australian North Kimberley Marine Park. The marine park covers an area of 8597 km² and water depth ranges between less than 15 m and 100 m, and is wholly contained within the combined EMBA. The marine park is comprised of two zones; Special Purpose Zone (VI) and Multiple Use Zone (VI) (Director of National Parks, 2018c).

The Joseph Bonaparte Marine Park has been deemed significant because "*it contains habitats, species and ecological communities associated with the Northwest Shelf Transition bioregion. It includes one key ecological feature: the carbonate bank and terrace system of the Sahul Shelf (valued as a unique seafloor feature with ecological properties of regional significance). The Marine Park contains a number of prominent shallow seafloor features including an emergent reef system, shoals, and sand banks. It is near an important wetland systems including the Ord River floodplain Ramsar site and provides connectivity between the nearshore and sea environments. The Marine Park includes habitats connecting to and complementing the adjacent Western Australian North Kimberley Marine Park*" (Director of National Parks, 2018c).

The Joseph Bonaparte Marine Park has both cultural and natural values.

The marine park protects the following natural values (Director of National Parks, 2018c):

+ Ecosystems representative of the Northwest Shelf Transition
+ BIAs for Marine Turtles
+ BIA for the Australian Snubfin Dolphin
+ KEFs represented in the park are:
    - Carbonate bank and terrace system of the Sahul Shelf (unique sea-floor feature)

The sea country of the marine park is part of the responsibility of the Miriuwung, Gajerrong, Doolboong, Wardenybeng and Gija and Balangarra people. Sea country is valued for Indigenous cultural identify and

Indigenous people have been sustainably using and managing their sea country, including the sea country within the Arnhem Marine Park for tens of thousands of years (Director of National Parks, 2018c).

No heritage listings apply to the marine park, however the marine park is adjacent to the West Kimberly National Heritage Place. Tourism, commercial fishing, mining and recreation are important socio-economic values for the park (Director of National Parks 2018c).

Table 12-1 Summary of marine network values, pressures, management programs and actions applicable to the combined EMBA

Marine network	Values	Pressures	Management programs and actions
SOUTH WEST	+ Nine bioregions + Key ecological features + EPBC listed species + Biologically important areas + Sea country indigenous values + Historic shipwrecks + Adjacent to Shark Bay World Heritage Area + Shipping and port activities + Commercial fishing + Marine tourism	+ Climate change + Hydrological changes from coastal development and agriculture (increase sediment loads and pollutants) + Illegal/unregulated/unreported fishing + Bycatch of non-target species + Habitat modification from mining + Human presence + Invasive species + Marine pollution	+ Communication, education and awareness programs + Promote suitable tourism experience + Facilitate partnerships between tourism operators and Indigenous operators + Indigenous engagement program + Marine monitoring programs + Park management via assessments / authorisation program for marine park activities + Marine park management and development of suitable infrastructure + Compliance planning and surveillance

Marine network	Values	Pressures	Management programs and actions
NORTH WEST	+ Eight bioregions + Key ecological features + EPBC listed species + Biologically important areas + Sea country indigenous values + Native title determinations + Traditional Indonesian fishers + World Heritage Properties (Ningaloo Coast, Shark Bay) + Ashmore Reef Marine Park and Eighty-Mile Beach Ramsar sites + Shipping and port activities + Commercial fishing, pearling, aquaculture + Marine tourism + Scientific research	+ Climate change + Hydrological changes from coastal development and agriculture (increase sediment loads and pollutants) + Illegal/unregulated/unreported fishing + Bycatch of non-target species + Habitat modification from mining + Human presence + Invasive species + Marine pollution	+ Communication, education and awareness programs + Promote suitable tourism experience + Facilitate partnerships between tourism operators and Indigenous operators + Indigenous engagement program + Marine monitoring programs + Park management via assessments / authorisation program for marine park activities + Marine park management and development of suitable infrastructure + Compliance planning and surveillance
NORTH	+ One bioregion + Key ecological features + EPBC listed species + Biologically important areas + Historic shipwrecks	+ Climate change + Hydrological changes reliance upon the large number of estuaries and waterways that feed into the Gulf of Carpentaria and the waters adjacent to the Northern Territory coastline + Illegal/unregulated/unreported fishing + Bycatch of non-target species + Physical Habitat modification + Marine pollution	+ Communication, education and awareness programs + Promote suitable tourism experience + Facilitate partnerships between tourism operators and Indigenous operators + Indigenous engagement program + Marine monitoring programs + Park management via assessments / authorisation program for marine park activities + Marine park management and development of suitable infrastructure + Compliance planning and surveillance

13. Conservation Management Plans

In order to protect, maintain and enhance recovery of certain threatened species and ecological communities the DAWE may prepare conservation management plans in the form of Conservation Advice or Recovery Plans.

13.1 Conservation Advice

When a native species or ecological community is listed as threatened under the EPBC Act, conservation advice is developed to assist its recovery. Conservation advice provides guidance on immediate recovery and threat abatement activities that can be undertaken to ensure the conservation of a newly listed species or ecological community.

13.2 Recovery Plans

The Australian Government Minister for the Environment may make or adopt and implement recovery plans for threatened fauna, threatened flora (other than conservation dependent species) and threatened ecological communities listed under the Commonwealth EPBC Act. Recovery plans set out the research and management actions necessary to stop the decline of, and support the recovery of, listed threatened species or threatened ecological communities. The aim of a recovery plan is to maximise the long-term survival in the wild of a threatened species or ecological community.

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Table 13-1: Summary of EPBC Act recovery plans applicable to the combined EMBA

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
Bird	Australian lesser noddy	Approved Conservation Advice for *Anous tenuirostris melanops* (Australian lesser noddy) (2015)	Habitat modification by pied cormorants (Houtman Abrolhos)
			Catastrophic destruction of habitat by cyclones
	Migratory species within the combined EMBA: + Asian dowitcher; + Bar-tailed godwit; + Black-tailed godwit; + Broad-billed sandpiper; + Common greenshank; + Common redshank; + Common sandpiper; + Curlew Sandpiper; + Double-banded plover; + Eastern Curlew; + Fork-tailed swift; + Grey plover; + Grey-tailed tattler; + Long-toed stint; + Little greenshank + Oriental plover; + Oriental pratincole; + Pacific golden plover; + Pectoral sandpiper; + Red-necked phalarope;	Wildlife Conservation Plan for Migratory Shorebirds (2015)	Habitat loss and degradation
			Pollution and Contaminants
			Invasive species
			Anthropogenic disturbance
			Climate change and variability
			Overharvesting of shorebird prey
			Fisheries bycatch
			Direct mortality (hunting)

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
	+ Red-necked stint; + Red knot; + Ruddy turnstone; + Ruff (reeve); + Sanderling; + Sharp-tailed sandpiper; + Streaked shearwater; + Terek sandpiper; + Whimbrel; and + Wood sandpiper.		
	Christmas Island frigatebird	Conservation Advice for the Christmas Island frigatebird *Fregata andrewsi* (2020a) Recovery Plan for the Christmas Island Frigatebird (*Fregeta andrewsi*) (2004)	Introduction of a new disease
			Disturbance of habitat
			Fisheries – prey depletion
			Illegal killing and hunting in south-east Asia
			Invasive weeds
			Fisheries - bycatch
			Drowning in artificial water bodies
			Heavy metal contamination
			Marine debris - plastics
	Australasian bittern	Conservation Advice for *Botaurus poiciloptilus* (Australasian Bittern) (2019)	habitat loss through water reductions and transition from ponded rice to other farming systems
			habitat degradation through increased salinity, siltation and pollution; grazing by livestock and feral animalsan d changes in abundance of plant species
			Climate change through changes in water availability; changes in fire regimes and salinisation of coastal wetlands
			Infrastructure through urban development

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Predation by introduced vertebrate pests such as foxes and cats
	Red knot	Approved Conservation Advice for *Calidris canutus* (Red knot) (2016) Wildlife Conservation Plan for Migratory Shorebirds (2015)	Habitat loss and habitat degradation
			Over-exploitation of shellfish
			Pollution/contamination impacts
			Disturbance
			Direct mortality (hunting)
			Diseases
			Extreme weather events
			Climate change impacts
	Curlew sandpiper	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (2015)	Ongoing human disturbance
			Habitat loss and degradation from pollution
			Changes to the water regime
			Invasive plants
	Great knot	Approved Conservation Advice for *Calidris tenuirostriss* (Great knot) (2016) Wildlife Conservation Plan for Migratory Shorebirds (2015).	Habitat loss and habitat degradation
			Pollution/contaminants
			Disturbance
			Diseases
			Direct mortality (hunting)
			Climate change impacts
	Greater sand plover	Approved Conservation Advice for *Charadrius leschenaultii* (Greater sand plover) (2016) Wildlife Conservation Plan for Migratory Shorebirds (2015)	Habitat loss and habitat degradation
			Pollution/contamination impacts
			Disturbance
			Direct mortality (hunting)

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Diseases
			Climate change impacts
	Lesser sand plover	Approved Conservation Advice for *Charadrius mongolus* (Lesser sand plover) (2016) Wildlife Conservation Plan for Migratory Shorebirds (2015)	Habitat loss and habitat degradation
			Pollution/contamination impacts
			Disturbance
			Direct mortality (hunting)
			Diseases
			Climate change impacts
	Antipodean albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution
			Climate change
			Intentional shooting/killing
			Feral pest species
			Human disturbance at the nest
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space
	Amsterdam albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Climate change
			Intentional shooting/killing
			Feral pest species
			Human disturbance at the nest
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space
	Tristan albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution
			Climate change
			Intentional shooting/killing
			Feral pest species
			Human disturbance at the nest
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space
	Southern royal albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution
			Climate change

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Intentional shooting/killing
			Feral pest species
			Human disturbance at the nest
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space
	Wandering albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution
			Climate change
			Intentional shooting/killing
			Feral pest species
			Human disturbance at the nest
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space
	Northern royal albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution
			Climate change
			Intentional shooting/killing

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Feral pest species
			Human disturbance at the nest
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space
	Blue petrel	Approved Conservation Advice for *Halobaena caerulea* (blue petrel) (2015)	Habitat loss, disturbance and modification
			Predation
	Western Alaskan bar-tailed godwit	Wildlife Conservation Plan for Migratory Shorebirds (2015) Approved Conservation Advice for *Limosa lapponica baueri* (Bar-tailed godwit (western Alaskan)) (2016)	Habitat loss and habitat degradation
			Over-exploitation of shellfish
			Pollution/contamination impacts
			Disturbance
			Direct mortality (hunting)
			Diseases
			Extreme weather events
			Climate change impacts
	Northern Siberian bar-tailed godwit	Approved Conservation Advice for *Limosa lapponica menzbieri* (Bar-tailed godwit (northern Siberian)) (2016)	Habitat loss and habitat degradation
			Over-exploitation of shellfish
			Pollution/contamination impacts
			Disturbance
			Direct mortality (hunting)
			Diseases
			Extreme weather events
			Climate change impacts

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
	Southern giant petrel	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution
			Climate change
			Intentional shooting/killing
			Feral pest species
			Human disturbance at the nest
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space
	Northern giant petrel	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution
			Climate change
			Intentional shooting/killing
			Feral pest species
			Human disturbance at the nest
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space
	Eastern curlew		Ongoing human disturbance

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
		Approved Conservation Advice *for Numenius madagascariensis* (eastern curlew) (2015)	Habitat loss and degradation from pollution
			Changes to the water regime
			Invasive plants
	Fairy prion (southern)	Approved Conservation Advice for *Pachyptila turtur subantarctica* (fairy prion (southern)) (2015)	Competition with blue petrels
			Soil erosion
			Fire
	Abbott's booby	Conservation Advice for the Abbott's booby *Papasula abbotti* (2020b)	Vegetation clearing – edge effects from previous clearing and new vegetation clearing
			Climate change – severe storm events and prey depletion
			Introduction of a new disease
			Invasive weeds
			Yellow crazy ants – habitat modification
			Fisheries – prey depletion
			Marine debris - plastics
	Christmas Island white-tailed tropicbird	Conservation Advice for *Phaethon lepturus fulvus* white-tailed tropicbird (Christmas Island) (2014)	Introduced predators on Christmas Island
			Crazy ants
	Sooty albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution
			Climate change
			Intentional shooting/killing
			Feral pest species
			Human disturbance at the nest

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space
	Soft-plumaged petrel	Approved Conservation Advice for *Pterodroma mollis* (soft-plumaged petrel) (2015)	Accidental introduction of predators (relevant only to Maatsuyker Island, located offshore of Tasmania)
	Australian painted snipe	Commonwealth Conservation Advice on *Rostratula australis* (Australian painted snipe) (2013)	Loss and degradation of wetlands, through drainage and the diversion of water for agriculture and reservoirs
			Grazing and associated trampling of wetland vegetation/nests, nutrient enrichment and disturbance to substrate by livestock
			Climate change
			Predation by feral animals
			Introduction of weeds
	Australian fairy tern	Commonwealth Conservation Advice on *Sternula nereis nereis* (fairy tern) (2011)	Predation by introduced mammals and native birds
			Disturbance by humans, dogs and vehicles
			Increasing salinity in waters adjacent to Fairy Tern colonies
			Irregular water management
			Weed encroachment
			Oil spills, particularly in Victoria (potential threat)
	Indian yellow-nosed albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution
			Climate change
			Intentional shooting/killing

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Feral pest species
			Human disturbance at the nest
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space
	Shy albatross	Conservation Advice *Thalassarche cauta* Shy Albatross (2020c) National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Fisheries bycatch
			Disease
			Competition for nesting habitat
			Marine plastics
			Human disturbance
			Previous harvesting for feathers and eggs
			Climate change
	White-capped albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution
			Climate change
			Intentional shooting/killing
			Feral pest species
			Human disturbance at the nest
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
	Campbell albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution
			Climate change
			Intentional shooting/killing
			Feral pest species
			Human disturbance at the nest
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space
	Black-browed albatross	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (2011)	Incidental catch resulting from fishing operations
			Competition with fisheries for marine resources
			Dependence on discards
			Marine pollution
			Climate change
			Intentional shooting/killing
			Feral pest species
			Human disturbance at the nest
			Parasites and diseases
			Loss of nesting habitat
			Competition for nest space
Mammals	Sei whale		Climate and oceanographic variability and change

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
		Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (2015)	Anthropogenic noise and acoustic disturbance
			Habitat degradation including pollution (increasing port expansion and coastal development)
			Pollution (persistent toxic pollutants)
			Vessel strike
			Prey depletion due to fisheries (potential threat)
			Resumption of commercial whaling (potential threat)
	Blue whale	Blue Whale Conservation Management Plan 2015 - 2025 (2015)	Whaling
			Climate Variability and Change
			Noise Interference
			Habitat Modification
			Vessel Disturbance
			Overharvesting of prey
	Fin whale	Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (2015)	Climate and oceanographic variability and change
			Anthropogenic noise and acoustic disturbance
			Habitat degradation including coastal development, port expansion and aquaculture
			Pollution (persistent toxic pollutants)
			Fisheries catch, entanglement and bycatch
			Vessel strike
			Resource depletion due to fisheries (potential threat)
			Resumption of commercial whaling (potential threat)
	Southern right whale	Conservation Management Plan for the Southern Right Whale 2011 – 2021 (2012)	Entanglement
			Vessel disturbance
			Whaling

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Climate variability and change
			Noise interference
			Habitat modification
			Overharvesting of prey
	Humpback whale	Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (2015)	Whaling
			Climate and Oceanographic Variability and Change
			Overharvesting of Prey
			Noise Interference
			Habitat degradation including coastal development and port expansion
			Entanglement
			Vessel disturbance and strike
	Australian sea-lion	Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (2013)	Fishery bycatch (primary threat)
			Entanglement in marine debris (primary threat)
			Marine aquaculture
			Habitat degradation
			Human disturbance
			Direct killing (primary threat)
			Disease
			Pollution and oil spills
			Noise
			Competition and prey depletion
			Climate change

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
Reptiles	Short-nosed seasnake	Approved Conservation Advice on *Aipysurus apraefrontalis* (Short-nosed seasnake) (2011)	Degradation of reef habitat, primarily as a result of coral bleaching (primary threat)
			Oil and gas exploration
			Incidental catch and death in commercial prawn trawling fisheries
	Leaf-scaled seasnake	Approved Conservation Advice on *Aipysurus foliosquama* (Leaf-scaled seasnake) (2011)	Degradation of reef habitat, primarily as a result of coral bleaching (primary threat)
			Oil and gas exploration
			Incidental catch and death in commercial prawn trawling fisheries (north-west marine area)
			Unsustainable and illegal fishing practices (currently the most significant threat in the Ashmore region)
	Loggerhead turtle	Recovery plan for marine turtles in Australia 2017 – 2027 (2017) Loggerhead turtle – WA genetic stock	Fisheries bycatch – international (moderate), domestic (high)
			Indigenous take (moderate)
			Terrestrial predation (moderate)
			Habitat modification – infrastructure/coastal development (moderate), dredging/trawling (moderate)
			Chemical and terrestrial discharge – acute (high), chronic (low)
			Marine debris – entanglement and ingestion (moderate; unknown)
			Climate change and variability (high)
			International take – outside Australia's jurisdiction (moderate), within Australia's jurisdiction (low)
			Light pollution (moderate)
			Vessel disturbance (moderate)
			Noise interference – acute (moderate), chronic (moderate; unknown)
			Recreational activities (low)
			Diseases and pathogens (low; unknown)
			Fisheries bycatch – international (moderate), domestic (high)

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Cumulative impacts of threats
	Green turtle	Recovery plan for marine turtles in Australia 2017 – 2027 (2017) Green turtle – NWS genetic stock (NWS), Scott-Browse genetic stock (ScBr), Ashmore genetic stock (AR)	Fisheries bycatch – international (moderate), domestic (moderate)
			Indigenous take (moderate)
			Terrestrial predation NWS – moderate, AR –high; unknown, ScBr – moderate; unknown)
			Habitat modification – infrastructure/coastal development (NWS – moderate, AR – low, ScBr – high), dredging/trawling (NWS – moderate, AR – low, ScBr – low)
			Chemical and terrestrial discharge – acute (NWS, AR, ScBr –high), chronic (NWS – moderate, AR – high, ScBr – high)
			Marine debris – entanglement (NWS – moderate, AR – very high, ScBr – moderate; unknown) and ingestion (NWS – low; unknown, AR – moderate, ScBr – moderate)
			Climate change and variability (NWS – moderate, AR – very high, ScBr – high)
			International take – outside Australia's jurisdiction (moderate; unknown for NWS and ScBr), within Australia's jurisdiction (moderate; unknown for NWS and ScBr)
			Light pollution (NWS – high, AR – moderate, ScBr – moderate)
			Vessel disturbance (moderate)
			Noise interference – acute (NWS – moderate; unknown, AR – low, ScBr – moderate), chronic (NWS – moderate; unknown, AR – low, ScBr – moderate; unknown)
			Recreational activities
			Diseases and pathogens (low; unknown for AR and ScBr)
			Cumulative impacts of threats
	Leatherback turtle	Approved Conservation Advice on *Dermochelys coriacea* (2008)	Incidental capture in commercial fisheries
			Harvest of eggs and meat
			Ingestion of marine debris
			Boat strike
			Predation on eggs by wild dogs, pigs and monitor lizards

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Degradation of foraging areas
			Changes to breeding sites
		Recovery plan for marine turtles in Australia 2017 – 2027 (2017)	Fisheries bycatch – international (high), domestic (high)
			Indigenous take (low)
			Terrestrial predation (moderate; unknown)
			Habitat modification – infrastructure/coastal development (moderate), dredging/trawling (low)
			Chemical and terrestrial discharge – acute (low), chronic (low; unknown)
			Marine debris – entanglement (moderate) and ingestion (high)
			Climate change and variability (high)
			International take – outside Australia's jurisdiction (high), within Australia's jurisdiction (low)
			Light pollution (low)
			Vessel disturbance (moderate)
			Noise interference – acute (low; unknown), chronic (low; unknown)
			Recreational activities (low)
			Diseases and pathogens (low; unknown)
			Fisheries bycatch – international (high), domestic (high)
			Cumulative impacts of threats
	Hawksbill turtle	Recovery plan for marine turtles in Australia 2017 – 2027 (2017) Hawksbill turtle – WA genetic stock	Fisheries bycatch – international (moderate), domestic (moderate)
			Indigenous take (moderate)
			Terrestrial predation (moderate)
			Habitat modification – infrastructure/coastal development (moderate), dredging/trawling (moderate)

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Chemical and terrestrial discharge – acute (moderate), chronic (moderate)
			Marine debris – entanglement (moderate) and ingestion (low; unknown)
			Climate change and variability (high)
			International take – outside Australia's jurisdiction (very high), within Australia's jurisdiction (moderate)
			Light pollution (high)
			Vessel disturbance (moderate)
			Noise interference – acute (moderate), chronic (moderate; unknown)
			Recreational activities (low)
			Diseases and pathogens (low; unknown)
			Cumulative impacts of threats
	Olive ridley turtle	Recovery plan for marine turtles in Australia 2017 – 2027 (2017) Olive ridley turtle – Northern Territory genetic stock	Fisheries bycatch – international (moderate), domestic (high)
			Indigenous take (moderate)
			Terrestrial predation (moderate; unknown)
			Habitat modification – infrastructure/coastal development (low), dredging/trawling (low)
			Chemical and terrestrial discharge – acute (high), chronic (moderate)
			Marine debris – entanglement (very high) and ingestion (moderate; unknown)
			Climate change and variability (very high)
			International take – outside Australia's jurisdiction (moderate), within Australia's jurisdiction (moderate)
			Light pollution (moderate)
			Vessel disturbance (moderate)
			Noise interference – acute (low), chronic (low; unknown)
			Recreational activities (low)

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Diseases and pathogens (low; unknown)
			Cumulative impacts of threats
	Flatback turtle	Recovery plan for marine turtles in Australia 2017 – 2027 (2017) Flatback turtle – Pilbara coast genetic stock (Pil), South-west Kimberley coast genetic stock (swKim) and Cape Domett (CD)	Fisheries bycatch – international (low), domestic (moderate)
			Indigenous take (moderate)
			Terrestrial predation (moderate)
			Habitat modification – infrastructure/coastal development (Pil – high, swKim – moderate), dredging/trawling (moderate)
			Chemical and terrestrial discharge – acute (high), chronic (moderate)
			Marine debris – entanglement (moderate) and ingestion (low)
			Climate change and variability (Pil – high, swKim – moderate)
			International take – outside Australia's jurisdiction (low), within Australia's jurisdiction (low)
			Light pollution (Pil – high, swKim – moderate)
			Vessel disturbance (moderate)
			Noise interference – acute (moderate), chronic (moderate; unknown)
			Recreational activities (Pil – low, swKim – moderate)
			Diseases and pathogens (low; unknown)
			Cumulative impacts of threats
Sharks and fish	Grey nurse shark	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (2014)	Mortality due to incidental capture by commercial and recreational fisheries
			Mortality die to shark control programs
			Ecotourism
			Public aquarium trade
			Pollution and disease
			Ecosystem effects - habitat modification and climate change

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
	Great white shark	Recovery plan for the White Shark (*Carcharodon carcharias*) (2013)	Mortality related to being caught accidentally (bycatch) or illegally (targeted) by commercial and recreational fisheries, including issues of post release mortality
			Mortality related to shark control activities such as beach meshing or drumlining (east coast population)
			Illegal trade in white shark products
			Ecosystem effects as a result of habitat modification and climate change
			Ecotourism
	Northern river shark	Approved Conservation Advice for *Glyphis garricki* (northern river shark) (2014)	Commercial fishing activities
			Recreational fishing
			Indigenous fishing
			Illegal, unreported and unregulated fishing
			Habitat degradation and modification
			Marine debris
			Collection of animals for display in public aquaria (no known occurrences to date)
		Sawfish and River Sharks Multispecies Recovery Plan (2015)	Fishing activities including: being caught as by-catch in the commercial and recreational sectors; through indigenous fishing; and illegal, unreported and unregulated fishing
			Habitat degradation and modification
	Dwarf sawfish	Approved Conservation Advice on *Pristis clavata* (dwarf sawfish) (2009)	Being caught as bycatch in commercial and recreational net fishing
			Illegal, unreported and unregulated fishing
			Habitat degradation due to increasing human development
		Sawfish and River Sharks Multispecies Recovery Plan (2015)	Fishing activities including: being caught as by-catch in the commercial and recreational sectors; through indigenous fishing; and illegal, unreported and unregulated fishing
			Habitat degradation and modification
	Freshwater sawfish	Approved Conservation Advice for *Pristis pristis* (largetooth sawfish) (2014)	Commercial fishing activities
			Recreational fishing

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
			Indigenous fishing
			Illegal, unreported and unregulated fishing
			Habitat degradation and modification
			Marine debris
			Collection of animals for display in public aquaria
		Sawfish and River Sharks Multispecies Recovery Plan (2015)	Fishing activities including: being caught as by-catch in the commercial and recreational sectors; through indigenous fishing; and illegal, unreported and unregulated fishing
			Habitat degradation and modification
	Green sawfish	Approved Conservation Advice for *Pristis zijsron* (green sawfish) (2008)	Capture as bycatch and byproduct in gillnet and trawl fisheries
			Illegal capture for fins and rostra
			Habitat degradation through coastal development
		Sawfish and River Sharks Multispecies Recovery Plan (2015)	Fishing activities including: being caught as by-catch in the commercial and recreational sectors; through indigenous fishing; and illegal, unreported and unregulated fishing
			Habitat degradation and modification
	Whale shark	Approved Conservation Advice for *Rhincodon typus* (whale shark) (2015)	Intentional and unintentional mortality from fishing outside of Australian waters
			Boat strike from large vessels
			Habitat disruption from mineral exploration, production and transportation
			Disturbance from domestic tourism operations
			Marine debris
			Climate change
	Blind gudgeon	Approved Conservation Advice for *Milyeringa veritas* (blind gudgeon) (2008)	Habitat degradation and modification associated with sedimentation from mining/construction, canal development, water abstraction, point source pollution from sewage, landfill, dumping and mining; and diffuse pollution from urban development/ petroleum infrastructure

Taxa	Common name	Recovery Plan / Conservation Advice	Threats
	Blind cave eel	Approved Conservation Advice for *Ophisternon candidum* (blind cave eel) (2008)	Habitat degradation and modification associated with sedimentation from mining/construction, canal development, water abstraction, point source pollution from sewage, landfill, dumping and mining; and diffuse pollution from urban development
	Balston's pygmy perch	Approved Conservation Advice for *Nannatherina balstoni* (Balston's pygmy perch) (2008)	Habitat degradation and modification associated with flow and increased salinisation, siltation and eutrophication that occur through changes to flow regimes (regulation and abstraction), road maintenance, mineral sand exploration and mining, ground water extraction and agricultural and forestry practices in the uppermost catchment
	Black-stripe minnow	Approved Conservation Advice for *Galaxiella nigrostriatal* (Black-striped minnow) (2018)	Climate change – increased air and water temperatures, decreased rainfall, increased evaporation, lowering groundwater table.
			Invasive species (*Gambusia holbrooki*), aggressive interactions and competition

14. Social, Economic and Cultural Features

14.1 Industry

In 2018/19, Western Australia's petroleum industry was worth $38.4 billion per annum. The petroleum sector accounted for 26% of the total value of WA's mineral and petroleum sales in 2018/19, with 20 per cent of all mineral and petroleum sales coming from Liquefied Natural Gas (LNG). Currently Western Australia has four operating LNG projects; the North West Shelf, Gorgon, Pluto and Wheatstone. There are also a number of Floating Production and Storage Offtake (FPSO) facilities in the Timor Sea and North West Shelf, as denoted on **Figure 14-1, Figure 14-2** and **Figure 14-3**. Offshore development is focussed in the Carnarvon Basin, Browse Basin and on the North West Shelf (DMP 2014). There are also domestic gas plants on Varanus Island in the North West Shelf, Devil Creek Onshore Gas Plant and Macedon Gas Plant in the Pilbara region and an oil facility near Dongara called Cliff Head. There are several exploration and production permits and leases throughout WA and Commonwealth waters in the combined EMBA. Existing petroleum infrastructure, permits and licences are shown in **Figure 14-1, Figure 14-2** and **Figure 14-3**.

14.2 Other Infrastructure

The Jasuraus submarine communication cable links Australia with Indonesia. The cable was installed as a link from Australia to provide telephone services connection to the world in 1995-1996. Travelling north out of Port Hedland for approximately 210 km the cable then heads north-west toward Jakarta, Indonesia. The cable runs up through Permit Areas WA-435-P and WA437-P. Its capacity and major role was overtaken in 2000 by other subsea cables out of Australia. However, Telstra continues to manage the cable as it remains an emergency backup link out of Australia. The cable includes two submerged repeaters in the wider region.

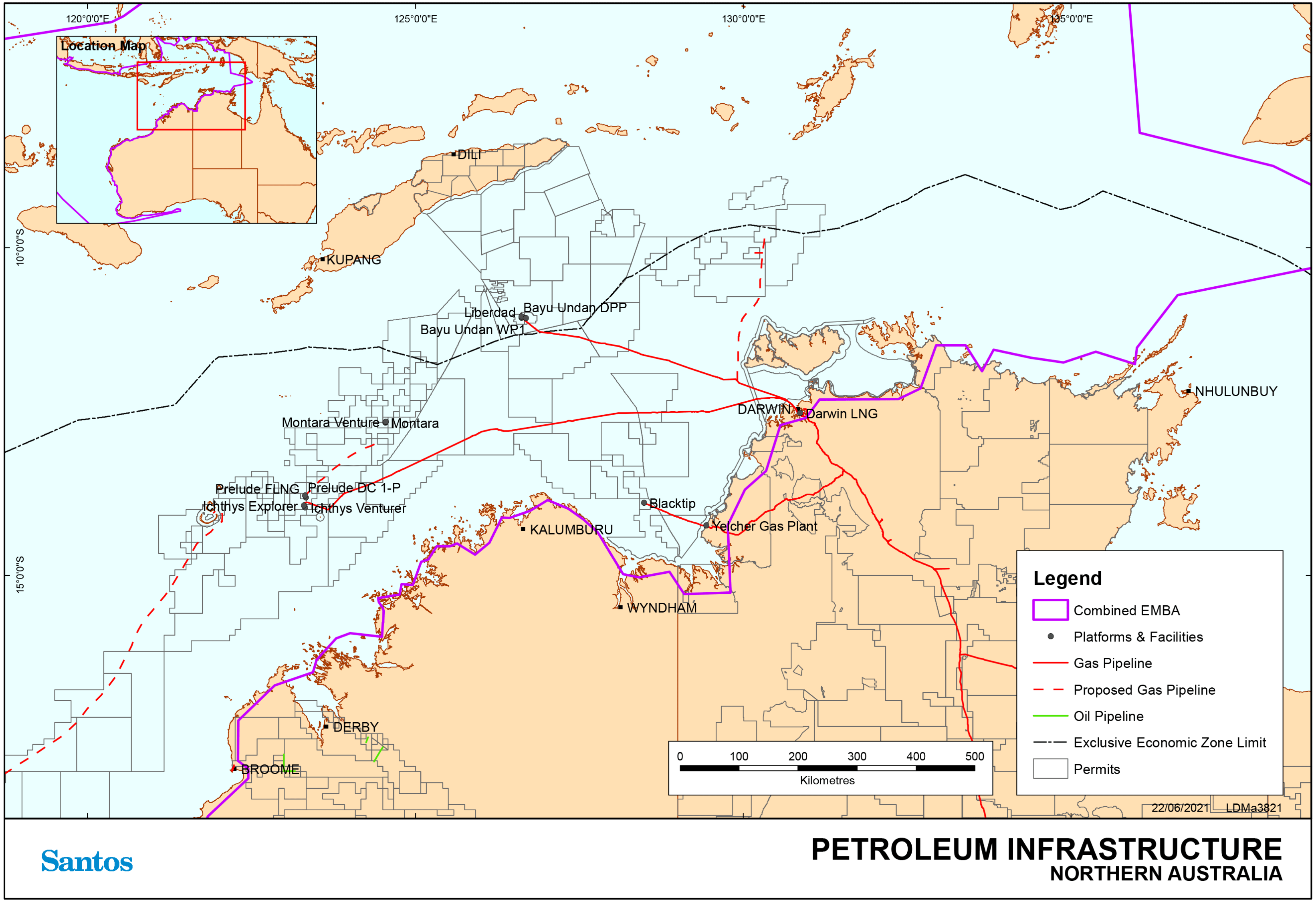

Figure 14-1: Existing petroleum infrastructure, permits and licences – Northern WA

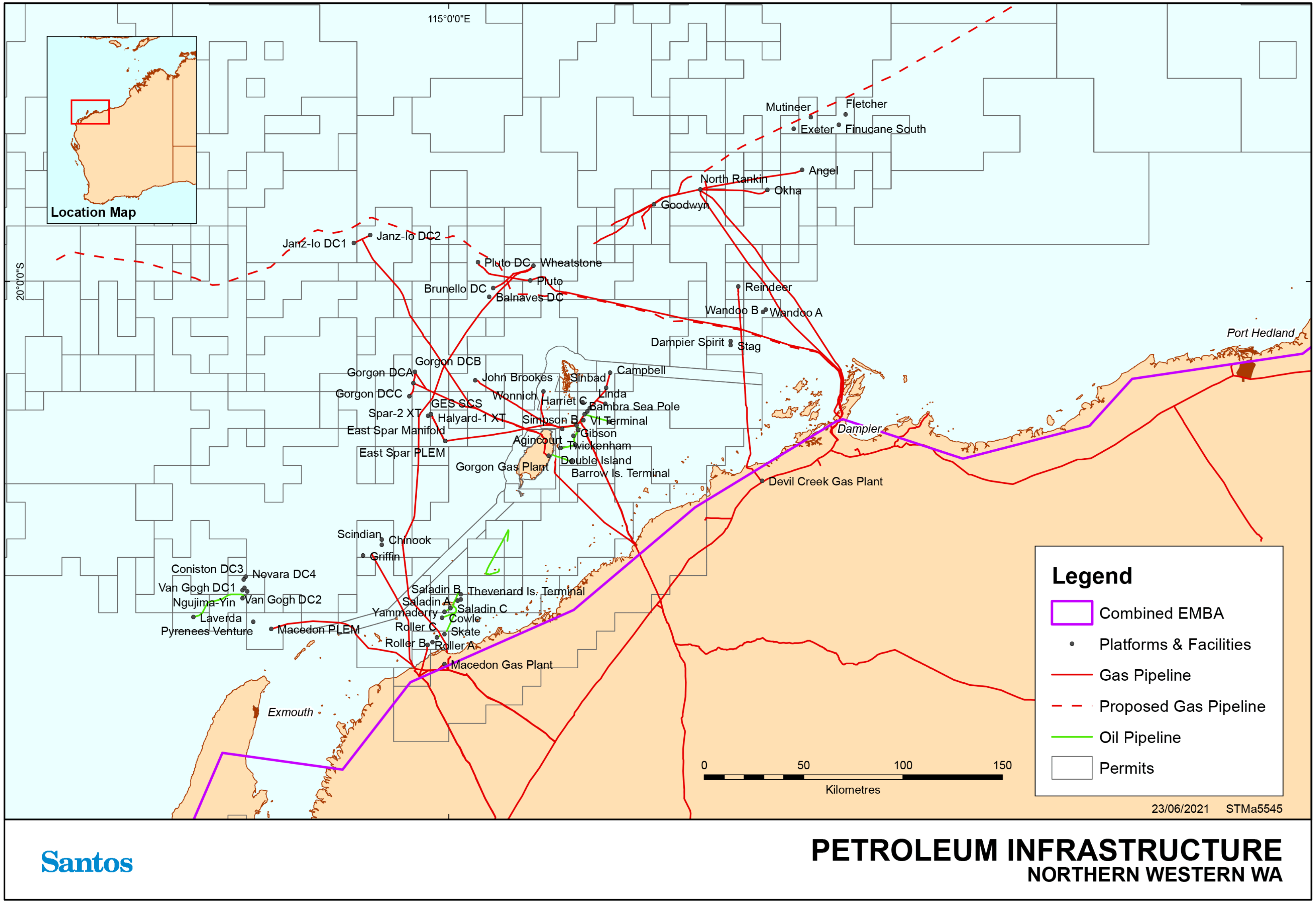

Figure 14-2: Existing petroleum infrastructure, permits and licences – Northern Western WA

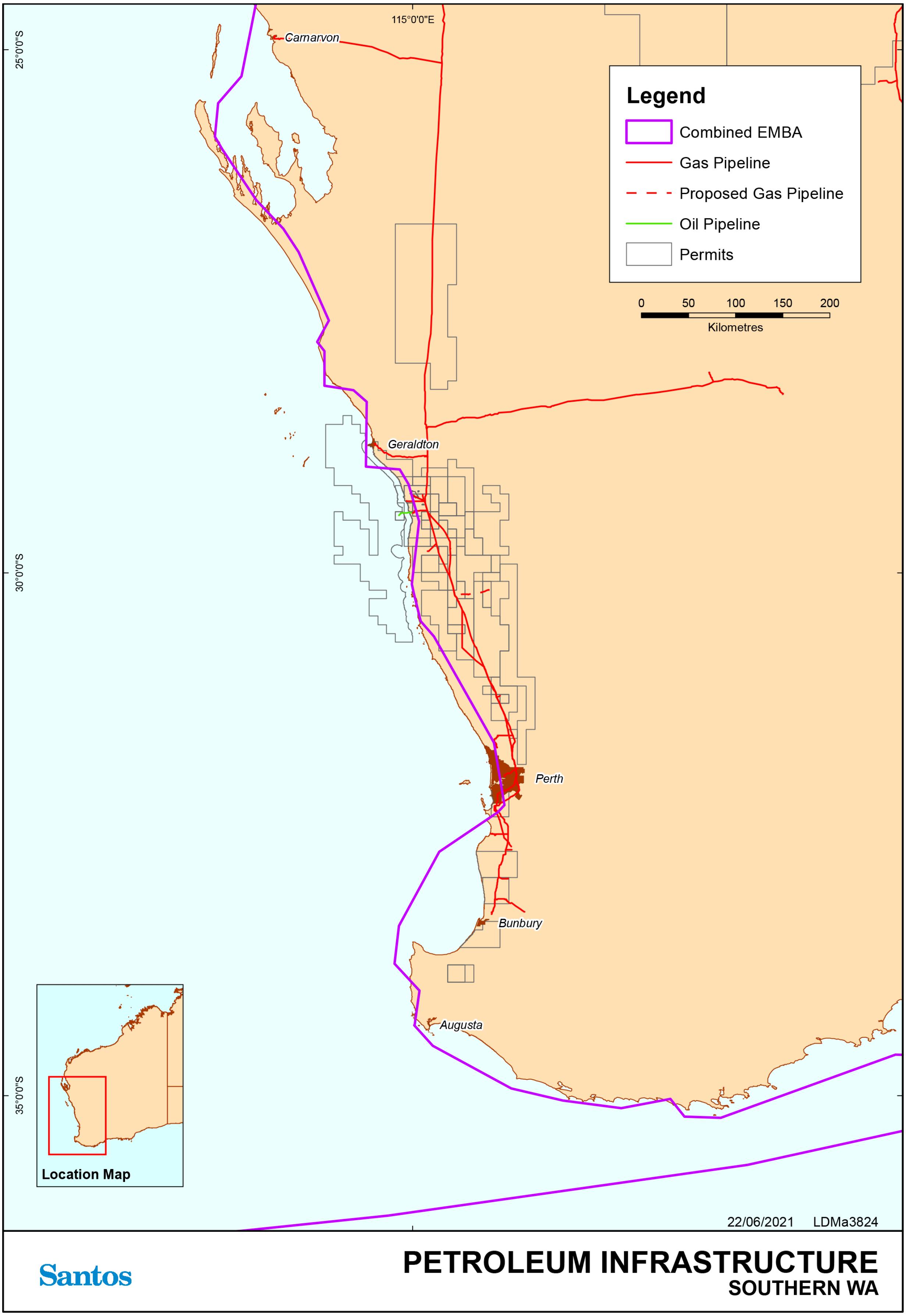

Figure 14-3: Existing petroleum infrastructure, permits and licences –Southern WA

14.3 Shipping

The Western Australian coastline supports twelve ports including the major ports of Dampier, Port Hedland and Broome which are operated by their respective port authorities. Large cargo vessels move through the region to and from Fremantle, transiting along coastline. Commercial shipping also moves to and from marine terminals associated with the oil and gas industry (see **Section 14.1**). Other large ports include Geraldton, Busselton, Albany and Esperance. Closer proximity shipping also includes construction vessels/barges/dredges, domestic support vessels, and offshore survey vessels.

The Australian Maritime Safety Authority (AMSA) has established a network of shipping fairways off the north-west coast of Australia to manage traffic patterns (AMSA 2013). The Shipping Fairways are designed to keep shipping traffic away from offshore infrastructure and aims to reduce the risk of collision (AMSA 2013).

Use of the fairways is strongly recommended but not mandatory. The International Regulations for *Preventing Collisions at Sea 1972* apply to all vessels navigating within or outside the shipping fairways. The use of these fairways does not give vessels any special right of way (AMSA 2012).

Under the *Commonwealth Navigation Act 2012*, certain vessels operating in Australian waters are required to report their location on a daily basis to the Rescue Coordination Centre (RCC) in Canberra. This Australian Ship Reporting System (AUSREP) is an integral part of the Australian Maritime Search and Rescue system and is operated by AMSA through the RCC. Vessels recorded in waters in the combined EMBA through the AUSREP system in 2021 are shown in **Figure 14-4**.

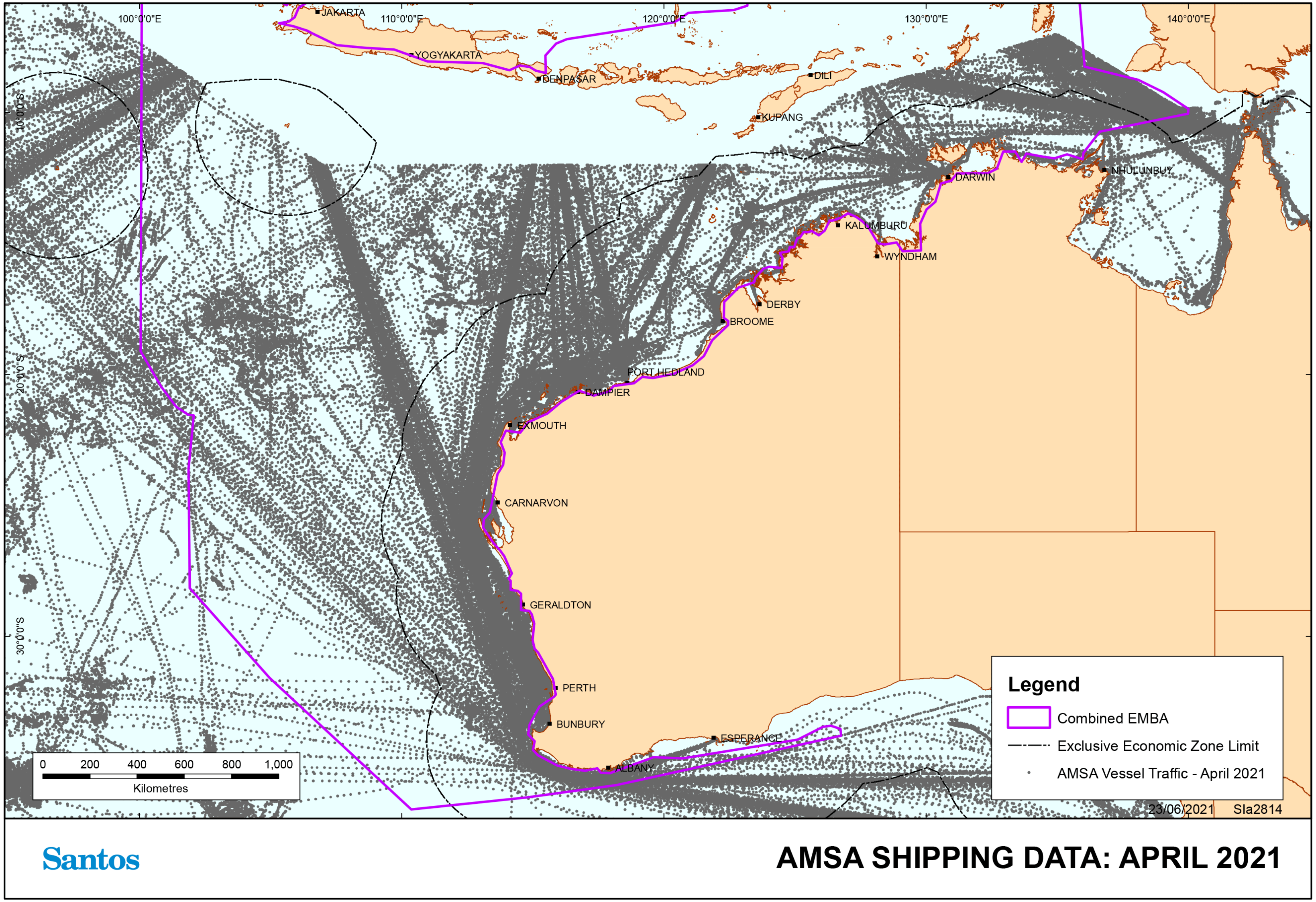

Figure 14-4:AMSA ship locations and shipping routes

14.4 Defence Activities

Key defence bases and facilities are illustrated in **Figure 14-5.**

The Naval Communication Station Harold E. Holt is located on the northwest coast of Australia, 6 km north of Exmouth. The town of Exmouth was built at the same time as the communications station to provide support to the base and to house dependent families of US Navy personnel (Shire of Exmouth 2018, DoE 2014).

The station provides very low frequency radio transmission to US Navy and Royal Australian Navy ships and submarines in the western Pacific Ocean and eastern Indian Ocean. With a transmission power of 1 megawatt, it is the most powerful transmission station in the southern hemisphere (Shire of Exmouth 2018, DoE 2014).

Two Royal Australian Airforce (RAAF) bases are located in the northwest of WA; Learmonth RAAF Base, near Exmouth and Curtin RAAF Base near Derby (RAAF 2014).

Designated military exercise areas occur over waters and airspace of the north west of WA and may be activated following the required notifications.

Additional defence activities that occur within the combined EMBA include:

+ Broome training depot;
+ Exmouth admin and high frequency transmitting;
+ Exmouth Very Low Frequency transmitting station;
+ Geraldton training depot “A” Company 16th Battalion;
+ HMAS Stirling-Rockingham;
+ HMAS Stirling-Garden Island;
+ Karratha training depot;
+ Learmonth – air weapons range;
+ Learmonth radar site – Vlaming Head Exmouth; and
+ Yampi Sound training area.
+ Bradshaw Defence field training area
+ Artillery Barracks – Fremantle
+ Camble Barracks- Swanborne
+ Irwin Barracks – Karrakatta
+ Lancelin Training Area
+ Leeuwin Barracks- East Fremantle
+ Preston Point Training Depot
+ Rockingham – Navy CPSO
+ Swanbourne Rifle Range

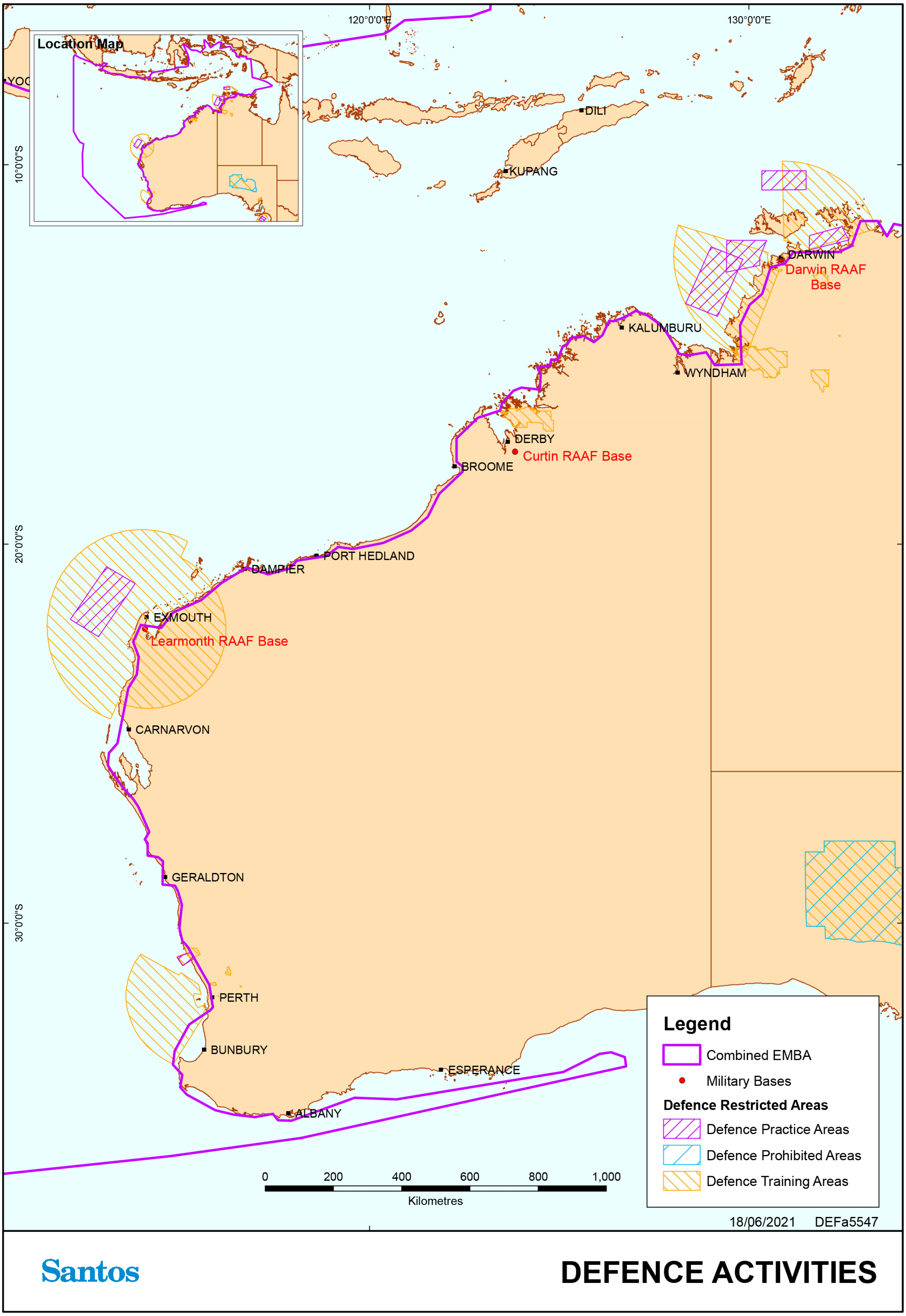

Figure 14-5: Defence activities

14.5 Tourism

The Kimberley, Pilbara and Gascoyne regions are popular visitor destination for Australian and international tourists. Tourism is concentrated in the vicinity of population centres including Broome, Dampier, Exmouth, Coral Bay and Shark Bay.

Marine and coastal use is also clustered around major population centres along the WA coastline including Perth, Bunbury, Geraldton, Margaret River, Jurien Bay, August and Albany.

Tourism contributes to local economies in terms of both income and employment and tourists include local, interstate and international visitors. Popular water-based activities include fishing, swimming, snorkelling/ diving, surfing/windsurfing/kiting and boating, while popular land based activities include bushwalking, camping, bird watching and four-wheel driving.

Seasonal nature-based tourism such as humpback whale watching, whale shark encounters and tours of turtle hatching mainly occurring around Ningaloo Reef, Cape Range National Park, Broome and Perth (Tourism Western Australia 2014). Seasonal aggregations of whale sharks, manta rays, sea turtles and whales, as well as the annual mass spawning of coral attract large numbers of visitors to Ningaloo each year (CALM 2005).

14.6 Cultural Heritage

Four places of cultural significance are protected as National Heritage Places in the waters from Busselton to the NT. The Dampier Archipelago (including Burrup Peninsula), Batavia Shipwreck Site and Survivor Camps Area 1629 – Houtman Abrolhos, Dirk Hartog Landing Site 1616 – Cape Inscription area and the HMAS Sydney II and HSK Kormoran Shipwreck Site are discussed in **Section 9**. Additional Commonwealth Heritage Places denoted for their historic value in the combined EMBA are listed in **Appendix A**.

14.6.1 Indigenous Heritage

Indigenous people have a strong ongoing association with the area that extends from the beginning of human settlement in Australia some 50,000 years ago. The close, long standing relationship between Aboriginal peoples and the coastal and marine environments of the area is evident in indigenous culture today, in addition to archaeological sites such as the Burrup Peninsula. The Indigenous peoples of the northwest continue to rely on coastal and marine environments and resources for their cultural identity, health and wellbeing, as well as their domestic and commercial economies (DEWHA 2008a). Within the combined EMBA, Barrow Island, Montebello Islands, Exmouth, Ningaloo Reef, Kimberly Coast, Eighty Mile Beach, Roebuck Bay, Dampier Peninsula and the South West and the adjacent foreshores have a long history of occupancy by Indigenous communities. Areas that are covered by registered native title claims are likely to practice indigenous fishing techniques at various sections of the WA coastline, most notably in the Kimberley coastal region and islands.

Marine resource use by Indigenous people is generally restricted to coastal waters. Fishing, hunting and the maintenance of maritime cultures and heritage through ritual, stories and traditional knowledge continue as important uses of the nearshore region and adjacent areas. However, while direct use by Aboriginal people deeper offshore waters is limited, many groups continue to have a direct cultural interest in decisions affecting the management of these waters. The cultural connections Aboriginal people maintain with the sea may be affected, for example, by offshore fisheries and industries. In addition, some Indigenous people are involved in commercial activities such as fishing and marine tourism, so have an interest in how these industries are managed in offshore waters with respect to their cultural heritage and commercial interests (DEWHA 2008a).

In the Northern Territory there are a number of sacred and significant sites located on the Tiwi Islands. There are currently four registered sacred sites on the Tiwi Islands (Aboriginal Areas Protection Authority, 2016). Another 56 sites of significance to Tiwi Islanders have been recorded, including two sites on the NT mainland (Tiwi Land Council, 2003). The Tiwi Islands sites hold importance as they have high spiritual and cultural history value (Tiwi Land Council 2003).

14.6.2 Maritime Heritage

Details of recorded shipwreck sites are available on the Australian National Shipwreck Database are managed by the DAWE although precise locations of the wrecks are sometimes unknown. the combined EMBA. Key shipwrecks in the North West Marine Region are shown in **Figure 14-10** to **Figure 14-6**, in addition to the Ann Millicent (DEWHA 2008a). Under the Commonwealth *Underwater Culture Heritage Act 2018* all shipwrecks older than 75 years are protected, while those dated pre-1900 are protected by WA law under the *Maritime Archaeology Act 1973*. Within the combined EMBA, there are 1033 shipwrecks known to be in excess of 75 years old.

Santos

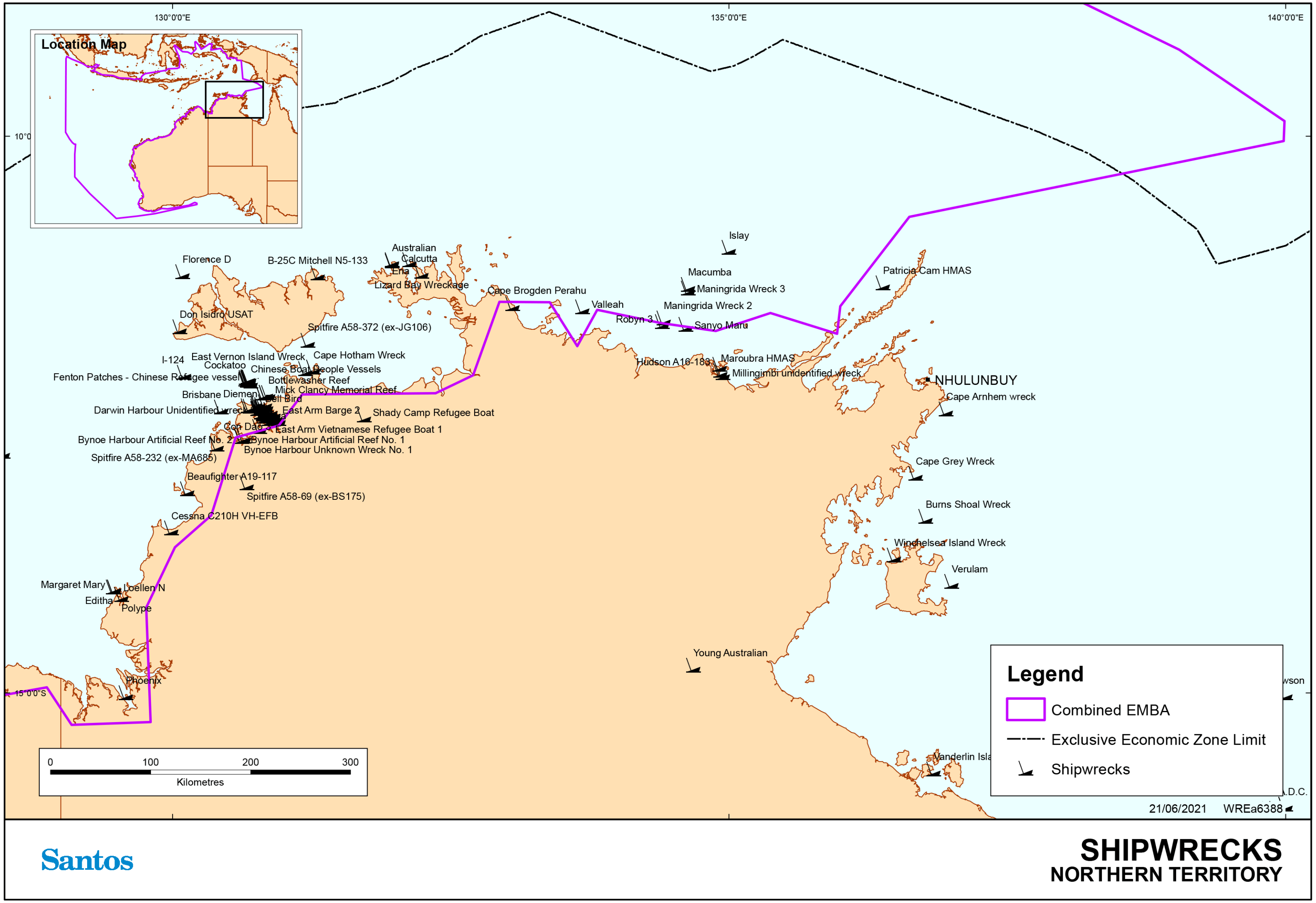

Figure 14-6: Shipwrecks –NT

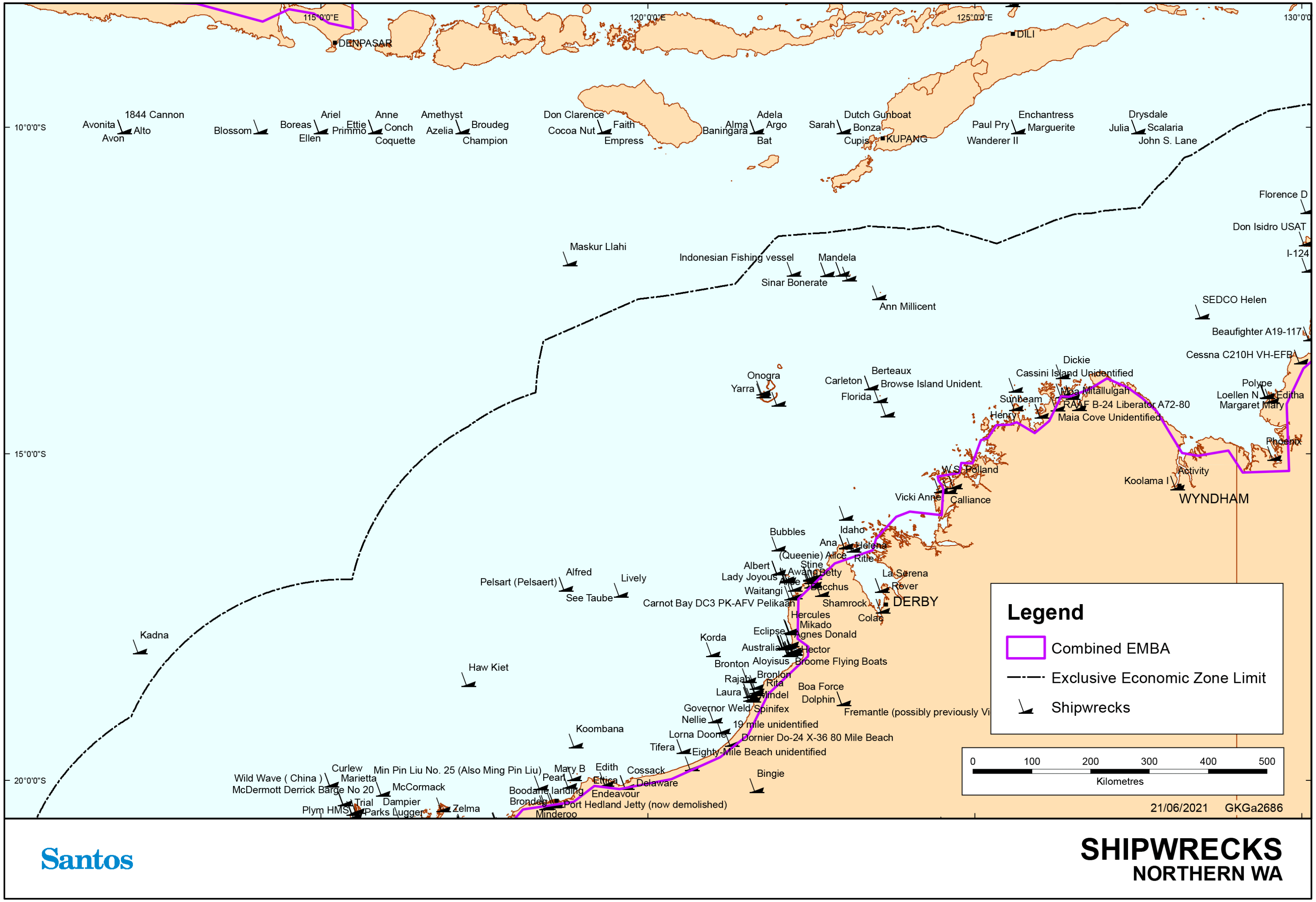

Figure 14-7: Shipwrecks – Northern WA

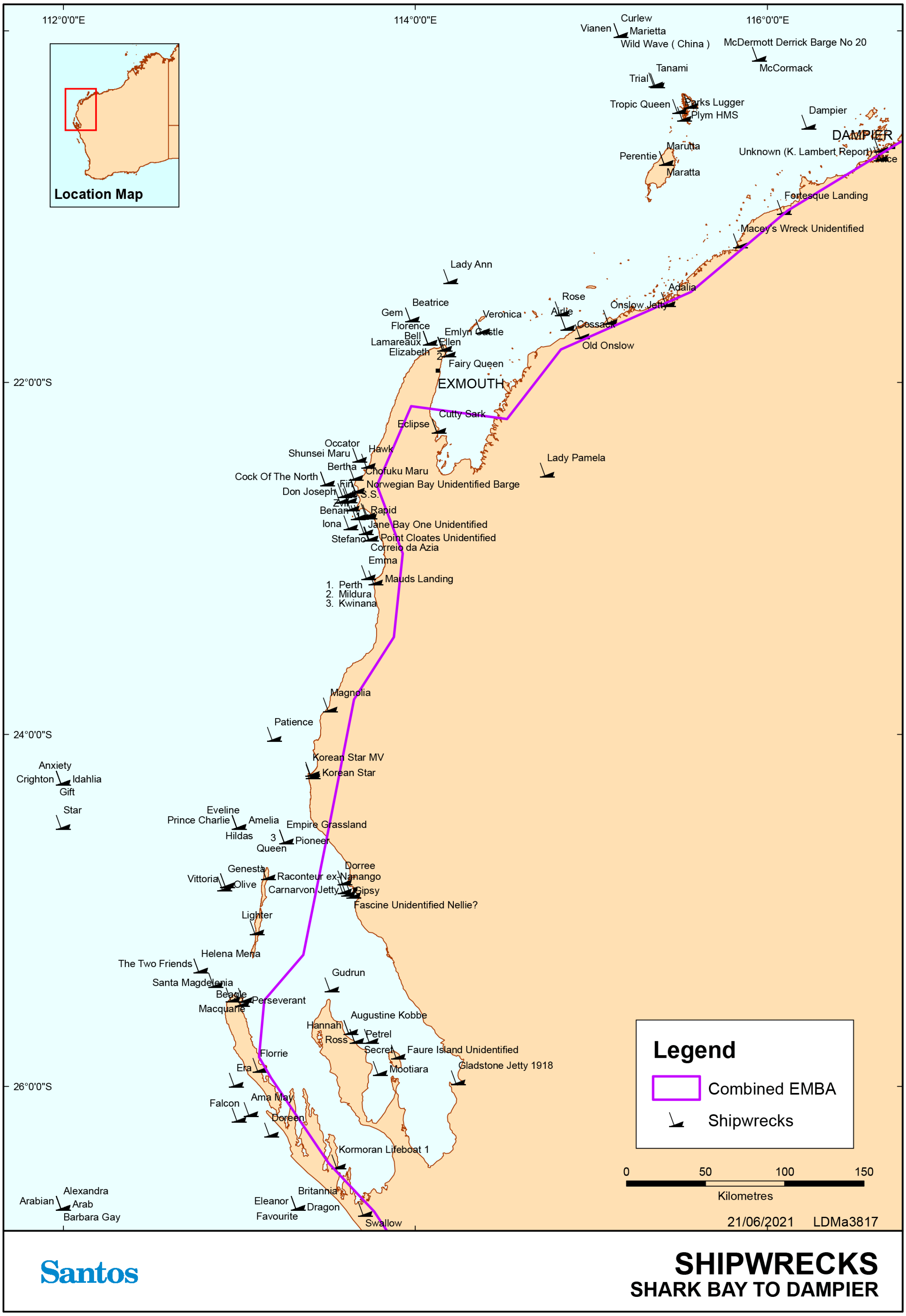

Figure 14-8: Shipwrecks – Shark Bay – Dampier

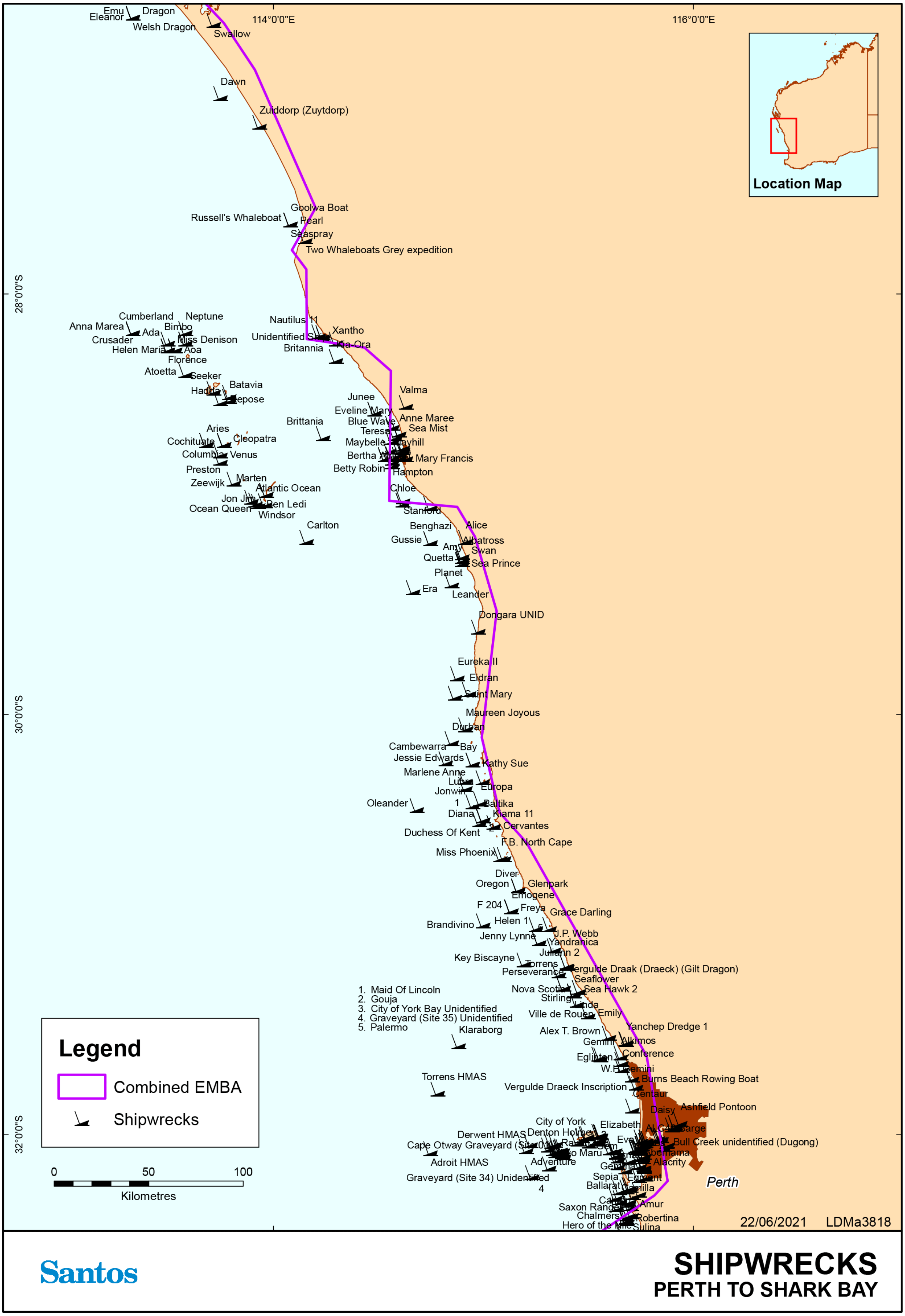

Figure 14-9: Shipwrecks – Perth – Shark Bay

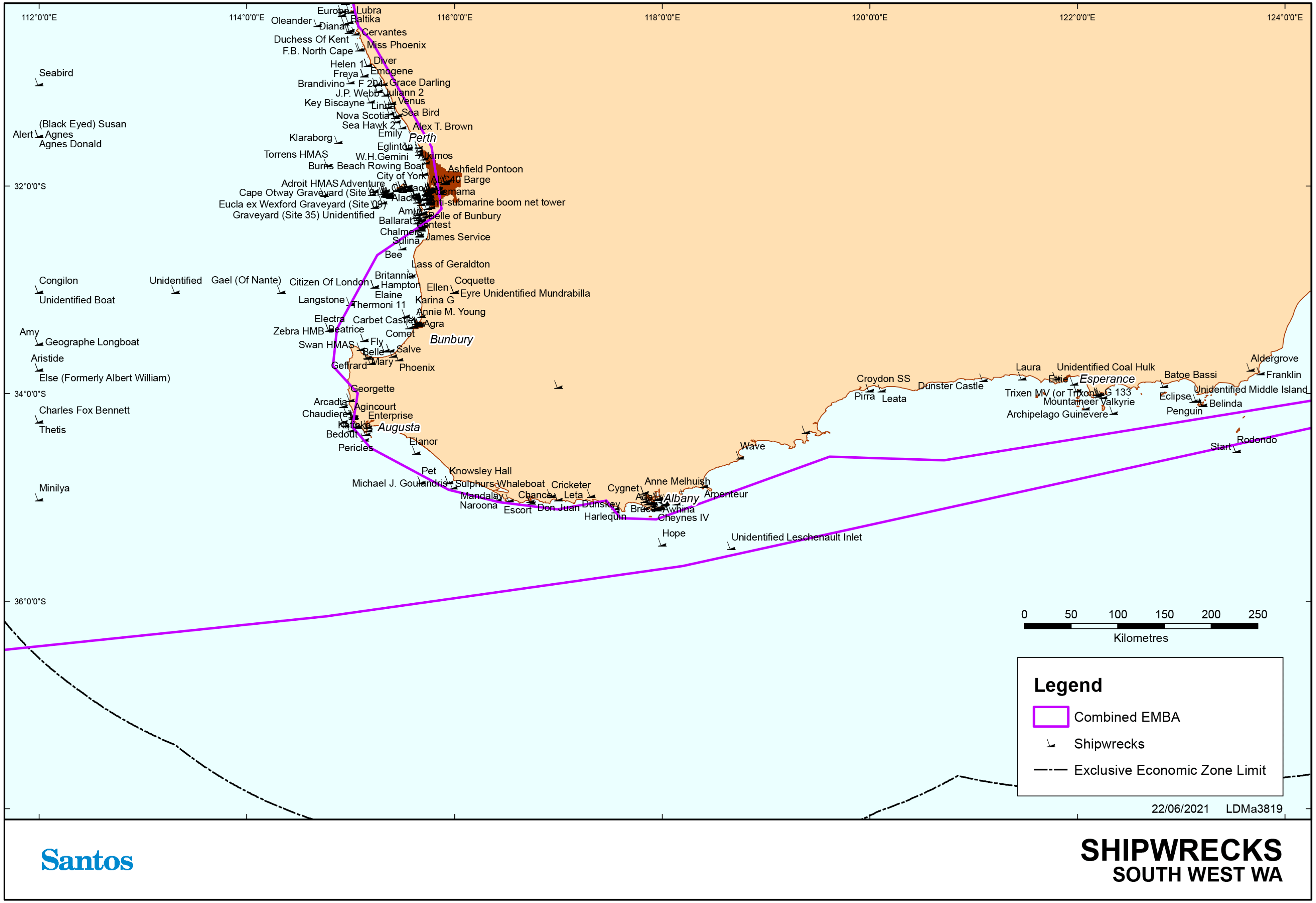

Figure 14-10: Shipwrecks – South West WA

14.7 Commercial Fisheries

A valuable and diverse commercial fishing industry is supported by both the offshore and coastal waters in the North Coast, Gascoyne, West Coast and South Coast Bioregions between the WA and NT and South Australian borders. The major fisheries in this area target tropical finfish, large pelagic fish species, crustaceans (prawns and scampi), Western Rock Lobster and pearl oysters (Fletcher and Santoro 2013). A number of smaller fisheries also exist in this area including the octopus and beche-de-mer fisheries.

14.7.1 State Fisheries

State fisheries are managed by the WA Department of Primary Industries and Regional Development (DPIRD) (formerly Department of Fisheries (DoF)) with specific management plans, regulations and a variety of subsidiary regulatory instruments under the *Fish Resources Management Act 1994* (WA). The information on State managed fisheries has been derived from '*The State of the Fisheries'* Report 2018/2019 (Gaughan *et al.* 2020) and direct consultation with DPIRD. Santos consults regularly with State fisheries relevant to activity operational areas, mainly by distribution of an Annual Consultation Update by post.

State commercial fisheries that exist between Kalbarri (WA) and the NT border are shown in **Figure 14-12**. Fisheries in the Northern Territory are shown in **Figure 14-11**. A summary of all commercial fisheries in the area is also provided in **Table 14-1**. These are:

North Coast Bioregion

- Onslow Prawn Managed Fishery (OPMF);
- Nickol Bay Prawn Managed Fishery (NBPMF) – referred to as Nickol Bay Prawn Limited Entry Fishery in **Figure 14-12;**
- Broome Prawn Managed Fishery (BPMF);
- Kimberley Prawn Managed Fishery (KPMF);
- Kimberley Gillnet & Barramundi Managed Fishery (KGBF);
- Kimberley Developing Mud Crab Fishery[15]**;**
- Northern Demersal Scalefish Managed Fishery (NDSF);
- North Coast Traditional Trochus Fishery[15];
- Pilbara Demersal Scalefish Fisheries[15]**;**
- Pilbara Developing Crab Fishery[15]**;**
- Pilbara Fish Trawl (Interim) Managed Fishery (PFTIMF);
- Pilbara Trap Managed Fishery (PTMF);
- Pilbara Line Fishery;
- Western Australian Sea Cucumber Fishery;
- Mackerel Managed Fishery (Area 1 – Kimberley and Area 2 – Pilbara);
- Western Australian Pearl Oyster Fishery – referred to as Pearl Oyster Managed Fishery in **Figure 14-12;**
- Northern Shark Fisheries (closed[15]**)** including:

[15] Not shown in **Figure 14-12**

- Western Australian North Coast Shark Fishery[15]; and
- Joint Authority Northern Shark Fishery[15]
- North Coast Trochus Fishery[15]; and
- Pilbara Developing Crab Fishery[15]**.**

Northern Territory

- Coastal Line Fishery;
- Aquarium Fishery;
- Trepang Fishery;
- Development Small Pelagic Fishery;
- Coastal Net Fishery;
- Spanish Mackerel Fishery;
- Offshore Net and Line Fishery;
- Timor Reef Fishery;
- Demersal Fishery; and
- Barramundi Fishery.

Gascoyne Bioregion

- Exmouth Gulf Prawn Managed Fishery;
- Gascoyne Demersal Scalefish Managed Fishery;
- Shark Bay Scallop Managed Fishery – referred to as Shark Bay Scallop Limited Entry Fishery on **Figure 14-12;**
- Shark Bay Prawn Managed Fishery – referred to as Shark Bay Prawn Limited Entry Fishery on **Figure 14-12;**
- Shark Bay Beach Seine and Mesh Net Managed Fishery[15]**;**
- Shark Bay Crab Interim Managed Fishery; and
- Mackerel Fishery (Area 3 – Gascoyne/West Coast).

West Coast Bioregion

- Roe's Abalone[15]**;**
- Abrolhos Islands and Mid-West Trawl Managed Fishery (AIMWRMF) (Closed) – referred to as Abrolhos Islands and Mid-West Trawl Limited Entry Fishery in **Figure 14-12;**
- West Coast Demersal Scalefish Interim Managed Fishery (WCDSIMF);
- South West Trawl Managed Fishery – referred to as South West Trawl Limited Entry Fishery in **Figure 14-12;**
- Mandurah to Bunbury Developing Crab Fishery[15]**;**
- Cockburn Sound Crab Managed Fishery[15]**;**
- Cockburn Sound Line and Pot Managed Fishery[15]**;**
- Cockburn Sound Mussel Managed Fishery[15]**;**

Santos

- Warnbro Sound Crab Managed Fishery (closed) [15];
- West Coast Nearshore and Estuarine Finfish Fisheries, including:
- Cockburn Sound Fish Net Managed Fishery[15];
- West Coast Beach Baited Managed Fishery[15];
- South West Beach Seine Fishery[15]; and
- West Coast Estuarine Managed Fishery[15];
- Temperate Demersal Gillnet and Demersal Longline Fisheries, including:

- West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery (West Coast Bioregion) [15];

- West Coast Deep Sea Crab (Interim) Managed Fishery – referred to as West Coast Deep Sea Crustacean Managed Fishery in **Figure 14-12;**
- West Coast Nearshore Net Managed Fishery [15];
- Octopus Interim Managed Fishery [15];
- West Coast Rock Lobster Managed Fishery; and
- West Coast Purse Seine Fishery [15].

South Coast Bioregion

- Greenlip/Brownlip Abalone Fishery [15];
- South Coast Crustacean Managed Fishery [15];
- South Coast Deep-Sea Crab Fishery [15];
- South Coast Estuarine Managed Fishery[15];
- South Coast Open Access Netting Fishery [15]; and
- South West Coast Beach Net [15].
- South Coast Salmon Managed Fishery;
- South Coast Trawl Fishery;
- South West Coast Salmon Managed Fishery [15];
- Temperate Demersal Gillnet and Demersal Longline Fisheries including:

- Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery (South Coast Bioregion)
- South West Trawl Managed Fishery (SWTMF) – referred to as South Coast Trawl Limited Entry Fishery in **Figure 14-12**; and
- Windy Harbour/Augusta Rock Lobster Managed Fishery [15].

Whole of State Fisheries

- Marine Aquarium Fish Managed Fishery (MAFMF);
- Specimen Shell Managed Fishery; and
- Hermit Crab Fishery (HCF) [15].

Some of the fisheries listed above will be more susceptible to impacts than others, particularly fisheries without the ability to escape impacts. For example, above average water temperatures over the last three years will have had an impact on prawn fisheries in Exmouth and scallops and blue swimmer crabs in Shark Bay which have been significantly affected by the initial heat wave event of 2010/11 (Caputi *et al*. 2014).

14.7.2 Commonwealth Fisheries

Commonwealth fisheries are those within the 200 nautical mile Australian Fishing Zone (AFZ) managed by Australian Fisheries Management Authority (AFMA) and are, on the high seas, and, in some cases, by agreement with the States and Territory, to the low water mark. Information on Commonwealth managed fisheries has been derived from '*Fishery Status'* Report 2019 (Department of Agriculture 2019)

Commonwealth fisheries who have permits to operate in the combined EMBA include as shown in **Figure 14-13**:

+ North West Slope Trawl (NWST);
+ Northern Prawn Fishery (NPF);
+ Southern Bluefin Tuna Fishery (SBFTF);
+ Western Tuna and Billfish Fishery (WTBF) (including Southern Tuna and Billfish Fishery);
+ Small Pelagic Fishery (SPF);
+ Southern and Eastern Scalefish and Shark Fishery (SESSF) – not shown in **Figure 14-13**;
+ Skipjack Tuna Fishery (STF) (referred to as Western Skipjack Tuna Fishery in **Figure 14-13**)**;** and
+ Western Deepwater Trawl (WDTF) (referred to as Western Deepwater Trawl Fishery in **Figure 14-13**).

Commonwealth commercial fisheries between Kalbarri (WA) and the NT Border are shown **Figure 14-13** and summarised in **Table 14-1**.

14.7.3 Indonesian Commercial and Subsistence Fishing

Within the northern and north-western extent of the combined EMBA is a defined area where a Memorandum of Understanding (MoU) exists between the Australian and Indonesian Governments. The Agreement between the Government of Australia and the Government of the Republic of Indonesia Relating to Cooperation in Fisheries (1992 Fisheries Cooperation Agreement) provides the framework for fisheries and marine cooperation between Australia and Indonesia, and facilitates information exchange on research, management and technological developments, complementary management of shared stocks, training and technical exchanges, aquaculture development, trade promotion and cooperation to deter illegal fishing.

Cooperation under the Agreement today takes place under the auspices of the Working Group on Marine Affairs and Fisheries. Established in 2001, the Working Group on Marine Affairs and Fisheries is the primary bilateral forum to enhance collaboration across the spectrum of marine and fisheries issues relevant to the areas of the Arafura and Timor seas. The Working Group brings together the fisheries, environment and scientific research portfolios and agencies from both countries.

The MoU Box (shown on **Figure 14-13**) is an area of Australian water in the Timor Sea where Indonesian traditional fishers, using traditional fishing methods only, are permitted to operate. Officially it is known as the Australia-Indonesia Memorandum of Understanding regarding the Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974.

As part of negotiations to delineate seabed boundaries, Australia and Indonesia entered into the MoU which recognises the rights of access for traditional Indonesian fishers in shared waters to the north of Australia. This access was granted in recognition of the long history of traditional Indonesian fishing in the area. The MoU provides Australia with a tool to manage access to its waters while for Indonesia, it enables Indonesian traditional fishers to continue their customary practices and target species such as trepang, trochus, abalone and sponges. Guidelines under the MoU were agreed in 1989 in order to clarify access boundaries for traditional fishers and take into account the declaration of the 200 nautical mile fishing zones. Because of its approximate shape the MoU area became known as the MoU Box.

Between 2006 and 2008, a series of surveys were undertaken to understand the traditional practice of Indonesian fishers that journey to Scott Reef within the MoU boundary (ERM 2008, 2009). The majority of perahu (vessels) that travel to Scott Reef originate from the islands of Rote (near West Timor) and Tonduk and Raas (in East Java). Some crew from the Rote perahus are recruited from the region of Alor (one of the Lesser Sundas chain, located north of East Timor and east of Bali). In 2007, an estimated 800 fishers (approximately 80 vessels) travelled from these home islands to Scott Reef, mainly to collect trepang. Similar vessel numbers sailed to Scott Reef in 2008.

Journeys to Scott Reef are generally restricted to drier months when wind speeds and directions are more desirable. Most Indonesian fishers travel to Scott Reef during July to October, although a few Rotenese make the journey to Scott Reef in the early season between April and June. Other fishers plan to go after Aidil Fitri, a religious holiday widely celebrated on Tonduk Island that celebrates the end of Ramadan.

The fishers focus their activities in and around the shallow water lagoons of Scott Reef primarily targeting trepang; and opportunistically gather trochus shells. They also catch fish largely for subsistence purposes although the average fish catch per lete-lete (traditional Indonesian fishing vessel) in 2008 increased to commercial volumes. Although deeper waters are more plentiful in trepang, deep diving is generally not undertaken by the fishers due to the MoU stipulation on the exclusive use of traditional equipment only (Woodside Energy Limited 2011).

14.8 Aquaculture

14.8.1 South West Bioregion

The predominant aquaculture activity undertaken in this region is the production of mussels and oysters from Oyster Harbour at Albany. This activity is restricted to this area where there are sufficient nutrient levels related to terrestrial run-off to provide the planktonic food necessary to promote growth of filter-feeding bivalves fishing (Fletcher and Santoro 2015). The high-energy environment and limited protected deep waters limits other forms of aquaculture such as sea cage farming.

Further invertebrate aquaculture operations are expected after recent funding to establish a South Coast Aquaculture Development Zone by DPIRD. An initial south coast aquaculture project aims to identify suitable areas for artificial farm structures to be constructed supporting shellfish production including abalone and edible oysters (Gaughan and Santoro 2020).

14.8.2 West Coast Bioregion

The principal aquaculture development activities in this region are the production of blue mussels (*Mytilus galloprovincialis*) and marine algae (*Dunaliella salina*) and the emerging black pearl industry based on the production of *Pinctada margaritifera* at the Abrolhos Islands. The main mussel farming area is in southern Cockburn Sound, where conditions are sheltered and the nutrient and planktonic food levels are sufficient to promote good growth rates fishing (Fletcher and Santoro 2015).

Further aquaculture operations are expected following the establishment of the Mid-West Aquaculture Development Zone by DPIRD, which aims to provide a platform to stimulate aquaculture investment and development in the bioregion (Gaughan and Santoro 2020).

14.8.3 Gascoyne Coast Bioregion

Hatchery production of oysters is the core of the pearling industry in the Gascoyne region. Hatcheries in Carnarvon and Exmouth supply spat to pearl farms in the north-west and several hatcheries supply juveniles to the black-lip pearl oyster to developing black pearl farms in the region. Pearl production is carried out on a small scale in Shark Bay and Exmouth Gulf. The local aquiculture sector is also focussing on the production of aquarium species.

14.8.4 North Coast Bioregion

Aquaculture development in this region is dominated by the production of pearls from the species *Pinctada maxima.* A large number of pearl oysters for seeding is obtained from wild stocks and supplemented by hatchery-produced oysters with major hatcheries operating at Broome and the Dampier Peninsular. Pearl farm sites are located mainly along the Kimberley coast, particularly in the Buccaneer Archipelago, in Roebuck Bay and at the Montebello Islands. Developing marine aquaculture initiatives in this region include growing trochus and barramundi.

The Pearl Oyster Fishery of Western Australia operates in shallow coastal waters (DoF 2006). All the leases are within the 35m diving depth. Through consultation the Pearl Producer's Association (PPA) have raised concern that spawning stock is found to the 100 m depth contour. However, this is not supported in the study by Condie *et al* (2006) who modelled oyster larva transport in the Eighty Mile Beach region and found that while some larvae travelled more than 60 km, most were transported less than 30 km. The model results suggest that spawning in the Eighty Mile Beach region is concentrated around the 8 to 15m depth range, with potential smaller contributions from the northeast. These spawning events are likely to lead to successful recruitment locally and alongshore to the southwest.

They also feed larvae into neighbouring shallow coastal environments (through tidal oscillations) and deeper waters to the west (>20 m). However, spat abundances seem to be low in these areas, suggesting that recruitment is strongly limited by habitat availability and possibly high mortality rates in shallow water. High local abundances of broodstock and spat observed occasionally in deeper water (<30 m) seem to be supported by intermittent larval transport from inshore populations. Spawning in this area seems to contribute little to recruitment in the inshore populations.

Further aquaculture in this region mainly focuses on barramundi farming within Cone Bay, with two aquaculture licences granted in this area located about 200 km north-east of Broome (Gaughan and Santoro 2020).

Further aquaculture operations have expanded in the region with the establishment of the Kimberley Aquaculture Development zone, which encompasses almost 2,000 ha of coastal waters within Cone Bay supporting the production of up to 20,000 t of finfish annually (Gaughan and Santoro 2020).

14.8.5 Northern Territory

The Northern Territory boasts a diverse and vibrant aquaculture industry. An extensive range of commercial activity includes barramundi farming, trepang (sea cucumber), pearling and the collection of marine fish and coral for the tropical aquarium market. A pond-based barramundi farm on the Adelaide River produces more than 1,000 tonnes of Barramundi a year (Northern Territory Government, 2016). Giant clams are also farmed with trials on Groote Eylandt and Goulburn Island growing sea clams in sea-based cages. The silver-lipped pearl oyster is farmed in four main areas of the NT: Bynoe Harbour, Beagle Gulf, Cobourg Peninsula and Croker Island around the islands north west of Nhulunbuy.

14.8.6 Indonesian Aquaculture

An analysis by WorldFish has indicated that aquaculture will overtake capture fisheries as the major source of fish in Indonesia before 2030 (Phillips *et al.* 2015). By volume, Indonesian aquatic production is dominated by seaweeds, but by value, domestically consumed species such tilapia and milkfish, together with export-orientated commodities such as shrimp and tuna, are of greater importance (Phillips *et al*. 2015).

Carrageenan seaweed farming based primarily on the cultivation of *Kappaphycus* and *Eucheuma* species has grown significantly in Indonesia. Due to the simple farming techniques required, low requirements of capital and material inputs, and short production cycles it has become a favourable livelihood for smallholder farmers and fishers (Valderrama *et al*. 2013). Indonesia's coastline provides ideal conditions for fish farming in "brackish waters". Aquaculture in Indonesia is predominantly used for seaweed production, whilst offshore fish cultivation remains relatively undeveloped (Global Business Guide 2014).

14.9 Recreational Fisheries

14.9.1 South West Bioregion

The South West Bioregion includes the water from Augusta to Eucla on the Western Australia/South Australia border. The continental shelf waters of this region are generally temperate but low in nutrients due to the seasonal presence of the tail of the tropical Leeuwin current and limited terrestrial run-off. As much of the south coast is remote or difficult to access, recreational beach and boat fishing tends to be concentrated around the main population and holiday centres. The major target species for beach and rock anglers are salmon, herring, whiting and trevally, while boat anglers target pink snapper, queen snapper, Bight redfish, a number of shark species, salmon fish and King George whiting. Another component of the recreational fishery is dinghy and shoreline fishing off estuaries and rivers where the main angling targets are black bream and whiting. Recreational netting primarily targeting mullet also occurs in these estuaries (WAFIC 2016).

14.9.2 West Coast Bioregion

The marine environment of the West Coast Bioregion which lies between Kalbarri and Augusta is predominantly a temperate oceanic zone, but it is heavily influenced by the Leeuwin current, which transports warm tropical water southward along the edge of the continental shelf. This region contains the state's major population centres and is the most heavily used bioregion for recreational fishing (Fletcher and Santoro 2015). The range of recreational fishing opportunities includes estuarine fishing, beach fishing and boat fishing either in embayments or offshore for demersal and pelagic game species often around the islands and out to the continental shelf (WAFIC 2016).

14.9.3 Gascoyne Coast Bioregion

The Gascoyne Coast Bioregion extends from just north of Kalbarri to the Ashburton River, south of Onslow. The marine environment of this region represents a transition between the fully tropical waters of the north-west shelf of the north coast region and the temperate waters of the west coast region. This region has been identified as one of the 18 world 'hotspots' in terms of tropical reef endemism and the second most divers marine environment in the world in terms of tropical reef species. This region is a focal point for winter recreational fishing and is a key component of many tourist visits. Angling activities include beach and cliff fishing (e.g. Steep Point and Quobba), embayment and shallow-water boat angling (e.g. Shark Bay, Exmouth Gulf and Ningaloo lagoons), and offshore boat angling for demersal and larger pelagic species (e.g. off Ningaloo). The predominant target species include the tropical species such as emperors, tropical snappers, groupers, mackerels, trevallies and other game fish. Temperate species at the northern end of their ranges such as pink snapper, tailor and whiting also provide significant catches, particularly in Shark Bay (WAFIC 2016).

14.9.4 North Coast Bioregion

The North Coast Bioregion (Pilbara/Kimberley) runs from the Ashburton River to the Western Australia/Northern Territory border (WAFIC 2016). The oceanography of this region includes waters of Pacific Ocean origin that enter through the Indonesian archipelago bringing warm, low salinity waters polewards via the Indonesian throughflow and Holloway currents which flow seasonally and interact with Indian ocean waters. Recreational fishing is experiencing a significant growth in this region, with a distinct seasonal peak in winter when the local population increases by significant numbers of metropolitan and inter-state tourists. This has been added to by the increased recreational fishing by those involved in the construction or operation of major developments in this region. Owing to the high tidal range, much of the angling activity is boat-based with beach fishing limited to periods of flood tides and high water. Numerous creek systems, mangroves, rivers and ocean beaches provide shore and small boat fishing for a variety of species including barramundi, tropical emperors, mangrove jack, trevallies, sooty grunter, threadfin, mud crabs and cods. Offshore islands, coral reef systems and continental shelf waters provide species of major recreational interest including saddletail snapper and red emperor, cods, coral and coronation trout, sharks, trevally, tuskfish, mackerels and billfish (WAFIC 2016).

14.9.5 Northern Territory

The most recent available data on recreational fishing in the Greater Darwin area indicates that line fishing (using bait, lures or flies) was the most common fishing method used, accounting for 72% of the total effort, followed by Mud Crab potting (23%). The use of cast nets and other fishing methods was far less common. Approximately 70% of all recreational fishing effort occurred in estuarine waters (Matthews et al, 2019). The Darwin Harbour region and its associated arms and creeks supported 40% of the total fishing effort, followed by Bynoe Harbour (14%) and Shoal Bay (6%). The offshore regions seaward of Bynoe Harbour and Dundee were the most popular sites for those fishers venturing beyond estuarine waters. Most of the catch (84%) comprised of fish species (i.e. bony fish and sharks/rays) with the bulk of the remaining catch consisting of crabs and prawns.

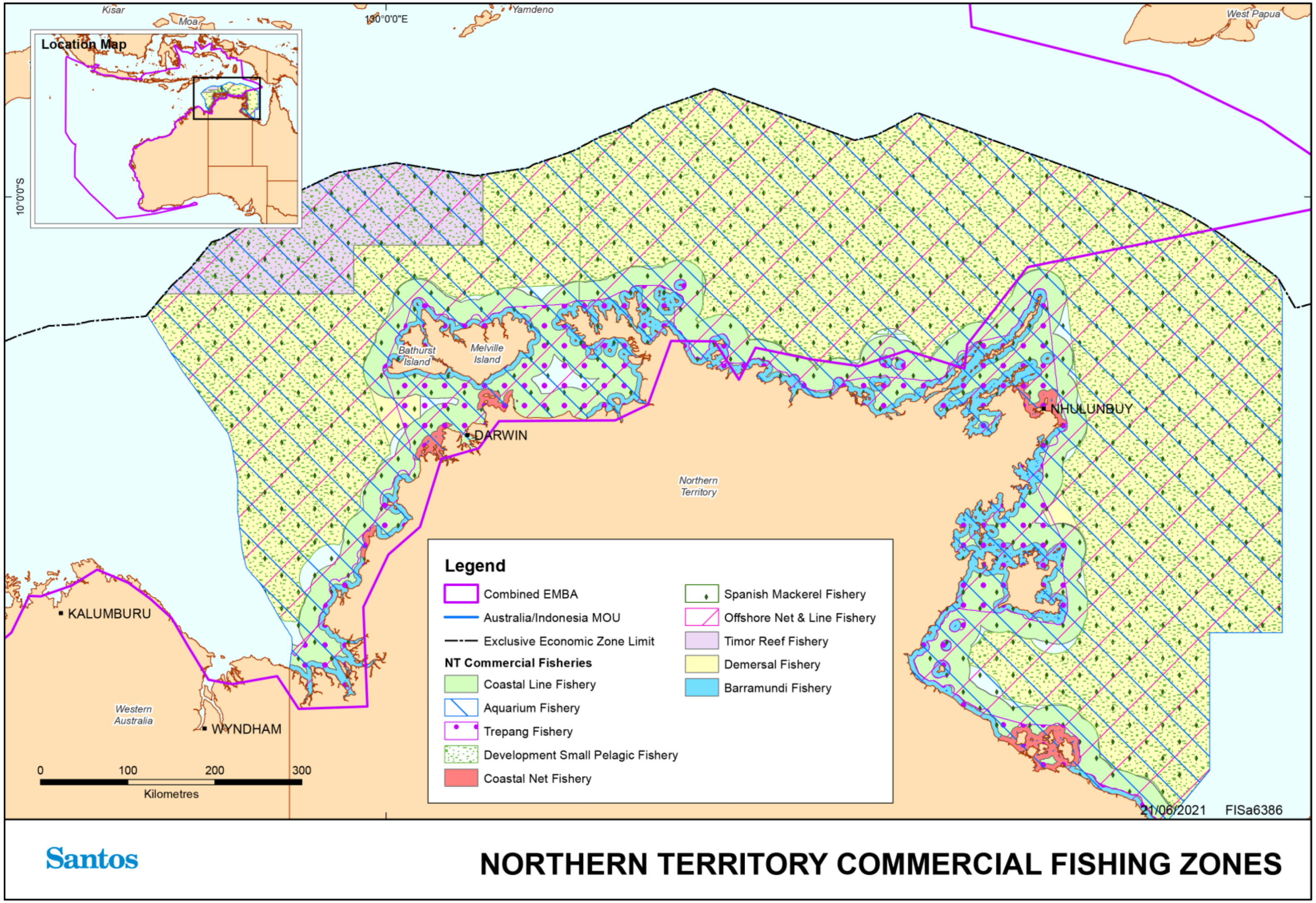

Figure 14-11:NT state commercial fishing zones

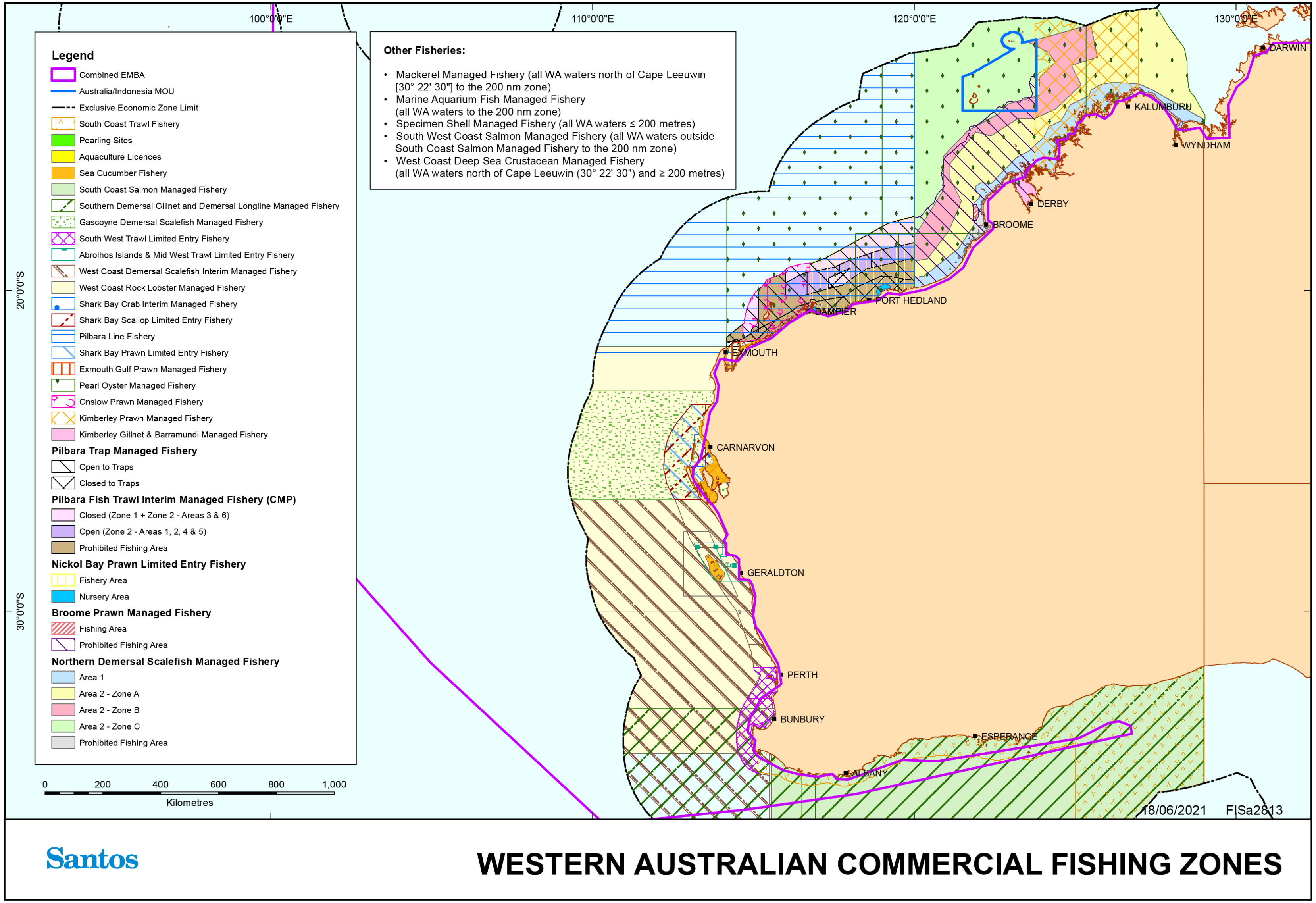

Figure 14-12:WA state commercial fishing zones

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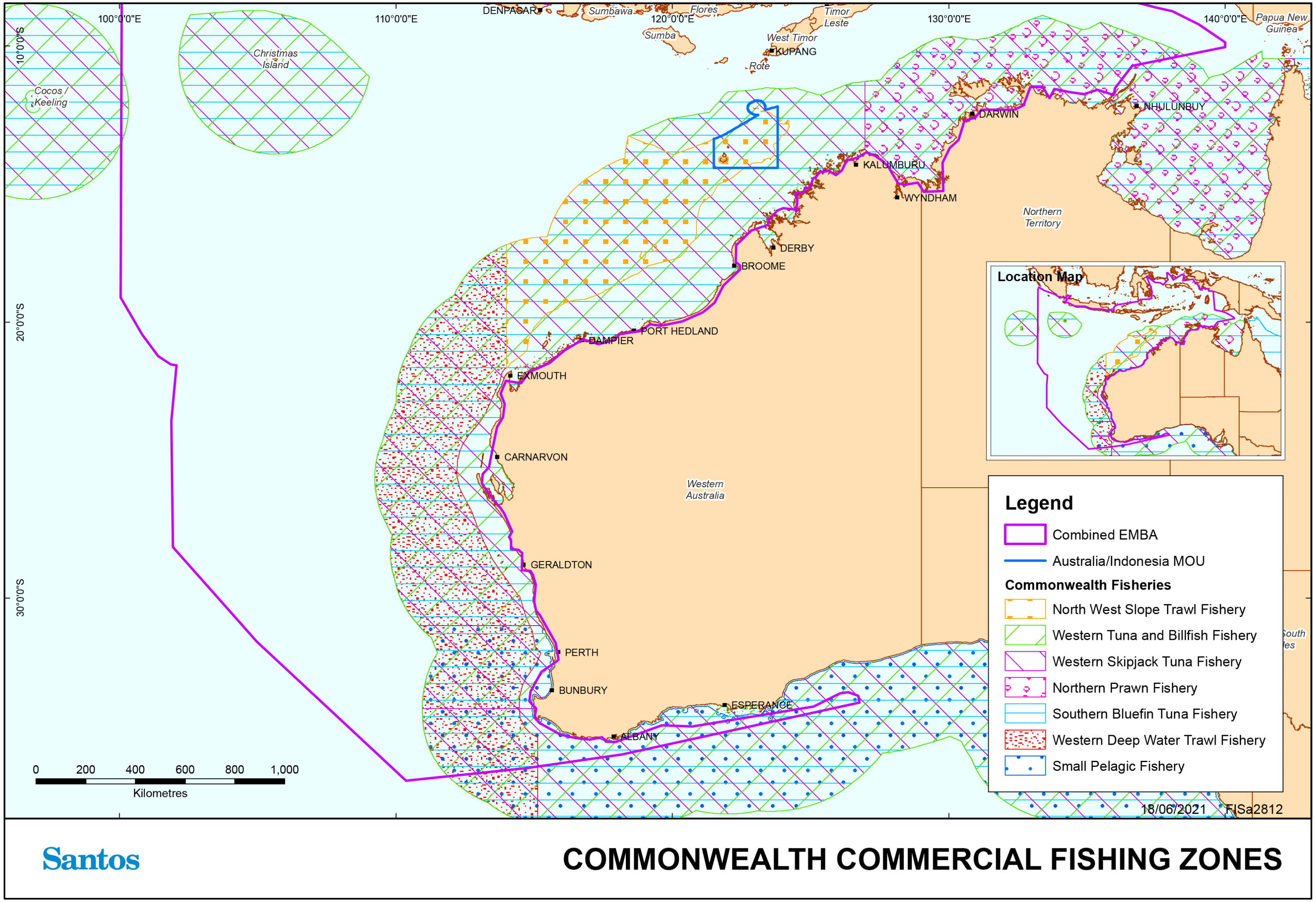

Figure 14-13: Commonwealth commercial fishing zones

Santos

Table 14-1: Commercial fisheries with permits to operate within the combined EMBA

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
State Managed Fisheries				
Abrolhos Islands and Mid-West Trawl Managed Fishery (AIMWTMF)	Saucer scallops (*Ylistrum balloti*), with a small component targeting the western king prawn (*Penaeus latisulcatus*)	2017/2018: 651 tonnes	Operates using low opening otter trawl systems.	All the waters of the Indian Ocean adjacent to Western Australia between 27°51´ south latitude and 29°03´ south latitude on the landward side of the 200 m isobath'.
Aquarium Fishery	Multi-species catch including; invertebtrates (hermit crabs, various snails, whelks and hard and soft corals) and finfish (rainbowfish, catfishes and scats).	Unknown	Dive-based method of collection, using barrier, cast, scoop, drag and skimmer nets, hand pumps, freshwater pumps and handheld instruments.	The Aquarium fishery is a small-scale, multi-species fishery that prospects freshwater, estuarine and marine habitats to the outer boundary of the AFZ. Most of the harvest occurs within 100km of Darwin, though one license holder does collect from two offshore locations; Evans Shoal and Lynedoch Bank. Fishing activities may occur year round.
Barramundi Fishery	Barramundi King threadfin	The fishery is restricted to 14 licences all of which are currently allocated to fishers.	Gill nets	The annual commercial barramundi fishing season in the NT is from 1 February to 30 September. Fishing is allowed from the high water mark to three nautical miles seaward of the low water mark. The area is restricted to waters seaward from the coast, river mouths and legislated closed lines
Broome Prawn Managed Fishery (BPMF)	Western king prawns (*Penaeus latisulcatus*) and coral prawns (a combined category of small penaeid species).	Extremely low fishing effort occurred as only a single boat undertook trial fishing to investigate whether catch rates were sufficient for commercial fishing. This resulted in negligible landings of western king prawns with no byproduct recorded.	Otter trawl	The BPMF operates in a designated trawl zone off Broome. The boundaries of the BPMF are 'all Western Australian waters of the Indian Ocean lying east of 120° east longitude and west of 123°45' east longitude on the landward side of the 200 m isobath'. The actual trawl area is contained within a delineated small area north west of Broome.

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
Coastal Line Fishery	Black jewfish Golden snapper	Fishery is restricted to 52 licenses, with approximately one third of these being active in 2015.	Lines, nets and traps	Fishing occurs along the NT coast between high water marks and 15 nm from low water mark. Majority of activity is concentrated around rocky reefs along the coastline within 100km from Darwin. Fishing activities occur year-round.
Coastal Net Fishery	Mullet	This fishery is restricted to five licences, all of which are allocated.	Nets	The fishery extends from the high water mark to three nautical miles out from the low water mark. The fishery is divided into regions including: • Darwin – from Cape Hotham to Native Point and Cape Ford to Cape Dooley • Gove – between Cape Arnhem and Cape Wilberforce • Borroloola – from Bing Bong Creek and Pelican Spit.
Cockburn Sound Mussel Managed Fishery	Blue mussels (*Mytilus edulis*)	2015: Unspecified	Agriculture	Main mussel farming occurs in southern Cockburn Sound.
Cockburn Sound Crab Managed Fishery	Blue Swimmer (*Portunus armatus)* Blue swimmer crab (*Portunus armartus)*	2017/2018: 5: closed to commercial and recreational fishing since April 2014	Drop nets, scoop nets, diving	Encompasses the inner waters of Cockburn Sound, from South Mole at Fremantle to Stragglers Rocks, through Mewstone to Carnac Island and Garden Island, along the eastern shore of Garden Island and back to John Point on the mainland.
Cockburn Sound Line and Pot Managed Fishery	Southern garfish (*Hyporhamphus melanochir*), Australian herring (*Arripis geogianus*)	2017/2018: 257 tonnes	Line (fish) Shelter and trigger pots (octopus)	Encompasses the inner waters of Cockburn Sound, from South Mole at Fremantle to Stragglers Rocks, through Mewstone to Carnac Island and Garden Island, along the eastern shore of Garden Island and back to John Point on the mainland.

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
Demersal Fishery	Red snappers Goldband snappers	There are currently 19 licenses issued for the fishery, with around 9 active.	Handline Dropline Fish traps Although, essentially trap-based since 2002	This fishery extends from waters 15nm from the coastal waters mark to the outer limit of the AFZ, excluding the area of the Timor Reef Fishery.
Exmouth Gulf Prawn Managed Fishery	Western king prawns (*Penaeus latisulcatus*), brown tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus* spp.) and banana prawns (*Penaeus merguiensis*).	2017/2018: 713 tonnes	Low opening otter trawls.	Sheltered waters of Exmouth Gulf Essentially the western half of the Exmouth Gulf (eastern part is a nursery ground). The Muiron Islands and Point Murat provide the western boundary; Serrurier Island provides the northern limit
Gascoyne Demersal Scalefish Managed Fishery (GDSMF)	Targets pink snapper (*Pagrus auratus*) and goldband snapper (*Pristipomoides multidens*). Other demersal species caught include the rosy snapper (*P. filamentosus*), ruby snapper (*Etelis carbunculus*), red emperor (*Lutjanus sebae*), emperors (Lethrinidae, including spangled emperor*, Lethrinus nebulosus*, and redthroat emperor, *L. miniatus*), cods (Epinephelidae, including Rankin cod, *Epinephelus multinotatus* and goldspotted rockcod, *E. coioides*), pearl perch (*Glaucosoma burgeri*), mulloway (*Argyrosomus japonicas*), amberjack (*Seriola dumerili*) and trevallies (Carangidae).	2017/2018: Snapper: 133 tonnes Other demersals: 144 tonnes	Mechanised handlines	The GDSF operates in the waters of the Indian Ocean and Shark Bay between latitudes 23°07'30"S and 26°30'S. Vessels are not permitted to fish in inner Shark Bay.
Abalone Managed Fishery	Greenlip abalone (*Haliotis laevigata*) Brownlip abalone (*H. conicopora)*	2017/2018: 98 tonnes	Dive fishery The principal harvest method is a diver working off 'hookah' (surface supplied breathing apparatus) or SCUBA using an abalone	Shallow coastal waters off the south-west and south coasts of Western Australia Covers all Western Australian coastal waters, which are divided into eight management areas. Commercial fishing for

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
			‘iron’ to prise the shellfish off rocks – both commercial and recreational divers employ this method.	greenlip/brownlip abalone is managed in three separate areas.
Hermit Crab Fishery (HCF)	Australian land hermit crab (*Coenobita variabilis*)	2017/2018: 58,643 (lowest reported in the last 10 years (2008-2017; catch range 58,643-118,203).	Land based hand collection typically using four-wheel drives to access remote beaches	Operates in Western Australian waters north of the Exmouth Gulf (22°30’S)
Kimberley Developing Mud Crab Managed Fishery	Mud crab (*Scylla serrata*)	2017/2018: 60 tonnes (also includes catch data from Pilbara Developmental crab fishery)	Mud Crab traps	This fishery operates between Broome and Cambridge Gulf. Three commercial operators are permitted to fish from King Sound to the Northern Territory border, with closed areas around communities and fishing camps. One Aboriginal Corporation is permitted to fish in King Sound, with the other Aboriginal Corporation permitted to fish in a small area on the western side of the Dampier peninsula, north of Broome. Notices issued under the *Fish Resources Management Act 1994* prohibit all commercial fishing for mud crabs in Roebuck Bay and an area of King Sound near Derby.
Kimberley Gillnet and Barramundi Managed Fishery (KGBF)	Barramundi *(Lates calcarifer),* King threadfin *(Polydactylus macrochir),* Blue threadfin *(Eleutheronema tetradactylum)*	2017/2018: 79.9 tonnes	Gill net in inshore waters	Nearshore and estuarine zones of the North Coast Bioregion from the WA/NT border (129ºE) to the top end of Eighty Mile Beach, south of Broome (19ºS). The waters of the KGBF are defined as ‘all Western Australian waters north of 19° south latitude and west of 129° east longitude and within three nautical miles of the high water mark of the mainland of Western Australia and the waters of King Sound south of 16°21.47´ south latitude.

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
Kimberley Prawn Managed Fishery (KPMF)	Banana prawns (*Penaeus merguiensis*) Tiger prawns (*Penaeus esculentus*) Endeavour prawns (*Metapenaeus endeavouri*) Western king prawns (*Penaeus latisulcatus*)	2017/2018: 269 tonnes	Otter trawl	The KPMF operates off the north of the state between Koolan Island and Cape Londonderry. The boundaries of the KPMF are 'all Western Australian waters of the Indian Ocean lying east of 123°45´ east longitude and west of 126°58´ east longitude'. It abuts the western boundary of the Commonwealth Northern Prawn Fishery (NPF).
Mandurah to Bunbury Developing Crab Fishery	Blue swimmer crab (*Portunus armartus)*	2017/2018: 5.2 tonnes	Drop nets, scoop nets, diving	Fishery extends from south of the Shoalwater Islands Marine Park (32°22'40''S) to Point McKenna near Bunbury (33°16'S) and offshore to 115°30'E. The fishery is divided into two zones with crab fishing historically being permitted within Area 1, Comet Bay between 32°22''40''S and 32°30'S, and Area 2, Cape Bouvard to the southern boundary of the fishery. In 2015 crab fishing within Area 2 ceased.
Marine Aquarium Fish Managed Fishery (MAFMF)	Over 250 target species of finfish. (228 species caught in 2012). Fishermen can also take coral, live rock, algae, seagrass and invertebrates. The main fish species landed in 2012 were scribbled angelfish (*Chaetodontoplus duboulayi*) and green chromis (*Chromis cinerascens*) The main coral species landed in 2012 were the coral like anemones of the Corallimorpharia.	2017/2018: Total catch of 150,544 fishes, 21.9 t of coral, live rock & living sand and 322 L of marine plants.	Hand harvest while diving or wading. Hand held nets	Dive based fishery operating all year throughout WA waters, but restricted by diving depths. The MAFMF is able to operate in all State waters (between the Northern Territory border and South Australian border). The fishery is typically more active in waters south of Broome with higher levels of effort around the Capes region, Perth, Geraldton, Exmouth and Dampier. Operators in the MAFMF are also permitted to take coral, live rock, algae, seagrass and invertebrates under the Prohibition on Fishing (Coral, 'Live Rock' and Algae) Order 2007 and by way of Ministerial Exemption (Gaughan & Santoro, 2018).

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
Nickol Bay Prawn Managed Fishery (NBPMF)	Primarily targets banana prawns (*Penaeus merguiensis*)	2017/2018: 227 tonnes	Otter trawl	Operates along the western part of the North-West Shelf in coastal shallow waters The boundaries of the NBPMF are 'all the waters of the Indian Ocean and Nickol Bay between 116°45' east longitude and 120° east longitude on the landward side of the 200 m isobath'. The NBPMF incorporates the Nickol Bay, Extended Nickol Bay, Depuch and De Grey size managed fish grounds (State of the Fisheries 2014-15).
North Coast Trochus Fishery	Trochus (*Tectus niloticus*)	2017/2018: Unspecified	Harvested by with handheld levers or chisels	Indigenous fishery operating within King Sound
Northern Demersal Scalefish Managed Fishery (NDSF)	Red emperor (*Lutjanus sebae*) Goldband snapper (*Pristipomoides multidens*)	2017/2018:1317 tonnes (total) Goldband snapper (not including other jobfish): 473 tonnes Red emperor: 34 – 47 tonnes	The permitted means of operation within the fishery include handline, dropline and fish traps, but since 2002 it has essentially been a trap-based fishery which uses gear time access and spatial zones as the primary management measures (State of the Fisheries 2014-15).	The Northern Demersal Scalefish Managed Fishery (NDSF) operates off the northwest coast of Western Australia in the waters east of 120° E longitude. These waters extend out to the edge of the Australian Fishing Zone (200 nautical miles). The Fishery consists of three zones; Zone A is an inshore area, Zone B comprises the area with most historical fishing activity and Zone C is an offshore deep slope developmental area. The fishery is further divided into two fishing areas; an inshore sector and an offshore sector. The inshore waters in the vicinity of Broome are closed to commercial fishing.
WA North Coast Shark Fisheries	Sandbar (*Carcharhinus plumbeus)*, hammer head (*Sphyrnidae*), blacktip (*Carcharhinus melanopterus*) and lemmon sharks (*Negaprion brevirostris*).	2017/2018: closed since 2008/2009	Gill net, longline	Comprised of the State-managed WA North Coast Shark Fishery in the Pilbara and western Kimberley, and the Joint Authority Northern Shark Fishery in the eastern Kimberley.
Octopus Interim Managed Fishery	*Octopus cf. tetricus*, with occasional bycatch of *O. ornatus* and *O. cyanea*	2017/2018:	Line and pots	Fishery in development phase. Four main categories in WA waters. Octopus are

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
	in the northern parts of the fishery, and *O.maorum* in the southern and deeper sectors.	Commercial: 257 tonnes Recreational: 1 tonne	Trawl and trap (land Octopus as byproduct)	primarily caught in the Developing Octopus Interim Managed Fishery (largest fishery) are limited to the boundaries of the developmental fishery, which is an area bounded by the Kalbarri Cliffs (26°30'S) in the north and Esperance in the south. Passive and by-product harvests of octopus occur in both the Cockburn Sound (Line and Pot) Managed Fishery and the West Coast Rock Lobster Managed Fishery.
Offshore Net and Line Fishery	Blacktip sharks Grey mackerel,	The number of licences for the fishery is restricted to 17 and only 10 boats operated in 2015. Limited effort was undertaken in the outer offshore area of the fishery during 2012.	Lines and nets	The fishery covers an area of over 522,000 km2 and extends from the NT high water mark to the boundary of the AFZ. Majority of the fishing effort is in the coastal zone (within 12 nm of the coast) and immediately offshore in the Gulf of Carpentaria.
Onslow Prawn Managed Fishery (OPMF)	Western king prawns (*Penaeus latisulcatus*), brown tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus* spp.)	2017/2018: Negligible (Minimal fishing occurred in 2017)	Otter trawl	Operates along the western part of the North-West Shelf with most prawning activities concentrated in the shallower water off the mainland. The boundaries of the OPMF are 'all the Western Australian waters between the Exmouth Prawn Fishery and the Nickol Bay prawn fishery east of 114º39.9' on the landward side of the 200 m depth isobath'.
Pilbara Developmental Crab Fishery	Blue Swimmer (*Portunus armatus)* Mud Crab (*Scylla* spp)	2017/2018: 60 tonnes (total number includes Kimberley Developing Mud Crab Fishery)	Variety of gear but mostly commercial crab pots (Hourglass traps used in inshore waters from Onslow through to Port Hedland with most commercial and activity occurring in and around Nickol Bay)	The majority of the commercially and recreationally-fished stocks are concentrated in the coastal embayments and estuaries between Geographe Bay in the south west and Nickol Bay in the north. Crabbing activity along the Pilbara coast is centred largely on the inshore waters from Onslow through to Port Hedland, with most commercial and

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
			Recreational fishers use drop nets or scoop nets, with diving for crabs becoming increasingly popular	recreational activity occurring in and around Nickol Bay.
Pilbara Fish Trawl (Interim) Managed Fishery (PFTIMF)	Variety of demersal scalefish including goldband snapper (*Pristipomoides multidens*), red emperor (*Lutjanus sebae*), bluespotted emperor (*Lethrinus punctulatus*), crimson snapper (*Lutjanus erythropterus*), saddletail snapper (*Lutjanus malabaricus*), Rankin cod (*Epinephelus multinotatus*), brownstripe snapper (*Lutjanus vitta*), rosy threadfin bream (*Nemipterus furcosus*), spangled emperor (*Lethrinus nebulosus*) and frypan Moses' snapper (*Argyrops Lutjanusspinifer russelli*).	2017/2018: 1,780 tonnes	Demersal trawl	The Pilbara Fish Trawl (Interim) Managed Fishery is situated in the Pilbara region in the north west of Australia. It occupies the waters north of latitude 21°35'S and between longitudes 114°9'36"E and 120°E. The Fishery is seaward of the 50 m isobath and landward of the 200 m isobath. The Fishery consists of two zones; Zone 1 in the south west of the Fishery (which is closed to trawling) and Zone 2 in the North, which consists of six management areas.
Pilbara Trap Managed Fishery (PTMF)	Blue-spot emperor (*Lethrinus hutchinsi*), Red snapper (*Lutjanus erythropterus*), Goldband snapper (*Pristipomoides multidens*), Scarlet perch (*Lutjanus malabaricus*), Red emperor (*Lutjanus sebae*), Spangled emperor (*Lethrinus nebulosus*), Rankin cod (*Epinephelus multinotatus*)	2017/2018: 400–600 tonnes	Use of rectangular traps with single opening and 50 mm x 70 mm rectangular mesh panels. Trap fishing normally targets areas around rocky outcrops and reefs	Permitted to operate within waters bounded by a line commencing at the intersection of 21°56´ S latitude and the high water mark on the western side of the North West Cape.
Pilbara Line Managed Fishery	Variety of demersal scalefish including goldband snapper (*Pristipomoides multidens*), red emperor (*Lutjanus sebae*), bluespotted emperor	2017/2018: 50–115 tonnes	Line	The Pilbara Trap Managed Fishery lies north of latitude 21°44´ S and between longitudes 114°9´36´´ E and 120° E on the landward side of a boundary approximating the 200 m

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
	(*Lethrinus punctulatus*), crimson snapper (*Lutjanus erythropterus*), saddletail snapper (*Lutjanus malabaricus*), Rankin cod (*Epinephelus multinotatus*), brownstripe snapper (*Lutjanus vitta*), rosy threadfin bream (*Nemipterus furcosus*), spangled emperor (*Lethrinus nebulosus*) and frypan snapper (*Argyrops spinifer*), Ruby snapper (*Etelis carbunculus*) and eightbar grouper (*Hyporthodus octofasciatus)*			isobath and seaward of a line generally following the 30 m isobath.
Roe's Abalone	Western Australian Roe's abalone (*Haliotis roei*)	2017/2018: Commercial: 49 tonnes Recreational: 23 tonnes	Dive and wade fishery. The commercial fishery harvest method is a single diver working off a 'hookah' (surface-supplied breathing apparatus) using an abalone 'iron' to prise the shellfish off rocks. Abalone divers operate from small fishery vessels (generally less than 9 metres in length).	Operating in shallow coastal waters along WA's western and southern coasts from Shark Bay to the SA border. Divided into 8 management areas. Commercial fishing for Roe's abalone is managed in 6 separate regions from the South Australian border to Busselton Jetty – Areas 1, 2, 5, 6, 7 and 8. Area 8 of the fishery was not fished in 2013.
Shark Bay Crab Interim Managed Fishery	Blue swimmer crab (*Portunus armatus*)	2017/2018: 443 tonnes total Crab: 153 tonnes	Trawl and trap	Waters of Shark Bay north of Cape Inscription, to Bernier and Dorre Islands and Quobba Point. In addition, two fishers with long-standing histories of trapping crabs in Shark Bay are permitted to fish in the waters of Shark Bay south of Cape Inscription.
Shark Bay Prawn Managed Fishery	Western king prawn (*Penaeus latisulcatus*), brown tiger prawn (*Penaeus esculentus*), Variety of smaller prawn species including	2017/2018: 1,608 tonnes	Low opening otter trawls	The boundaries of the Shark Bay Prawn Managed Fishery are located in and near the waters of Shark Bay

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
	endeavour prawns (*Metapenaeus* spp.) and coral prawns (various species).			
Shark Bay Scallop Managed Fishery	Saucer Scallop (*Ylistrum balloti*)	2017/2018: 1,632 tonnes	Low opening otter trawls	The boundaries of the Shark Bay Scallop Managed Fishery are located in and near the waters of Shark Bay
South Coast Open Access Netting Fishery	Insufficient information	Insufficient information	Insufficient information	Bunbury to the South Australian Border
Specimen Shell Managed Fishery (SSF)	Shells (cowries, cones) The Specimen Shell Managed Fishery (SSF) is based on the collection of individual shells for the purposes of display, collection, cataloguing, classification and sale. Just under 200 (196) different Specimen Shell species were collected in 2012, using a variety of methods.	2017/2018: 7,806 shells	Hand harvest while diving or wading along coastal beaches below the high water mark An exemption method being employed by the fishery is using a remote controlled underwater vehicle at depths between 60 and 300 m.	Dive based fishery operating all year throughout WA waters, but restricted by diving depths. The fishing area includes all Western Australian waters between the high water mark and the 200 m isobath. While the fishery covers the entire WA coastline, there is some concentration of effort in areas adjacent to population centres such as Broome, Karratha, Exmouth, Shark Bay, metropolitan Perth, Mandurah, the Capes area and Albany.
South Coast Salmon Managed Fishery	WA salmon (*Arripis truttaceus*)	2017: 50 tonnes	Beach seine net, rod and line	Licensees operate from 18 designated beaches within the South Coast Bioregion, many of which have huts that are referred to as salmon camps.
South West Coast Salmon Managed Fishery	WA salmon (*Arripis truttaceus*)	Insufficient information	Insufficient information	Insufficient information
South West Coast Beach Net	Insufficient information	Insufficient information	Insufficient information	Insufficient information

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
South West Trawl Managed Fishery (SWTMF)	Saucer scallops (*Ylistrum balloti*)	2017/2018: 460 t meat weight (2,301 t whole weight)	Otter trawls	Waters between 31°34'27''S and 115°8'8''E where it intersects with the high water mark at Cape Leeuwin and on the landward side of the 200 m isobath.
Spanish Mackerel Fishery	Narrow-barred spanish Mackerel	In 2012, there were 16 fishery licences of which 12 were actively operating (DPIF 2014). The 2012 fishing effort was 719 boat-days; a decrease from 813 boat-days in 2011 but an increase from the 672 boat-days in 2010.	Near-surface trolling gear from vessels or handline.	The fishery extends from the NT waters seaward off the coast and river mouths to the outer limit of the AFZ. The majority of the fishing effort occurs coastal areas around reefs, shoals and headlands. The majority of the catch is taken in the Kimberley Area and north of Port Hedland.
Temperate Demersal Gillnet and Demersal Longline Fisheries (TDGDLF)	Gummy shark (*Mustelus antarcticus*), dusky shark (*Carcharhinus obscurus*), whiskery shark (*Furgaleus macki*) and sandbar shark (*Carcharhinus plumbeus*).	2017/2018: 2016-17Sharks and rays: 936 tonnes Scalefish: 133 tonnes	Demersal gillnets and power-hauled reels (to target sharks) Demersal longline	The Temperate Demersal Gillnet and Demersal Longline fisheries consists of Zone 1 of the Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery and the West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery. The Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery (JASDGDLF) spans the waters from 33° S latitude to the WA/SA border and comprises three management zones Zone 1 extends southwards from 33° S to 116° 30' E longitude off the south coast. Zone 2 extends from 116°30' E to the WA/SA border (129° E). A small number of Zone 3 units permit fishing throughout Zone 1 and eastwards to 116° 55'40" E. The West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery (WCDGDLF) technically extends northwards from 33° S latitude to 26° S longitude. However, the use of shark fishing

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
				gear has been prohibited north of 26° 30' S (Steep Point) since 1993. Demersal gillnet and longline fishing inside the 250 metre depth contour has been prohibited off the Metropolitan coast (between latitudes 31° S and 33° S) since November 2007.
Trepang Fishery	Sea cucumber (sandfish species)	The fishery is restricted to six licences, all of which are currently allocated.	Trepang are harvested by hand, either on foot or by diving.	Commercial fishing for sea cucumber is allowed from the high water mark to three nautical miles seaward from the territorial sea baseline. Most sea cucumbers are collected along the Arnhem Land coast, mainly around the Cobourg Peninsula and Groote Eylandt
Timor Reef Fishery	Goldband snapper	Consultation undertaken in 2016 confirmed there are only two active fishers currently operating in the fishery	Drop lines primarily in the 100 m–200 m depth range	Operates in remote offshore waters in the Timor Sea in a defined area approximately 370 km north-west of Darwin.
Warnbro Sound Crab Managed Fishery	Blue Swimmer (*Portunus armatus)* Blue swimmer crab (*Portunus armartus)*	2017/2018: closed to commercial and recreational fishing	Drop nets, scoop nets, diving	Includes Warnbro sound and adjacent water, extending from Becher Point to John Point.
West Coast Deep Sea Crustacean (Interim) Managed Fishery	Crystal (Snow) crabs (*Chaceon albus*), Giant (King) crabs (*Pseudocarcinus gigas*) and Champagne (Spiny) crabs (*Hypothalassia acerba*).	2017/2018: 164.4 tonnes	Baited pots operated in a longline formation in the shelf edge waters (>150 m)	North of latitude 34° 24' S (Cape Leeuwin) and west of the Northern Territory border on the seaward side of the 150 m isobath out to the extent of the AFZ, mostly in 500 to 800 m of water.
West Coast Demersal Scalefish (Interim) Managed Fishery	West Coast Inshore Demersals: West Australian Dhufish (*Glaucosoma hebraicum*), Pink snapper (*Pagrus auratus*) with other species captured including Redthroat Emperor (*Lethrinus miniatus*), Bight Redfish (*Centroberyx gerrardi*) and Baldchin Groper (*Choerodon rubescens*).	2017/2018: 248 tonnes	Handline and drop line	The WCDSIMF encompasses the waters of the Indian Ocean just south of Shark Bay (at 26°30'S) to just east of Augusta (at 115°30'E) and extends seaward to the 200 nm boundary of the Australian Fishing Zone (AFZ). The commercial fishery is divided into five management areas comprising four inshore areas and one offshore area. The inshore

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
	West Coast Offshore Demersals: Eightbar Grouper *Hyporthodus octofasciatus*, Hapuku *Polyprion oxygeneios*, Blue-eye Trevalla *Hyperoglyphe antarctica* and Ruby Snapper *Etelis carbunculus*.			areas, i.e. Kalbarri, Mid-West, Metropolitan and South-West, extend outwards to the 250 m depth contour, while the Offshore Area extends the entire length of the fishery from the 250 m depth contour to the boundary of the AFZ.
West Coast Estuarine Managed Fishery	Blue swimmer crab (*Portunus armartus)*	2017/2018: 353 tonnes (blue swimmer crab) commercial and 58-77 tonnes recreational	Drop nets, scoop nets, diving (crabs)	Includes the waters of the Swan and Canning Rivers (Area 1), the waters of the Peel Inlet and Harvey Estuary, together with the Murray Serpentine, Harvey and Dandalup Rivers (Area 2) and waters of the Hardy Inlet (Area 3). Of these areas only Areas 1-2 are permitted for crab fishing.
West Coast Nearshore and Estuarine Finfish Fisheries	<u>Nearshore:</u> whitebait (*Hyperlophus vittatus*), western Australian salmon (*Arripis truttaceus*), Australian herring (*Arripis georgianus*), sourthern school whiting (*Sillago bassensis*), yellowfin whiting (*Sillago schomburgkii*), yelloweye mullet (*Aldrichetta forsteri*), tailor (*Pomatomus saltarix*), southern garfish (*Hyporhamphus melanochir*), silver trevally (*Pseudocaranx georgianus*) and King George whtiting (*Sillaginodes punctate*). <u>Estuarine:</u> sea mullet (*Mugil cephalus*), estuary cobbler (*Cnidoglanis macrocephalus*) and black bream (*Acanthopagrus butcheri*).	2017/2018: 353 tonnes	Haul, beach seine and gill netting (commercial). Line fishing (recreational)	Five commercial fisheries target nearshore and/or estuarine finfish in the West Coast Bioregion. <u>Nearshore:</u> Cockburn Sound Fish Net Managed Fishery operating within in Cockburn sound, South West Coast Salmon Managed Fishery operating on various beaches south of the Perth Metropolitan area, West Coast Beach Bait Managed Fishery operating on beaches spanning from Moore River to Tim's Thicket and the South West Beach Seine Fishery operating on various beaches from Tim's Thicket southwards to Port Geographe Bay Marina. <u>Estuarine:</u> West Coast Estuarine Managed Fishery operating in the Swan/Canning and Peel Harvey estuaries, and in the Hardy Inlet
West Coast Nearshore Net Managed Fishery	Southern garfish (Hyporhamphus melanochir), Australian herring (Arripis georgianus),	Insufficient information	Insufficient information	Insufficient information

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
West Coast Purse Seine Fishery	Scaly mackerel (*Sardinella lemuru*), pilchard (*S. sagax*), Australian anchovy (*Engraulis australis*), yellowtail scad (*Trachurus novaezelandiae*) and maray (*Etrumeus teres*).	2017/2018: 1,095 tonnes	Purse seine gear	Waters between Ningaloo and Cape Leeuwin including three separate zones: Northern Development (22°00'S to 31°00'S), Perth Metropolitan (31°00'S to 33°00'S) and Southern Development Zone (33°00'S to Cape Leeuwin).
West Coast Rock Lobster Managed Fishery (WCRLMF)	Western rock lobster (*Panulirus cygnus*)	2016: 272 – 400 tonnes (346-481 tonnes based on updated average weight)	Baited traps (pots). Pots and diving (recreational catch)	The fishery is situated along the west coast of Australia between Latitudes 21°44´ to 34°24´ S. The fishery is managed in three zones: Zone A – Abrolhos Islands, north of latitude 30° S excluding the Abrolhos Islands (Zone B) and south of latitude 30° S (Zone C).
West Coast Demersal Gillnet and Demersal Longline (WCDGDLF)*	Gummy shark (*Mustelus antarcticus*), dusky shark (*Carcharhinus obscurus*), whiskery shark (*Furgaleus macki*) and sandbar shark (*C. plumbeus*)	2016/2018: 936 tonnes of sharks and rays	Demersal gillnets and demersal longline (not widely used)	Operates between 26° and 33° S.
Mackerel Fishery	Spanish mackerel *(Scomberomorus commerson)*, grey mackerel *(S.semifasciatus)*, with other species from the genera *Scomberomorus*, *Grammatorcynus* and *Acanthocybium* also contributing to commercial catches.	2016: Commercial: The commercial catch of spanish mackerel was 276 tonnes in 2016 (Gaughan & Santoro, 2018)	Trolling or handline Near-surface trolling gear from vessels in coastal areas around reefs, shoals and headlands. Jig fishing is also used to capture grey mackerel *(S.semifasciatus)*	The Fishery extends from the West Coast Bioregion to the WA/NT border, to the 200 nautical mile AFZ with most effort and catches recorded north of Geraldton, especially from the Kimberley and Pilbara coasts of the Northern Bioregion. Restricted to coastal and shallower waters. Catches are reported separately for three Areas: Area 1 - Kimberley (121º E to WA/NT border); Area 2 -Pilbara (114º E to 121º E); Area 3 - Gascoyne (27º S to 114º E) and West Coast (Cape Leeuwin to 27º S).

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
Western Australian Pearl Oyster Managed Fishery	Indo- Pacific silver-lipped pearl oyster (*Pinctada maxima*).	2018: 468,573 shells	Drift diving restricted to shallow diveable depths. The collection of pearl oysters for the Pearl Oyster Managed Fishery is restricted to shallow diving depths below 35 m. Divers are attached to large outrigger booms on a vessel and towed slowly over the pearl oyster beds, harvesting legalised oysters by hand as they are seen.	The fishery is separated into four zones: Pearl Oyster Zone 1: NW Cape (including Exmouth Gulf) to longitude 119°30'E. There are five licensees in this zone. No fishing in this zone since 2008 Pearl Oyster Zone 2: East of Cape Thouin (118°20´ E) and south of latitude 18°14´ S. The 9 licensees in this zone also have full access to Zone 3. This zone is the mainstay of the fishery. Pearl Oyster Zone 3: West of longitude 125°20´ E and north of latitude 18°14´ S. The 2 licensees in this zone also have partial access to Zone 2. Pearl Oyster Zone 4: East of longitude 125°20´ E to the Western Australia/Northern Territory border. Although all licensees have access to this zone, exploratory fishing has shown that stocks in this area are not economically viable. However, pearl farming does occur.
Western Australian Sea Cucumber Fishery (formerly known as Beche-de-mer)	Sandfish (*Holothuria scabra*) and deepwater redfish (*Actinopyga echinites*).	2016: 93 tonnes	Hand-harvest fishery, with animals caught principally by diving, and a smaller amount by wading.	The Western Australian Sea Cucumber Fishery is permitted to operate throughout WA waters with the exception of a number of specific closures around the Dampier Archipelago, Cape Keraudren, Cape Preston and Cape Lambert, the Rowley Shoals and the Abrolhos Islands. The fishery is primarily based in the northern half of the State, from Exmouth Gulf to the Northern Territory border.
Commonwealth Managed Fisheries				

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
North West Slope Trawl	Scampi (crayfish): velvet scampi (*Metanephrops velutinus*) and boschmai scampi (*Metanephrops boschmai*). Deepwater prawns (penaeid and carid): pink prawn (*Parapenaeus longirostris*), red prawn (*Aristaeomorpha foliacea*), striped prawn (*Aristeus virilis*), giant scarlet prawn (*Aristaeopsis edwardsiana*), red carid prawn (*Heterocarpus woodmasoni*) and white carid prawn (*Heterocarpus sibogae*). Snapper.	2017-18: 79.7 total tonnes.	Demersal crustacean trawl seaward of the 200 m isobath.	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).
Western Skipjack Tuna Fishery	Skipjack tuna (*Katsuwonus pelamis*)	2017-18: None in either zones	Purse seine	The Skipjack Tuna Fishery is split into two sectors; east and west. The Western Skipjack Tuna Fishery is located in all Australia waters west of 142° 30' 00°E, out to 200 nm from the coast. There has been no fishing effort in the Skipjack Tuna Fishery since the 2008-09 season, and in that season activity concentrated off South Australia (Department of Agriculture 2019).
Small Pelagic Fishery	Australian sardine (*Sardinops sagax*), blue mackerel (*Scomber australasicus*), jack mackerel (*Trachurus declivis*) and redbait (*Emmelichthys nitidus*).	2018-19: 9,424 tonnes	Purse-seine and midwater trawling	Extends from Queensland to southern Western Australia.
Southern Bluefin Tuna Fishery	Southern bluefin tuna (*Thunnus maccoyii*).	2017-18: 6,159 tonnes	Purse seine vessels primarily in Great Australian Bight all year round and longline off southern NSW in winter.	Fishery includes all waters of Australia, out to 200 nm from the coast. No current effort on the North West Shelf, fishing activity is concentrated in the Great Australian Bight

Fishery	Target Species	Catch[1]	Fishing Method	Area Description
			Around 98% of Australia's SBT quota is taken by 5–10 purse seine vessels fishing for 13–25 kg southern bluefin tuna.	and off South-east Australia (Department of Agriculture 2019).
Western Deepwater Trawl Fishery	A diverse range of species are caught, ranging from tropical and ruby snappers on the shelf edge to orange roughy (*Hoplostethus atlanticus*), oreo dories and bugs (*Ibacus* spp.) in the deeper temperate waters.	2017-18: 101.9 tonnes	Demersal fish trawl seaward of the 200 m isobath.	Its northernmost point is from the boundary of the AFZ to longitude 114° E, and its southernmost point is from the boundary of the AFZ to longitude 115°08' E. Deep water off WA, from the 200 m isobath to the edge of the AFZ.
Western Tuna and Billfish Fishery	Broadbill swordfish (*Xiphias gladius*), albacore tuna (*Thunnus alalunga*), striped marlin (*Kajikia audax*), bigeye tuna (*T. obesus*) and yellowfin tuna (*T. albacares*).	2018: 278 tonnes	Pelagic, longline, minor line and purse seine.	Extends westward from Cape York Peninsula (142°30' E) off Queensland to 34° S off the WA west coast. It also extends eastward from 34° S off the west coast of WA across the Great Australian Bight to 141° E at the South Australian–Victorian border. In recent years, fishing effort has concentrated off south-west Western Australia and South Australia with no current effort on the North West Shelf (Department of Agriculture 2019).

Source: Apache (2008); Australian Fisheries Management Authority (2011); Department of Fisheries (2013), Stakeholder consultation.

[1]Sources for catch data: Department of Agriculture 2019; Gaughan *et al*, 2019; DPIRD 2018.

15. Document review

This document is to be reviewed annually at a minimum. The review and revision will consider any changes to the spatial scope of the document, i.e. the Environment that May be Affected (EMBA), as well as any changes to EPBC Act Matters of National Environmental Significance (MNES) from one review year to the next, regardless of any changes to the spatial extent of the combined EMBA. A review of changes to MNES shall consider at a minimum any changes to EPBC Act species lists, species management/recovery plans and MNES spatial layers. Changes are to be recorded within the MNES review register (**Appendix B**).

16. References

16.1 Physical Environment

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16.10 Key Ecological Features

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Appendix A: EPBC Act Protected Matters Reports

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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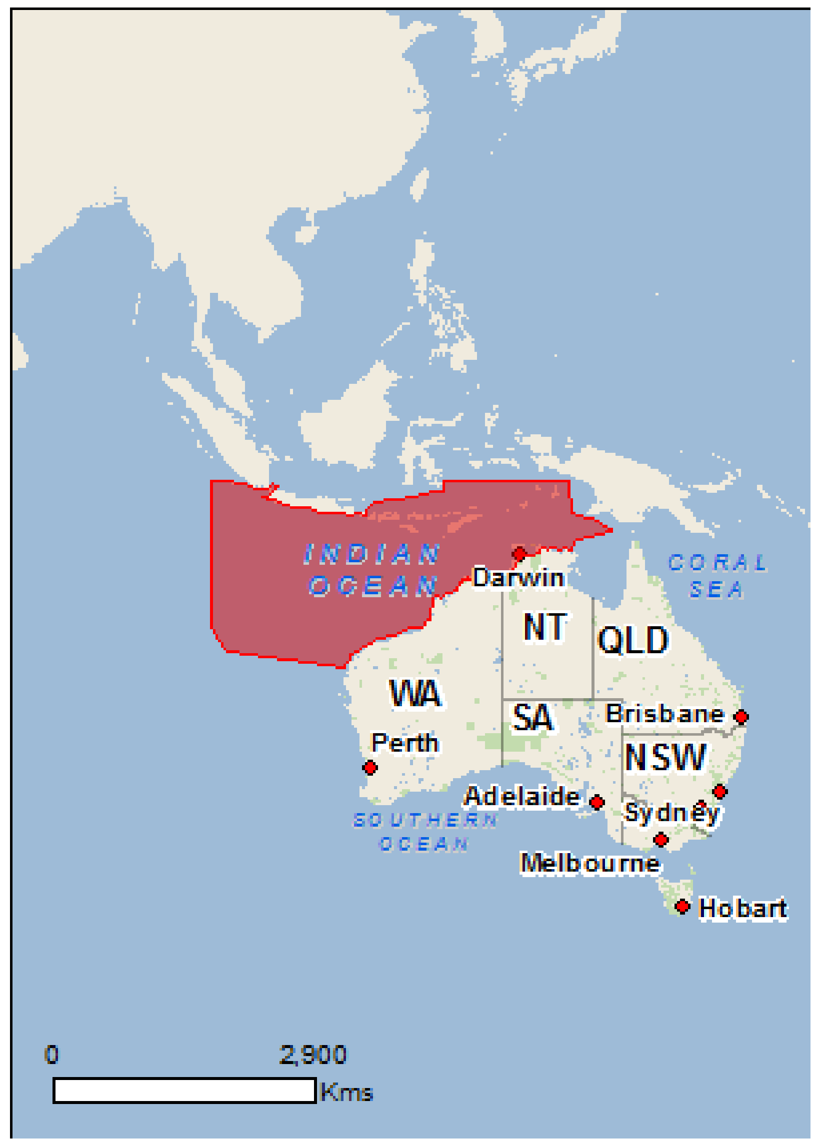

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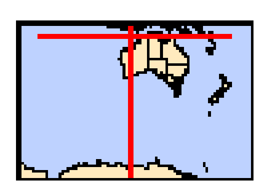


Summary

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:	2
National Heritage Places:	3
Wetlands of International Importance:	6
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	103
Listed Migratory Species:	92

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:	33
Commonwealth Heritage Places:	23
Listed Marine Species:	164
Whales and Other Cetaceans:	32
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	2
Australian Marine Parks:	27

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	45
Regional Forest Agreements:	None
Invasive Species:	47
Nationally Important Wetlands:	17
Key Ecological Features (Marine)	17

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
Kakadu National Park	NT	Declared property
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
Kakadu National Park	NT	Listed place
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
Cobourg peninsula	Within Ramsar site
Hosnies spring	Within Ramsar site
Kakadu national park	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
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Endangered	Community likely to occur within area
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

Name	Status	Type of Presence
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 habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known 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	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Epthianura crocea tunneyi Alligator Rivers Yellow Chat, Yellow Chat (Alligator Rivers) [67089]	Endangered	Species or species habitat known 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
Malurus leucopterus edouardi White-winged Fairy-wren (Barrow Island), Barrow Island Black-and-white Fairy-wren [26194]	Vulnerable	Species or species habitat likely to occur within area
Melanodryas cucullata melvillensis Tiwi Islands Hooded Robin, Hooded Robin (Tiwi	Critically Endangered	Species or species

Name	Status	Type of Presence
Islands) [67092]		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
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
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may 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 known 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
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Mammals		
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

Name	Status	Type of Presence
		to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia lesueur Barrow and Boodie Islands subspecies Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Species or species habitat known to occur within area
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
Isoodon auratus auratus Golden Bandicoot (mainland) [66665]	Vulnerable	Species or species habitat likely to occur within area
Isoodon auratus barrowensis Golden Bandicoot (Barrow Island) [66666]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes conspicillatus conspicillatus Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus Central Australian subspecies Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Breeding likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat may 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 known to occur within area
Mesembriomys gouldii melvillensis Black-footed Tree-rat (Melville Island) [87619]	Vulnerable	Species or species habitat known to occur within area
Osphranter robustus isabellinus Barrow Island Wallaroo, Barrow Island Euro [89262]	Vulnerable	Species or species habitat likely to occur within area
Petrogale concinna canescens Nabarlek (Top End) [87606]	Endangered	Species or species habitat likely to occur within area
Petrogale concinna concinna Nabarlek (Victoria River District) [87605]	Critically Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Petrogale concinna monastria Nabarlek (Kimberley) [87607]	Endangered	Species or species habitat known to occur within area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Phascogale pirata Northern Brush-tailed Phascogale [82954]	Vulnerable	Species or species habitat known to occur within area
Phascogale tapoatafa kimberleyensis Kimberley brush-tailed phascogale, Brush-tailed Phascogale (Kimberley) [88453]	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
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat known 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
Stylidium ensatum a triggerplant [86366]	Endangered	Species or species habitat known to occur within area
Tectaria devexa [14767]	Endangered	Species or species habitat likely to occur within area
Typhonium jonesii a herb [62412]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Typhonium mirabile a herb [79227]	Endangered	Species or species habitat known to occur within area
Typhonium taylori a herb [65904]	Endangered	Species or species habitat likely 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 known 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	Breeding 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
Cryptoblepharus gurrmul Arafura Snake-eyed Skink [83106]	Endangered	Species or species habitat known to occur within area
Ctenotus zastictus Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat known 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	Foraging, feeding or related behaviour 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
Lucasium occultum Yellow-snouted Gecko, Yellow-snouted Ground Gecko [82993]	Endangered	Species or species habitat likely 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		

Name	Status	Type of Presence
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
Glyphis glyphis Speartooth Shark [82453]	Critically Endangered	Species or species habitat known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	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 likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata 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

Name	Threatened	Type of Presence
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
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
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	Breeding known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	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

Name	Threatened	Type of Presence
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
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]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur

Name	Threatened	Type of Presence
		within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting known to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa incana Wandering Tattler [831]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Customs Service
Commonwealth Land - Australian Government Solicitor
Commonwealth Land - Christmas Island National Park
Commonwealth Land - Department of Administrative Services
Commonwealth Land - Department of Community Services & Health
Commonwealth Land - Department of Immigration Local Government & Ethnic Affairs
Commonwealth Land - Department of Transport & Regional Development
Commonwealth Land - Deputy Crown Solicitor
Commonwealth Land - Director of Property Services Defence Estate
Commonwealth Land - Kakadu National Park
Defence - AUSTRALIAN ARMY BAND - DARWIN
Defence - BERRIMAH ONE
Defence - BRADSHAW FIELD TRAINING AREA
Defence - DARWIN - AP10 RADAR SITE - LEE POINT
Defence - DARWIN - AP3 RECEIVING STATION - LEE POINT
Defence - DARWIN - TRANSMITTING STATION '11 MILE'
Defence - DARWIN RELOCATIONS CENTRE
Defence - DEFENCE FORCE CAREERS REFERENCE CENTRE
Defence - Esanda Builidng
Defence - HMAS COONAWARRA (Berrimah)
Defence - KOWANDI NORTH COMMUNICATION STATION
Defence - LARRAKEYAH BARRACKS
Defence - LEANYER BOMBING RANGE
Defence - MT GOODWIN RADAR SITE
Defence - Patrol Boat Base (DARWIN NAVAL BASE)
Defence - QUAIL ISLAND BOMBING RANGE
Defence - RAAF BASE DARWIN
Defence - ROBERTSON BARRACKS (Waler Barracks)
Defence - SHOAL BAY RECEIVING STATION
Defence - STOKES HILL OIL FUEL INSTALLATION
Defence - WINNELLIE ONE
Defence - WINNELLIE TWO

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
Larrakeyah Barracks Headquarters Building	NT	Listed place
Larrakeyah Barracks Precinct	NT	Listed place
Larrakeyah Barracks Sergeants Mess	NT	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
RAAF Base Commanding Officers Residence	NT	Listed place
RAAF Base Precinct	NT	Listed place
RAAF Base Tropical Housing Type 2	NT	Listed place
RAAF Base Tropical Housing Type 3	NT	Listed place

Name	State	Status
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
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]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Fregata 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
Gallinago megala Swinhoe's Snipe [864]		Roosting known to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Heteroscelus incanus Wandering Tattler [59547]		Roosting known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting 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
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area

Name	Threatened	Type of Presence
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 minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat 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 Bosunbird [26021]	Endangered	Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
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

Name	Threatened	Type of Presence
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Stiltia isabella Australian Pratincole [818]		Roosting known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
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

Name	Threatened	Type of Presence
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
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

Name	Threatened	Type of Presence
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
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

Name	Threatened	Type of Presence
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773]		Species or species habitat may occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour 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 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

Name	Threatened	Type of Presence
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 Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area

Name	Status	Type of Presence
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
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

Name	Status	Type of Presence
		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)
Kakadu	NT	National Park (Commonwealth)

Australian Marine Parks [Resource Information]

Name	Label
Arafura	Multiple Use Zone (IUCN VI)
Arafura	Special Purpose 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)
Arnhem	Special Purpose Zone (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	Habitat Protection Zone (IUCN IV)
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	National Park Zone (IUCN II)
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
Barrow Island	WA
Bedout Island	WA
Boodie, Double Middle Islands	WA
Browse Island	WA
Buffalo Creek	NT
Cape Range	WA
Casuarina	NT
Channel Point	NT
Charles Darwin	NT

Name	State
Dambimangari	WA
Djukbinj	NT
Garig Gunak Barlu	NT
George Brown Darwin	NT
Holmes Jungle	NT
Howard Springs	NT
Howard Springs	NT
Keep River	NT
Knuckey Lagoons	NT
Lawley River	WA
Lesueur Island	WA
Low Rocks	WA
Lowendal Islands	WA
Marri-Jabin (Thamurrurr - Stage 1)	NT
Marthakal	NT
Mary River	NT
Mijing	WA
Mitchell River	WA
Montebello Islands	WA
Niiwalarra Islands	WA
Ord River	WA
Pelican Island	WA
Shoal Bay	NT
Swan Island	WA
Tree Point Conservation Area	NT
Unnamed WA28968	WA
Unnamed WA40828	WA
Unnamed WA41080	WA
Unnamed WA41775	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		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
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

Name	Status	Type of Presence
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		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 javanicus Banteng, Bali Cattle [15]		Species or species habitat likely to occur within area
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Bubalus bubalis Water Buffalo, Swamp Buffalo [1]		Species or species habitat likely to occur within area
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus 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

Name	Status	Type of Presence
		within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Annona glabra Pond Apple, Pond-apple Tree, Alligator Apple, Bullock's Heart, Cherimoya, Monkey Apple, Bobwood, Corkwood [6311]		Species or species habitat may occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		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
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		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
Opuntia spp. Prickly Pears [82753]		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
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
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		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

Name	Status	Type of Presence
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
Lepidodactylus lugubris		
Mourning Gecko [1712]		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
Adelaide River Floodplain System	NT
Ashmore Reef	EXT
Cape Range Subterranean Waterways	WA
Cobourg Peninsula System	NT
Daly-Reynolds Floodplain-Estuary System	NT
Finniss Floodplain and Fog Bay Systems	NT
Hosine's Spring, Christmas Island	EXT
Kakadu National Park	NT
Legune Wetlands	NT
Mary Floodplain System	NT
Mermaid Reef	EXT
Moyle Floodplain and Hyland Bay System	NT
Murgenella-Cooper Floodplain System	NT
Ord Estuary System	WA
Port Darwin	NT
Shoal Bay - Micket Creek	NT

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
Gulf of Carpentaria basin	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

-7.36981 115.89261,-7.19135 116.29949,-6.55485 120.37194,-6.45848 120.55397,-6.19436 120.92517,-6.09044 122.66372,-5.91198 123.1872,-5.19516 123.20505,-5.0 123.30171,-5.0 135.75335,-8.24306 136.04424,-8.60962 137.51393,-8.75048 138.07868,-9.22161 139.04237,-9.86407 139.99177,-10.04253 139.98463,-10.72382 136.62178,-11.52618 135.99955,-11.77364 135.96981,-11.58685 135.37375,-11.74851 134.8812,-11.67712 134.38627,-11.55815 133.8152,-11.88652 133.63912,-11.48968 133.38979,-11.48677 132.93956,-12.14826 132.70162,-12.30784 132.365,-12.31736 131.16575,-12.59747 130.95403,-12.70638 130.56727,-13.40612 130.3488,-13.69213 130.02282,-14.23465 129.76584,-15.26257 129.80391,-15.28538 129.09681,-14.94928 128.87374,-15.03207 128.41037,-14.98497 128.16585,-14.62508 127.94872,-14.35212 127.78478,-14.14918 127.56355,-13.98357 127.33702,-13.84842 127.01722,-14.01273 126.7518,-14.12444 126.43663,-14.11902 126.31522,-14.49944 126.13206,-14.68485 125.91315,-14.51543 125.63714,-14.55422 125.52746,-14.55822 125.32684,-14.75504 125.19884,-14.81285 125.02928,-14.97063 124.91824,-15.02928 124.81225,-15.29304 124.7617,-15.34812 124.43249,-15.71938 124.51209,-15.84727 124.1046,-15.85025 123.58112,-16.31722 123.12308,-16.43833 122.97091,-16.30699 122.7639,-16.31841 122.51405,-16.58681 122.22566,-16.84665 122.02293,-18.11788 121.96844,-18.38967 121.84471,-18.49318 121.56274,-19.1856 121.16656,-19.32182 119.91259,-20.05946 118.11371,-20.23125 117.09824,-20.27051 116.58428,-20.6203 116.24164,-21.34484 115.08522,-21.58695 114.57006,-21.61586 114.38411,-21.70533 114.09667,-21.81336 113.98512,-21.90758 113.92516,-22.26736 113.89946,-22.41013 113.67246,-22.97204 113.32089,-21.53425 101.85645,-21.22968 101.3996,-20.44921 100.82852,-19.1072 100.04806,-5.0 100.09375,-5.0 101.31603,-5.13788 103.52417,-5.69943 104.43788,-5.75654 105.3516,-5.90168 105.61809,-5.59254 105.83277,-5.32348 106.26055,-5.43055 106.79236,-5.54834 106.78165,-5.99448 106.07852,-6.3514 105.92861,-6.52077 105.69911,-6.59054 105.32899,-6.71546 105.90363,-6.87964 106.41045,-6.99029 106.6139,-7.4293 107.52047,-7.52805 108.64596,-7.58515 109.71196,-8.04867 111.00163,-8.10578 113.10031,-8.38465 114.10801,-8.1943 114.5149,-8.25854 114.89323,-8.40488 115.12166,-8.48697 115.49286,-7.81953 115.47858,-7.36981 115.89261

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.

Department of Agriculture Water and the Environment
GPO Box 858
Canberra City ACT 2601 Australia
+61 2 6274 1111

Australian Government

Department of Agriculture, Water and the Environment

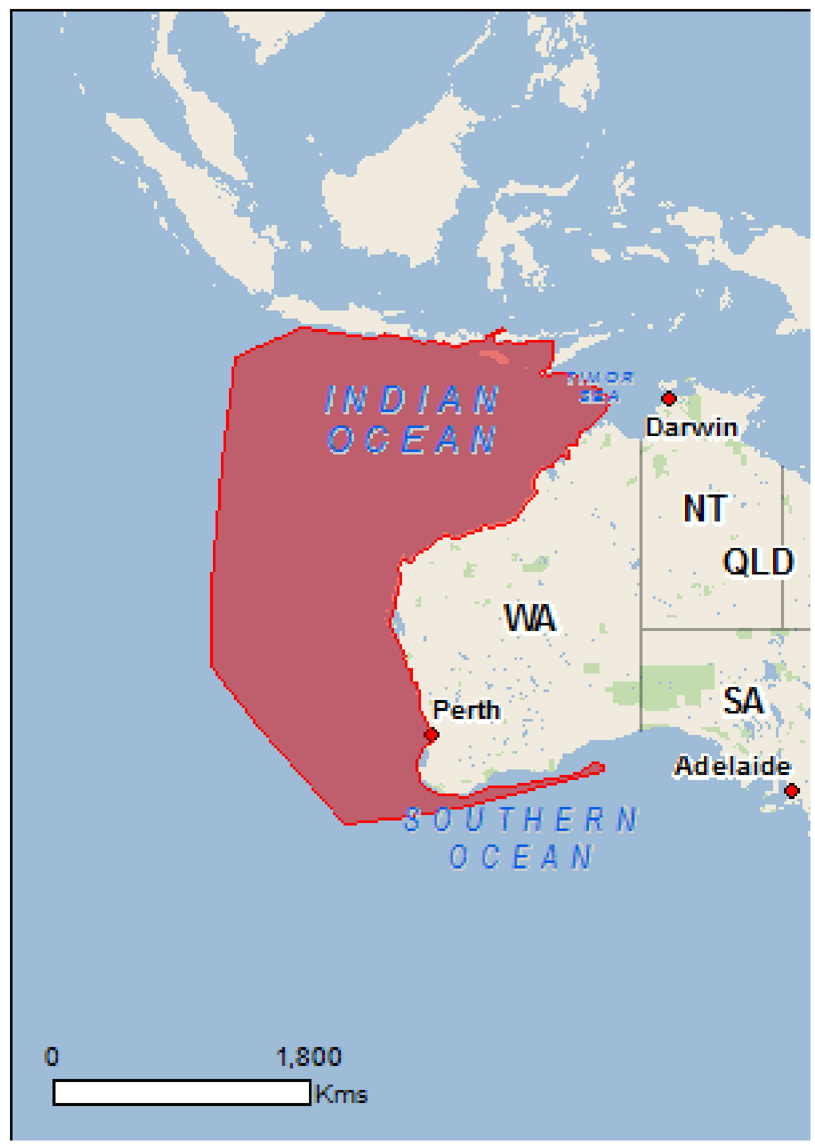
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

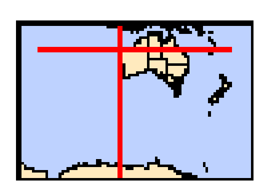
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 18/12/20 15:00:04



Coordinates

Buffer: 0.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	4
National Heritage Places:	9
Wetlands of International Importance:	8
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	10
Listed Threatened Species:	175
Listed Migratory Species:	110

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:	18
Commonwealth Heritage Places:	24
Listed Marine Species:	215
Whales and Other Cetaceans:	44
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	1
Australian Marine Parks:	44

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	144
Regional Forest Agreements:	1
Invasive Species:	65
Nationally Important Wetlands:	27
Key Ecological Features (Marine)	23

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
Australian Convict Sites (Fremantle Prison Buffer Zone)	WA	Buffer zone
Australian Convict Sites (Fremantle Prison)	WA	Declared property
Shark Bay, Western Australia	WA	Declared property
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
Lesueur National Park	WA	Listed place
Shark Bay, Western Australia	WA	Listed place
The Ningaloo Coast	WA	Listed place
The West Kimberley	WA	Listed place
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place
Historic		
Batavia Shipwreck Site and Survivor Camps Area 1629 - Houtman Abrolhos	WA	Listed place
Dirk Hartog Landing Site 1616 - Cape Inscription Area	WA	Listed place
Fremantle Prison (former)	WA	Listed place
HMAS Sydney II and HSK Kormoran Shipwreck Sites	EXT	Listed place

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Ashmore reef national nature reserve	Within Ramsar site
Becher point wetlands	Within 10km of Ramsar
Eighty-mile beach	Within Ramsar site
Forrestdale and thomsons lakes	Within Ramsar site
Hosnies spring	Within Ramsar site
Peel-yalgorup system	20 - 30km upstream
Roebuck bay	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-west
South-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
Aquatic Root Mat Community 3 in Caves of the	Endangered	Community known to

Name	Status	Type of Presence
Leeuwin Naturaliste Ridge		occur within area
Aquatic Root Mat Community 4 in Caves of the Leeuwin Naturaliste Ridge	Endangered	Community known to occur within area
Aquatic Root Mat Community in Caves of the Swan Coastal Plain	Endangered	Community known to occur within area
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Endangered	Community likely to occur within area
Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia	Endangered	Community may occur within area
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	Endangered	Community known to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
Thrombolite (microbial) community of coastal freshwater lakes of the Swan Coastal Plain (Lake Richmond)	Endangered	Community known to occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically 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
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris		
Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calyptorhynchus banksii naso		
Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii		
Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Breeding known to occur within area
Calyptorhynchus latirostris		
Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding known to occur within area
Cereopsis novaehollandiae grisea		
Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]	Vulnerable	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	Roosting known to occur within area
Charadrius mongolus		
Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area

Name	Status	Type of Presence
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may 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
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [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
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Malurus leucopterus edouardi White-winged Fairy-wren (Barrow Island), Barrow Island Black-and-white Fairy-wren [26194]	Vulnerable	Species or species habitat likely to occur within area
Malurus leucopterus leucopterus White-winged Fairy-wren (Dirk Hartog Island),	Vulnerable	Species or species

Name	Status	Type of Presence
Dirk Hartog Black-and-White Fairy-wren [26004]		habitat likely 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
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
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
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Turdus poliocephalus erythropleurus Christmas Island Thrush [67122]	Endangered	Species or species habitat likely to occur within area
Turnix varius scintillans Painted Button-quail (Houtman Abrolhos) [82451]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely to occur within area
Crustaceans		
Cherax tenuimanus Hairy Marron, Margaret River Hairy Marron, Margaret River Marron [78931]	Critically Endangered	Species or species habitat may occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Nannatherina balstoni Balston's Pygmy Perch [66698]	Vulnerable	Species or species habitat likely to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Insects		
Hesperocolletes douglasi Douglas' Broad-headed Bee, Rottnest Bee [66734]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia lesueur Barrow and Boodie Islands subspecies Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Species or species habitat known to occur within area
Bettongia lesueur lesueur Burrowing Bettong (Shark Bay), Boodie [66659]	Vulnerable	Species or species habitat known to occur within area
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat known to occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat likely to occur within area
Crocidura trichura Christmas Island Shrew [86568]	Critically Endangered	Species or species habitat likely to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area

Name	Status	Type of Presence
Isoodon auratus auratus Golden Bandicoot (mainland) [66665]	Vulnerable	Species or species habitat likely to occur within area
Isoodon auratus barrowensis Golden Bandicoot (Barrow Island) [66666]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes conspicillatus conspicillatus Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus Central Australian subspecies Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within area
Lagorchestes hirsutus bernieri Rufous Hare-wallaby (Bernier Island) [66662]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus dorreae Rufous Hare-wallaby (Dorre Island) [66663]	Vulnerable	Species or species habitat known to occur within area
Lagostrophus fasciatus fasciatus Banded Hare-wallaby, Merrnine, Marnine, Munning [66664]	Vulnerable	Species or species habitat known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat known to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Breeding known to occur within area
Osphranter robustus isabellinus Barrow Island Wallaroo, Barrow Island Euro [89262]	Vulnerable	Species or species habitat likely to occur within area
Parantechinus apicalis Dibbler [313]	Endangered	Species or species habitat known to occur within area
Perameles bougainville bougainville Western Barred Bandicoot (Shark Bay) [66631]	Endangered	Species or species habitat known to occur within area
Petrogale concinna monastria Nabarlek (Kimberley) [87607]	Endangered	Species or species habitat known to occur within area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Phascogale tapoatafa kimberleyensis Kimberley brush-tailed phascogale, Brush-tailed Phascogale (Kimberley) [88453]	Vulnerable	Species or species habitat likely to occur within area
Pipistrellus murrayi Christmas Island Pipistrelle [64383]	Critically Endangered	Species or species habitat known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat known to occur

Name	Status	Type of Presence
		within area
Pseudomys fieldi Shark Bay Mouse, Djoongari, Alice Springs Mouse [113]	Vulnerable	Species or species habitat likely to occur within area
Pteropus natalis Christmas Island Flying-fox, Christmas Island Fruit-bat [87611]	Critically Endangered	Roosting known to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat known to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat may occur within area
Other		
Idiosoma nigrum Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider [66798]	Vulnerable	Species or species habitat known to occur within area
Kumonga exleyi Cape Range Remipede [86875]	Vulnerable	Species or species habitat known to occur within area
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Androcalva bivillosa Straggling Androcalva [87807]	Critically Endangered	Species or species habitat likely to occur within area
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat likely to occur within area
Asplenium listeri Christmas Island Spleenwort [65865]	Critically Endangered	Species or species habitat known to occur within area
Banksia nivea subsp. uliginosa Swamp Honeypot [82766]	Endangered	Species or species habitat may occur within area
Banksia squarrosa subsp. argillacea Whicher Range Dryandra [82769]	Vulnerable	Species or species habitat may occur within area
Beyeria lepidopetala Small-petalled Beyeria, Short-petalled Beyeria [18362]	Endangered	Species or species habitat likely to occur within area
Caladenia barbarella Small Dragon Orchid, Common Dragon Orchid [68686]	Endangered	Species or species habitat may occur within area
Caladenia bryceana subsp. cracens Northern Dwarf Spider-orchid [64556]	Vulnerable	Species or species habitat known to occur

Name	Status	Type of Presence
		within area
Caladenia elegans Elegant Spider-orchid [56775]	Endangered	Species or species habitat known to occur within area
Caladenia excelsa Giant Spider-orchid [56717]	Endangered	Species or species habitat likely to occur within area
Caladenia hoffmanii Hoffman's Spider-orchid [56719]	Endangered	Species or species habitat known to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Caladenia lodgeana Lodge's Spider-orchid [68664]	Critically Endangered	Species or species habitat likely to occur within area
Calectasia cyanea Blue Tinsel Lily [7669]	Critically Endangered	Species or species habitat likely to occur within area
Chorizema varium Limestone Pea [16981]	Endangered	Species or species habitat known to occur within area
Conostylis dielsii subsp. teres Irwin's Conostylis [3614]	Endangered	Species or species habitat may occur within area
Conostylis micrantha Small-flowered Conostylis [17635]	Endangered	Species or species habitat may occur within area
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
Drakaea concolor Kneeling Hammer-orchid [56777]	Vulnerable	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Drummondita ericoides Morseby Range Drummondita [9193]	Endangered	Species or species habitat may occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus argutifolia Yanchep Mallee, Wabling Hill Mallee [24263]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Eucalyptus beardiana Beard's Mallee [18933]	Vulnerable	Species or species habitat may occur within area
Eucalyptus cuprea Mallee Box [56773]	Endangered	Species or species habitat likely to occur within area
Gastrolobium papilio Butterfly-leaved Gastrolobium [78415]	Endangered	Species or species habitat may occur within area
Grevillea batrachioides Mt Lesueur Grevillea [21735]	Endangered	Species or species habitat may occur within area
Grevillea humifusa Spreading Grevillea [61182]	Endangered	Species or species habitat may occur within area
Hemiandra gardneri Red Snakebush [7945]	Endangered	Species or species habitat likely to occur within area
Isopogon uncinatus Albany Cone Bush, Hook-leaf Isopogon [20871]	Endangered	Species or species habitat likely to occur within area
Kennedia glabrata Northcliffe Kennedia [16452]	Vulnerable	Species or species habitat likely to occur within area
Lambertia echinata subsp. occidentalis Western Prickly Honeysuckle [64528]	Endangered	Species or species habitat may occur within area
Lechenaultia chlorantha Kalbarri Leschenaultia [16763]	Vulnerable	Species or species habitat likely to occur within area
Leucopogon marginatus Thick-margined Leucopogon [12527]	Endangered	Species or species habitat likely to occur within area
Leucopogon obtectus Hidden Beard-heath [19614]	Endangered	Species or species habitat may occur within area
Macarthuria keigheryi Keighery's Macarthuria [64930]	Endangered	Species or species habitat likely to occur within area
Marianthus paralius [83925]	Endangered	Species or species habitat known to occur within area
Melaleuca sp. Wanneroo (G.J. Keighery 16705) [89456]	Endangered	Species or species habitat known to occur within area
Paracaleana dixonii Sandplain Duck Orchid [86882]	Endangered	Species or species habitat known to occur within area
Pityrodia augustensis Mt Augustus Foxglove [4962]	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

Name	Status	Type of Presence
Pterostylis sinuata Northampton Midget Greenhood, Western Swan Grrenhood [84991]	Endangered	Species or species habitat known to occur within area
Seringia exastia Fringed Fire-bush [88920]	Critically Endangered	Species or species habitat known to occur within area
Sphenotoma drummondii Mountain Paper-heath [21160]	Endangered	Species or species habitat may occur within area
Stachystemon nematophorus Three-flowered Stachystemon [81447]	Vulnerable	Species or species habitat may occur within area
Synaphea sp. Serpentine (G.R. Brand 103) [86879]	Critically Endangered	Species or species habitat may occur within area
Tectaria devexa [14767]	Endangered	Species or species habitat likely to occur within area
Tetratheca nephelioides [83217]	Critically Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area
Wurmbea tubulosa Long-flowered Nancy [12739]	Endangered	Species or species habitat known to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Cryptoblepharus egeriae Christmas Island Blue-tailed Skink, Blue-tailed Snake-eyed Skink [1526]	Critically Endangered	Species or species habitat likely to occur within area
Ctenotus lancelini Lancelin Island Skink [1482]	Vulnerable	Species or species habitat known to occur within area
Ctenotus zastictus Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat known 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	Foraging, feeding or related behaviour known to occur within area
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-	Endangered	Species or species

Name	Status	Type of Presence
tailed Skink [64483]		habitat known to occur within area
Emoia nativitatis Christmas Island Forest Skink, Christmas Island Whiptail-skink [1400]	Critically Endangered	Species or species habitat 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	Foraging, feeding or related behaviour 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
Lerista nevinae Nevin's Slider [85296]	Endangered	Species or species habitat known to occur within area
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat known to occur within area
Liopholis pulchra longicauda Jurien Bay Skink, Jurien Bay Rock-skink [83162]	Vulnerable	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	Foraging, feeding or related behaviour known to occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Breeding likely to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Breeding known to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Ardenna tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely 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
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	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

Name	Threatened	Type of Presence
Phoebetria fusca		
Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Sterna dougallii		
Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons		
Little Tern [82849]		Breeding known to occur within area
Sula dactylatra		
Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster		
Brown Booby [1022]		Breeding known to occur within area
Sula sula		
Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche carteri		
Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta		
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida		
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely 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*	Breeding known 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	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata		
Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Carcharhinus longimanus		
Oceanic Whitetip Shark [84108]		Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour 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]		Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Pristis clavata		
Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis		
Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations)		
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
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
Motacilla flava		
Yellow Wagtail [644]		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]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba		
Sanderling [875]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Christmas Island National Park
Defence - ARTILLERY BARRACKS - FREMANTLE
Defence - BROOME TRAINING DEPOT
Defence - CAMPBELL BARRACKS - SWANBOURNE
Defence - EAST FREMANTLE SMALL CRAFT BASE
Defence - EXMOUTH ADMIN & HF TRANSMITTING
Defence - EXMOUTH VLF TRANSMITTER STATION
Defence - HMAS STIRLING-ROCKINGHAM ;HMAS STIRLING - GARDEN ISLAND
Defence - IRWIN BARRACKS - KARRAKATTA
Defence - LANCELIN TRAINING AREA
Defence - LEARMONTH - AIR WEAPONS RANGE
Defence - LEARMONTH RADAR SITE - TWIN TANKS EXMOUTH
Defence - LEARMONTH RADAR SITE - VLAMING HEAD EXMOUTH
Defence - LEEUWIN BARRACKS - EAST FREMANTLE
Defence - PRESTON POINT TRAINING DEPOT
Defence - ROCKINGHAM - NAVY CPSO
Defence - SWANBOURNE RIFLE RANGE

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ashmore Reef National Nature Reserve	EXT	Listed place
Christmas Island Natural Areas	EXT	Listed place
Garden Island	WA	Listed place
Lancelin Defence Training Area	WA	Listed place
Learmonth Air Weapons Range Facility	WA	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
Army Magazine Buildings Irwin Barracks	WA	Listed place
Artillery Barracks	WA	Listed place
Bungalow 702	EXT	Listed place
Claremont Post Office	WA	Listed place

Name	State	Status
Cliff Point Historic Site	WA	Listed place
Drumsite Industrial Area	EXT	Listed place
HMAS Sydney II and HSK Kormoran Shipwreck Sites	EXT	Listed place
Industrial and Administrative Group	EXT	Listed place
J Gun Battery	WA	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
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 alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Cereopsis novaehollandiae grisea Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]	Vulnerable	Species or species habitat likely to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor Little Penguin [1085]		Breeding 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
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area
Hirundo 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
Larus pacificus Pacific Gull [811]		Breeding known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	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

Name	Threatened	Type of Presence
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat known to occur within area
Pelagodroma marina White-faced Storm-Petrel [1016]		Breeding 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 Bosunbird [26021]	Endangered	Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding likely to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Breeding known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Puffinus assimilis Little Shearwater [59363]		Breeding known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Breeding known to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Puffinus huttoni Hutton's Shearwater [1025]		Foraging, feeding or related behaviour known to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Puffinus tenuirostris Short-tailed Shearwater [1029]		Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Sterna albifrons Little Tern [813]		Breeding known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Stiltia isabella Australian Pratincole [818]		Roosting known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys 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

Name	Threatened	Type of Presence
		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
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

Name	Threatened	Type of Presence
		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
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		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 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 breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		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
Hippocampus subelongatus West Australian Seahorse [66722]		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
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		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
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		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
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		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

Name	Threatened	Type of Presence
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
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Breeding known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus 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 pooleorum Shark Bay Seasnake [66061]		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

Name	Threatened	Type of Presence
		habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnston's River 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	Foraging, feeding or related behaviour 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 area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known 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
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area

Name	Status	Type of Presence
Hyperoodon planifrons Southern Bottlenose Whale [71]		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
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may 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
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		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]		Foraging, feeding or

Name	Status	Type of Presence
		related behaviour known to occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tasmacetus shepherdi Shepherd's Beaked Whale, Tasman Beaked Whale [55]		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
Abrolhos	Habitat Protection Zone (IUCN IV)
Abrolhos	Multiple Use Zone (IUCN VI)
Abrolhos	National Park Zone (IUCN II)
Abrolhos	Special Purpose Zone (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)
Bremer	National Park Zone (IUCN II)
Bremer	Special Purpose Zone (Mining
Carnarvon Canyon	Habitat Protection Zone (IUCN IV)
Cartier Island	Sanctuary Zone (IUCN Ia)
Dampier	Habitat Protection Zone (IUCN IV)
Dampier	Multiple Use Zone (IUCN VI)
Dampier	National Park Zone (IUCN II)
Eastern Recherche	National Park Zone (IUCN II)

Name	Label
Eastern Recherche	Special Purpose Zone (IUCN VI)
Eighty Mile Beach	Multiple Use Zone (IUCN VI)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Jurien	National Park Zone (IUCN II)
Jurien	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	National Park Zone (IUCN II)
Ningaloo	Recreational Use Zone (IUCN IV)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Perth Canyon	Habitat Protection Zone (IUCN IV)
Perth Canyon	Multiple Use Zone (IUCN VI)
Perth Canyon	National Park Zone (IUCN II)
Roebuck	Multiple Use Zone (IUCN VI)
Shark Bay	Multiple Use Zone (IUCN VI)
South-west Corner	Habitat Protection Zone (IUCN IV)
South-west Corner	Multiple Use Zone (IUCN VI)
South-west Corner	National Park Zone (IUCN II)
South-west Corner	Special Purpose Zone (IUCN VI)
South-west Corner	Special Purpose Zone (Mining
Two Rocks	Multiple Use Zone (IUCN VI)
Two Rocks	National Park Zone (IUCN II)

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Adele Island	WA
Airlie Island	WA
Alfred Cove	WA
Bardi Jawi	WA
Barrow Island	WA
Bedout Island	WA
Beekeepers	WA
Bernier And Dorre Islands	WA
Bessieres Island	WA
Bold Park	WA
Boodie, Double Middle Islands	WA
Boullanger, Whitlock, Favourite, Tern And Osprey Islands	WA
Broome Bird Observatory	WA
Broome Wildlife Centre	WA
Browse Island	WA
Bundegi Coastal Park	WA
Burnside And Simpson Island	WA
Cape Range	WA
Carnac Island	WA
Coulomb Point	WA
Dambimangari	WA
Dambimangari	WA
Dirk Hartog Island	WA
Dongara	WA
Escape Island	WA
Freycinet, Double Islands etc	WA
Gnandaroo Island	WA
Hamelin Island	WA
Harry Waring Marsupial Reserve	WA
Jarrkunpungu	WA
Jinmarnkur	WA
Jinmarnkur Kulja	WA
Jurabi Coastal Park	WA
Kalbarri	WA

Name	State
Karajarri	WA
Keanes Point Reserve	WA
Kings Park	WA
Koks Island	WA
Kujungurru Warrarn	WA
Kujungurru Warrarn	WA
Lacepede Islands	WA
Lake Joondalup	WA
Lancelin And Edwards Islands	WA
Leda	WA
Leeuwin-Naturaliste	WA
Lesueur	WA
Little Rocky Island	WA
Locker Island	WA
Lowendal Islands	WA
Matilda Bay Reserve	WA
Montebello Islands	WA
Muiron Islands	WA
Murujuga	WA
NTWA Bushland covenant (0144)	WA
Nambung	WA
Nanga Station	WA
Neerabup	WA
Neerabup	WA
Nilgen	WA
North Sandy Island	WA
North Turtle Island	WA
Nyangumarta Warrarn	WA
Part Murchison house	WA
Penguin Island	WA
Port Gregory	WA
Prince Regent	WA
Recherche Archipelago	WA
Rottnest Island	WA
Round Island	WA
Serrurier Island	WA
Southern Beekeepers	WA
Swan Island	WA
Swan River	WA
Tamala Pastoral Lease (Part)	WA
Tanner Island	WA
Tent Island	WA
Thomsons Lake	WA
Unnamed WA21176	WA
Unnamed WA26400	WA
Unnamed WA28968	WA
Unnamed WA31906	WA
Unnamed WA34039	WA
Unnamed WA36907	WA
Unnamed WA36909	WA
Unnamed WA36910	WA
Unnamed WA36913	WA
Unnamed WA36915	WA
Unnamed WA37168	WA
Unnamed WA37338	WA
Unnamed WA37383	WA
Unnamed WA37500	WA
Unnamed WA39584	WA
Unnamed WA39752	WA
Unnamed WA40322	WA
Unnamed WA40828	WA
Unnamed WA40877	WA
Unnamed WA41080	WA
Unnamed WA41775	WA
Unnamed WA42469	WA
Unnamed WA43290	WA

Name	State
Unnamed WA43903	WA
Unnamed WA44414	WA
Unnamed WA44665	WA
Unnamed WA44667	WA
Unnamed WA44669	WA
Unnamed WA44672	WA
Unnamed WA44673	WA
Unnamed WA44682	WA
Unnamed WA44688	WA
Unnamed WA45772	WA
Unnamed WA45773	WA
Unnamed WA46926	WA
Unnamed WA46982	WA
Unnamed WA46983	WA
Unnamed WA46984	WA
Unnamed WA48291	WA
Unnamed WA48858	WA
Unnamed WA48968	WA
Unnamed WA49220	WA
Unnamed WA49561	WA
Unnamed WA49994	WA
Unnamed WA50067	WA
Unnamed WA51105	WA
Unnamed WA51162	WA
Unnamed WA51497	WA
Unnamed WA51583	WA
Unnamed WA51617	WA
Unnamed WA51658	WA
Unnamed WA51932	WA
Unnamed WA52237	WA
Unnamed WA52354	WA
Unnamed WA52366	WA
Unnamed WA53015	WA
Uunguu	WA
Victor Island	WA
Wanagarren	WA
Wandi	WA
Wedge Island	WA
Weld Island	WA
Woodvale	WA
Y Island	WA
Yanchep	WA
Yawuru	WA
Zuytdorp	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

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		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Carduelis carduelis European Goldfinch [403]		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 domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pavo cristatus Indian Peafowl, Peacock [919]		Species or species habitat likely to occur within area
Phasianus colchicus Common Pheasant [920]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur

Name	Status	Type of Presence
		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
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus exulans Pacific Rat, Polynesian Rat [79]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus declinatus Bridal Veil, Bridal Veil Creeper, Pale Berry Asparagus Fern, Asparagus Fern, South African Creeper [66908]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may 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
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		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
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		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
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		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
Booragoon Swamp	WA
Bunda-Bunda Mound Springs	WA
Bundera Sinkhole	WA
Cape Range Subterranean Waterways	WA
De Grey River	WA
Eighty Mile Beach System	WA
Exmouth Gulf East	WA
Gibbs Road Swamp System	WA
Herdsman Lake	WA
Hosine's Spring, Christmas Island	EXT
Joondalup Lake	WA
Karakin Lakes	WA
Lake MacLeod	WA
Lake Thetis	WA
Learmonth Air Weapons Range - Saline Coastal Flats	WA
Leslie (Port Hedland) Saltfields System	WA
Loch McNess System	WA
Mermaid Reef	EXT
Roebuck Bay	WA
Rottnest Island Lakes	WA
Shark Bay East	WA
Spectacles Swamp	WA
Swan-Canning Estuary	WA
Thomsons Lake	WA
Willie Creek Wetlands	WA

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
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
Seringapatam Reef and Commonwealth waters in	North-west
Wallaby Saddle	North-west
Albany Canyons group and adjacent shelf break	South-west
Ancient coastline at 90-120m depth	South-west
Cape Mentelle upwelling	South-west
Commonwealth marine environment surrounding	South-west
Commonwealth marine environment surrounding	South-west
Commonwealth marine environment within and	South-west
Diamantina Fracture Zone	South-west
Naturaliste Plateau	South-west
Perth Canyon and adjacent shelf break, and other	South-west
Western demersal slope and associated fish	South-west
Western rock lobster	South-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
-8.110051 120.376181,-8.413432 119.686137,-8.976808 119.872067,-8.857075 120.295123,-8.748104 120.365003,-8.944443 121.387017,-8.896056 121.73862,-8.77642 121.87834,-8.752625 122.125804,-8.691748 123.110175,-8.687346 123.482423,-9.75854 123.516666,-10.383148 123.263849,-10.567755 123.03086,-10.658619 122.803699,-10.808072 122.716331,-10.890417 122.798676,-10.786665 122.978512,-10.944817 123.205601,-10.818947 123.821447,-10.988525 125.037471,-11.913499 126.641108,-12.448877 127.200281,-13.147091 126.715455,-13.318401 126.494889,-14.227094 125.717017,-14.343262 125.111429,-14.575878 125.169519,-15.146948 124.962506,-15.13404 124.72429,-15.340607 124.400669,-15.498246 124.50395,-15.543968 124.516619,-15.936579 124.492348,-15.883041 124.006938,-15.964387 123.794187,-16.292067 123.493814,-16.479298 123.438507,-16.679321 122.85478,-17.217961 122.29943,-17.829879 122.291578,-17.954801 122.452192,-18.100415 122.450351,-18.679346 121.838291,-19.299554 121.531765,-19.644576 121.103462,-19.9777 120.359881,-20.133753 119.569602,-20.082028 119.18133,-20.326489 118.862903,-20.440596 118.092132,-20.654766 117.898254,-20.801688 117.32701,-20.62405 116.78223,-20.634023 116.752999,-21.023086 116.114577,-21.485594 115.564995,-21.81298 114.827666,-22.208356 114.521006,-22.133497 113.977382,-22.585628 113.781286,-22.971101 113.927623,-23.445803 113.877654,-23.801236 113.652646,-24.50168 113.514146,-25.252995 113.363645,-25.510993 113.142207,-25.833347 113.111916,-25.952346 113.179916,-26.437668 113.50771,-26.712407 113.765502,-26.934213 113.913108,-27.591313 114.201271,-27.792218 114.089596,-27.883892 114.157798,-28.214768 114.158935,-28.255736 114.432758,-28.365415 114.560728,-28.984599 114.552035,-29.012543 114.875396,-29.154795 114.96022,-29.509539 115.062795,-30.110359 114.992653,-30.197812 115.013206,-30.465331 115.0763,-30.60938 115.205131,-31.625489 115.777608,-32.220354 115.876139,-32.289384 115.812959,-32.667715 115.254594,-33.37603 114.869555,-33.736593 114.828494,-33.995457 115.066998,-34.32194 115.017795,-34.324079 115.017205,-34.522746 115.19192,-34.928478 115.943279,-35.044299 116.433171,-35.116634 116.994723,-35.031112 117.460781,-35.199211 117.598659,-35.210207 117.943954,-34.605829 119.612364,-34.641803 120.712898,-33.927965 125.103003,-33.445529 126.058654,-33.403888 126.367984,-33.52881 126.724904,-33.778653 126.760595,-35.660569 118.196677,-36.144352 114.765123,-36.602661 110.370604,-31.572685 104.971902,-28.146261 101.926192,-23.586421 101.882172,-16.27751 102.557939,-9.716324 103.455669,-8.002934 107.563135,-8.535209 111.991021,-8.455371 112.785888,-8.327118 112.865283,-8.464486 113.085367,-8.457829 113.730901,-8.559822 113.900249,-8.573748 114.394216,-8.822094 114.947409,-8.748677 115.119112,-8.858564 115.464227,-8.750721 115.752243,-8.830925 115.831405,-8.793232 115.941134,-8.910794 116.496366,-8.823057 116.584103,-8.94709 116.667788,-9.000602 116.92052,-9.0984 117.015989,-9.106275 117.556779,-8.987189 117.986975,-8.802474 118.393495,-8.802441 119.052454,-8.59679 119.258104,-8.339112 119.324791,-8.378125 119.467189,-7.878053 120.310745,-8.110051 120.376181

Acknowledgements

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- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of Agriculture Water and the Environment
GPO Box 858
Canberra City ACT 2601 Australia
+61 2 6274 1111

Appendix B: MNES Review Register

Table B-1: Review Register

Taxon	2021 Review (Rev 9 09/07/21)	Reason for Change	Sections Updated within this Document
Threatened Species			
Sharks	Speartooth shark *(Glyphis glyphis)*	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 5-1, Section 5.3, Section 5.3.5
Birds	Addition of *Territory Parks and Wildlife Conservation Act* 1976 conservation status	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 8-1, Section 8.2
Birds	Greater crested tern (*Thalasseus bergii)*	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 8-3
Birds	Little curlew (*Numenius minutus)*	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 8-3
Birds	Swinhoe's snipe (*Gallinago magala)*	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 8-3
Birds	Wandering Tattler (*Tringa glareola)*	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 8-3
Birds	Bar-tailed godwit	NT sites of international importance added	Table 8-5
Birds	Common greenshank	NT sites of international importance added	Table 8-5
Birds	Common sandpiper	NT sites of international importance added	Table 8-5
Birds	Fork-tailed swift	NT sites of international importance added	Table 8-5
Birds	Oriental pratincole	NT sites of international importance added	Table 8-5
Migratory Species-			
Reptiles	Salt-water crocodile *(Crocodylus porosus)*	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 6-1, Section 6.3

Taxon	2021 Review (Rev 9 09/07/21)	Reason for Change	Sections Updated within this Document
Provinces			
Provincial Bioregions	Timor Province	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Section 2.1
	Northwest Shelf Transition	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Section 2.1
	Timor Transition	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Section 2.1, 3.1, 3.3, 3.4, 4.1, 5.1
	Northern Shelf Province	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Section 2.1, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 5.1
Protected Areas			
World Heritage Areas	Kakadu National Park	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.1.3
Wetlands of International Importance	Cobourg Peninsula	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.2.9
	Kakadu National Park	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.2.10
	Ord River Floodplain	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.2.11
Wetlands of National Importance	Adelaide River Floodplain System	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.3.21

Taxon	2021 Review (Rev 9 09/07/21)	Reason for Change	Sections Updated within this Document
	Kakadu National Park	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.3.22
	Mary Floodplain System	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.3.23
	Cobourg Peninsula System	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.3.24
	Daly-Reynolds Floodplain-Estuary System	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.3.25
	Finniss Floodplain and Fog Bay Systems	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.3.26
	Moyle Floodplain and Hyland Bay System	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.3.27
	Murgenella-Cooper Floodplain System	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.3.28
	Ord Estuary System	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.3.29
	Port Darwin	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.3.30
	Shoal Bay - Micket Creek	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, Section 9.3.31

Taxon	2021 Review (Rev 9 09/07/21)	Reason for Change	Sections Updated within this Document
National Heritage Place	Kakadu National Park	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, 9.4.10
Commonwealth Heritage Place	Bradshaw Defence Area	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-1, 9.5.10 Section 14.4
Coastal terrestrial Conservation Reserves	Five additional national parks included and four reserves	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 9-2 and 9-3
KEFs	Shelf Break and Slope of the Arafura Shelf	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Section 10.1.29
	Tributary Canyons of the Arafura Depression	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Section 10.1.30
Australian Marine Parks	Arafura Marine Park	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	12.4.2
	Arnhem Marine Park	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	12.4.3
	Joseph Bonaparte Marine Park	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	12.4.4
International Protected Areas	Additional international areas included	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Section 9.8
Social, Economic and Cultural Features			
Defence Activities	Bradshaw defence training area	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Section 14.4

Taxon	2021 Review (Rev 9 09/07/21)	Reason for Change	Sections Updated within this Document
Indigenous heritage	Tiwi Islands significant sites	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Section 14.6.1
Maritime heritage	Additional shipwrecks within EMBA, new figure provided	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Section 14.6.2
Fisheries	Additional NT fisheries	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Section 14.7.1 and 14.8
Legislation			
Conservation Status Legislation	Addition of *Territory Parks and Wildlife Conservation Act* 1976 conservation status to all species	Included with new PMST search for Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	Table 5-1, 6-1, 7-1, 8-1
Other edits			
-	Figures updated throughout to represent new EMBA	Included with revised EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	All figures in document
-	Text updated throughout to reflect new EMBA entering NT waters	Included with revised r Stairway EMBA based on Stairway TFN Rev 0 (SO-91-RZ-20027)	All text in document

Appendix D – EPBC Protected Matters Search Tool Results

D.1 – EPBC PMST Report for the OA

D.2 – EPBC PMST Report for the light and noise boundaries

D.3 – EPBC PMST Report for the combined MEVA

D.4 – EPBC PMST Report for the combined EMBA

Australian Government

Department of Agriculture, Water and the Environment

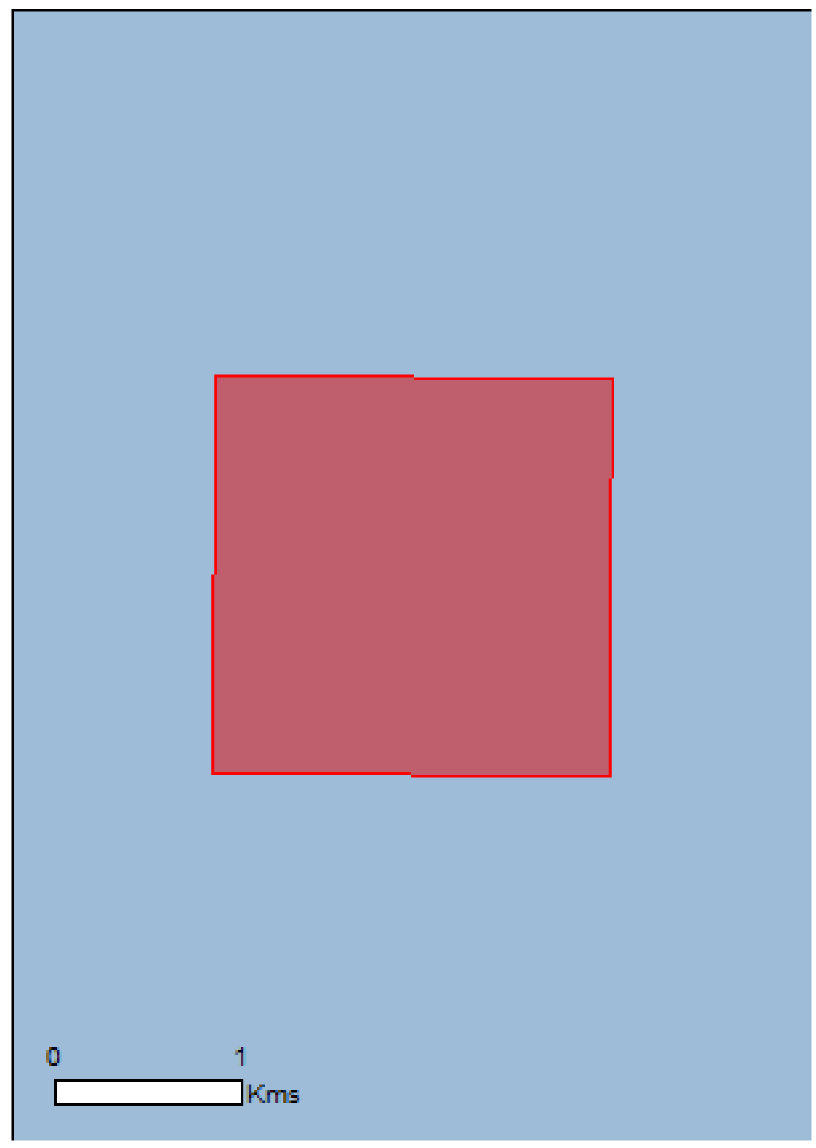
EPBC Act Protected Matters Report

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.

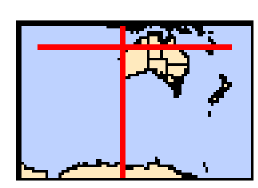
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 03/08/21 12:39:11



Coordinates

Buffer: 0.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	17
Listed Migratory Species:	31

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:	61
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	1

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus		
Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Sternula nereis nereis		
Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Mammals		
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
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 ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Congregation or aggregation known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area

Name	Status	Type of Presence
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Montebello	Multiple Use Zone (IUCN VI)

Extra Information

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-20.334559 115.796398,-20.352628 115.796258,-20.352495 115.7771,-20.334426 115.777242,-20.334559 115.796398

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.

Department of Agriculture Water and the Environment
GPO Box 858
Canberra City ACT 2601 Australia
+61 2 6274 1111

Australian Government

Department of Agriculture, Water and the Environment

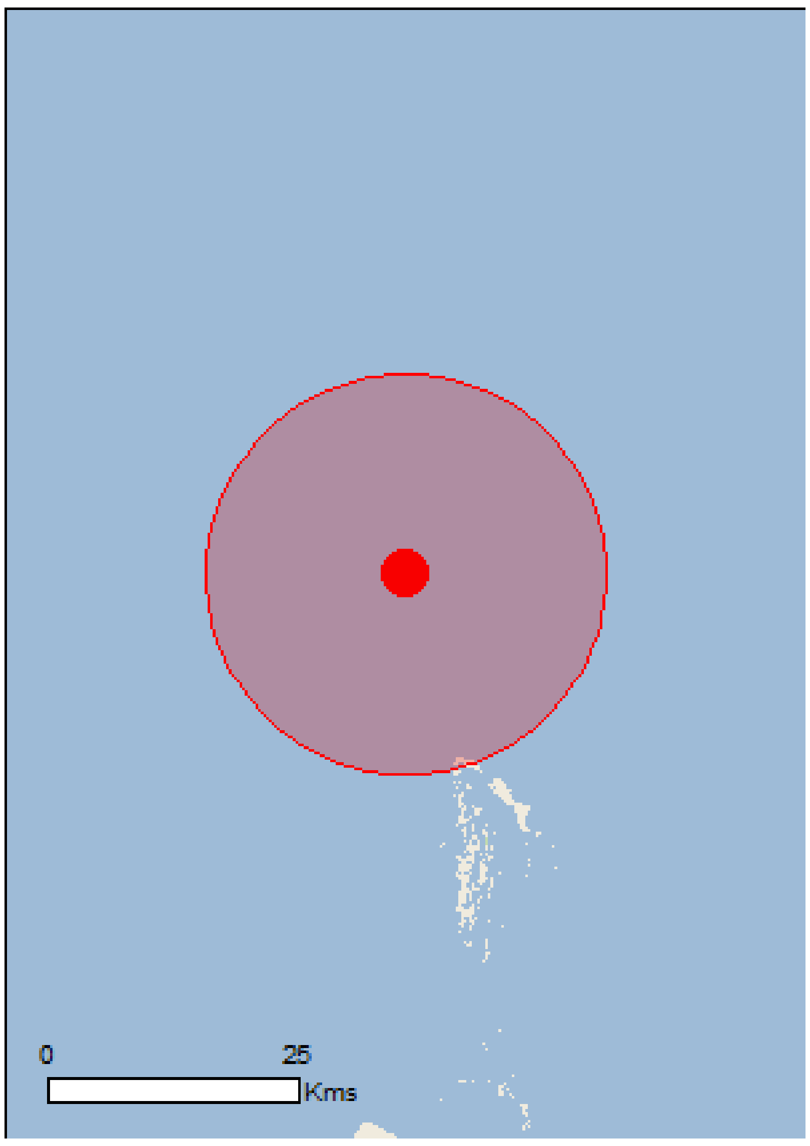
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

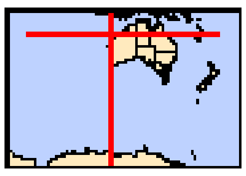
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 13/09/21 11:56:37



Coordinates

Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	23
Listed Migratory Species:	43

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:	77
Whales and Other Cetaceans:	15
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	1

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely 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
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely 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	Foraging, feeding or related behaviour 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	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur

Name	Threatened	Type of Presence
		within area
[Manta alfredi](#) Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
[Manta birostris](#) Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
[Megaptera novaeangliae](#) Humpback Whale [38]	Vulnerable	Breeding known to occur within area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Orcinus orca](#) Killer Whale, Orca [46]		Species or species habitat may occur within area
[Pristis clavata](#) Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
[Pristis zijsron](#) Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
[Rhincodon typus](#) Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Sousa chinensis](#) Indo-Pacific Humpback Dolphin [50]		Species or species habitat may occur within area
[Tursiops aduncus (Arafura/Timor Sea populations)](#) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
[Hirundo rustica](#) Barn Swallow [662]		Species or species habitat may occur within area
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat known to 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 likely to occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to 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 known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to 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 likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		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
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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]		Species or species habitat 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 likely to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
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	Foraging, feeding or related behaviour known

Name	Threatened	Type of Presence
		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
[Ephalophis greyi] North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
[Eretmochelys imbricata] Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Hydrophis czeblukovi] Fine-spined Seasnake [59233]		Species or species habitat may occur within area
[Hydrophis elegans] Elegant Seasnake [1104]		Species or species habitat may occur within area
[Hydrophis ornatus] Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
[Natator depressus] Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Pelamis platurus] Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
[Balaenoptera acutorostrata] Minke Whale [33]		Species or species habitat may occur within area
[Balaenoptera borealis] Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
[Balaenoptera edeni] Bryde's Whale [35]		Species or species habitat may occur within area
[Balaenoptera musculus] Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
[Balaenoptera physalus] Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
[Delphinus delphis] Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area

Name	Status	Type of Presence
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Montebello	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Montebello Islands	WA
Unnamed WA41080	WA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-20.20367 115.47123

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.

Department of Agriculture Water and the Environment
GPO Box 858
Canberra City ACT 2601 Australia
+61 2 6274 1111

Australian Government
Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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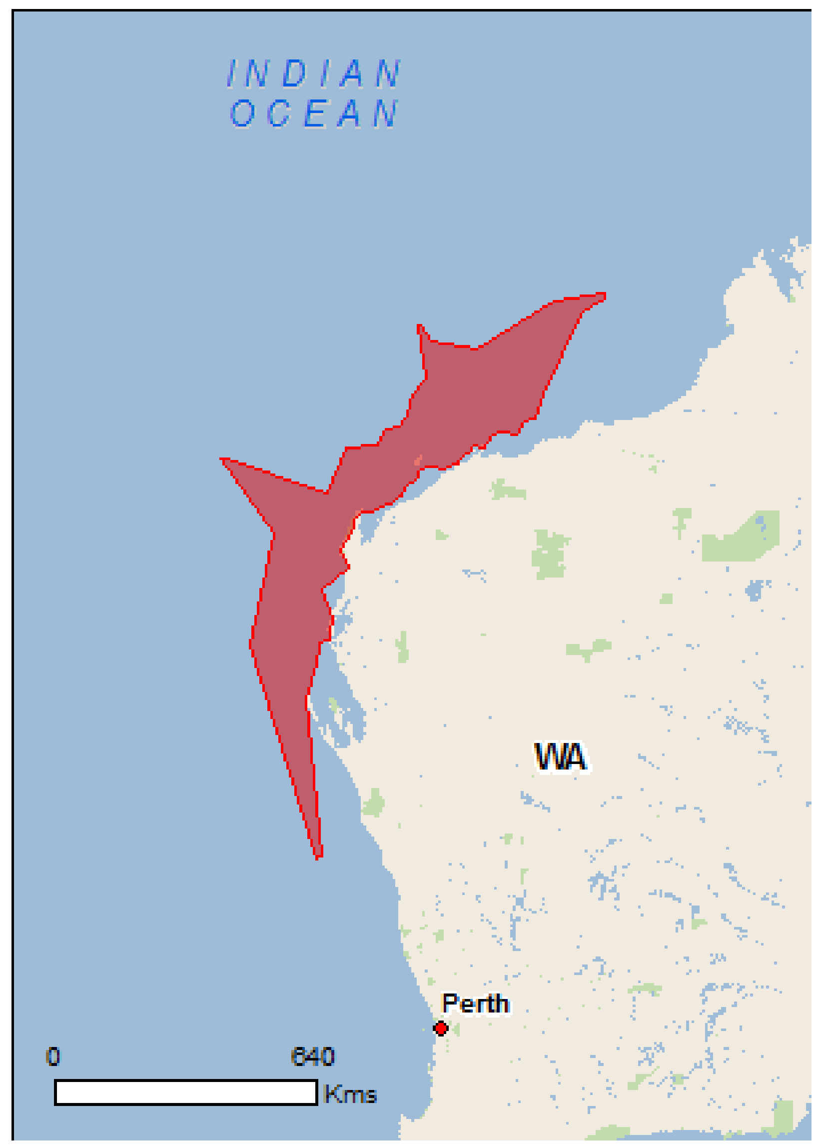

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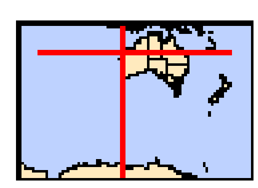

Summary

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:	2
National Heritage Places:	4
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	63
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:	2
Listed Marine Species:	148
Whales and Other Cetaceans:	33
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	12

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	19
Regional Forest Agreements:	None
Invasive Species:	17
Nationally Important Wetlands:	4
Key Ecological Features (Marine)	8

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
Shark Bay, Western Australia	WA	Declared property
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
Shark Bay, Western Australia	WA	Listed place
The Ningaloo Coast	WA	Listed place
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place
Historic		
Dirk Hartog Landing Site 1616 - Cape Inscription Area	WA	Listed place

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
South-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically 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
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Malurus leucopterus edouardi White-winged Fairy-wren (Barrow Island), Barrow Island Black-and-white Fairy-wren [26194]	Vulnerable	Species or species habitat likely to occur within area
Malurus leucopterus leucopterus White-winged Fairy-wren (Dirk Hartog Island), Dirk Hartog Black-and-White Fairy-wren [26004]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Fish		
Milyeringa veritas		
Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum		
Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia lesueur Barrow and Boodie Islands subspecies		
Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Species or species habitat known to occur within area
Bettongia lesueur lesueur		
Burrowing Bettong (Shark Bay), Boodie [66659]	Vulnerable	Species or species habitat known to occur within area
Bettongia penicillata ogilbyi		
Woylie [66844]	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
Isoodon auratus barrowensis		
Golden Bandicoot (Barrow Island) [66666]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes conspicillatus conspicillatus		
Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus Central Australian subspecies		
Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within area
Lagorchestes hirsutus bernieri		
Rufous Hare-wallaby (Bernier Island) [66662]	Vulnerable	Species or species habitat known to occur within area
Lagostrophus fasciatus fasciatus		
Banded Hare-wallaby, Merrnine, Marnine, Munning [66664]	Vulnerable	Species or species habitat known to occur within area
Macroderma gigas		
Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Breeding known to occur within area

Name	Status	Type of Presence
Osphranter robustus isabellinus Barrow Island Wallaroo, Barrow Island Euro [89262]	Vulnerable	Species or species habitat likely to occur within area
Perameles bougainville bougainville Western Barred Bandicoot (Shark Bay) [66631]	Endangered	Species or species habitat known to occur within area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Pseudomys fieldi Shark Bay Mouse, Djoongari, Alice Springs Mouse [113]	Vulnerable	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Other		
Kumonga exleyi Cape Range Remipede [86875]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Ctenotus zastictus Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely 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 likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may 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
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding likely to occur

Name	Threatened	Type of Presence
		within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Congregation or aggregation known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely 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	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding 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 zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat 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		
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known 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 known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically 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 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 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 known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area

Name	Threatened	Type of Presence
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Defence - EXMOUTH VLF TRANSMITTER STATION
Defence - LEARMONTH - AIR WEAPONS RANGE
Defence - LEARMONTH RADAR SITE - VLAMING HEAD EXMOUTH

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Learmonth Air Weapons Range Facility	WA	Listed place
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known 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
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		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 known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may 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 known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding likely to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Foraging, feeding or related behaviour known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		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]		Congregation or aggregation known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		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 subelongatus West Australian Seahorse [66722]		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
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		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
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		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
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus pooleorum Shark Bay Seasnake [66061]		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	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans

[Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or

Name	Status	Type of Presence
		related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		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
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may 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

Name	Status	Type of Presence
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Abrolhos	Multiple Use Zone (IUCN VI)
Abrolhos	National Park Zone (IUCN II)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Dampier	Habitat Protection Zone (IUCN IV)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Montebello	Multiple Use Zone (IUCN VI)
Ningaloo	National Park Zone (IUCN II)
Ningaloo	Recreational Use Zone (IUCN IV)
Shark Bay	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Barrow Island	WA
Bernier And Dorre Islands	WA
Bessieres Island	WA
Boodie, Double Middle Islands	WA
Cape Range	WA
Dirk Hartog Island	WA
Jurabi Coastal Park	WA
Koks Island	WA
Lowendal Islands	WA
Montebello Islands	WA

Name	State
Muiron Islands	WA
Round Island	WA
Serrurier Island	WA
Unnamed WA36915	WA
Unnamed WA37383	WA
Unnamed WA40828	WA
Unnamed WA40877	WA
Unnamed WA41080	WA
Unnamed WA44665	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
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
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Prosopis spp.		
Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Bundera Sinkhole	WA
Cape Range Subterranean Waterways	WA
Learmonth Air Weapons Range - Saline Coastal Flats	WA
Shark Bay East	WA

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Canyons linking the Cuvier Abyssal Plain and the	North-west
Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west
Western demersal slope and associated fish	South-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

-21.129022 115.356979,-21.203975 115.249903,-21.269766 115.118644,-21.270999 115.118219,-21.499475 115.039511,-21.535309 114.883048,-21.645716 114.79358,-21.718924 114.518146,-21.767481 114.458044,-21.797938 114.393323,-21.822887 114.146395,-21.866713 114.062963,-21.94509 114.003159,-21.996248 113.960329,-22.099755 113.947242,-22.233005 113.887755,-22.440018 113.769972,-22.513781 113.731901,-22.56256 113.685501,-22.616098 113.687881,-22.69343 113.743798,-22.91353 113.853253,-22.967417 113.818554,-23.370407 113.277011,-24.00169 113.461,-24.245719 113.421221,-24.400979 113.446205,-24.484855 113.217777,-24.9496 113.13694,-24.986194 113.080201,-25.503727 112.974315,-25.558408 112.903188,-28.679657 113.267344,-28.718349 113.159595,-24.521779 111.644614,-22.270838 112.210683,-20.73476 111.042251,-20.73101 111.117874,-21.445448 113.380597,-20.493264 113.797651,-20.455204 114.5126,-20.142203 114.680628,-20.064509 114.981333,-19.838449 115.122281,-19.389974 115.223872,-19.083502 115.51582,-17.930235 115.375535,-17.93723 115.449949,-18.303984 115.638287,-18.470821 116.671868,-17.45428 118.390019,-17.290632 119.458071,-17.378077 119.451527,-17.700766 118.991875,-19.429754 118.109187,-19.922461 117.946753,-19.965765 117.698186,-20.233229 117.560897,-20.163678 117.257387,-20.234121 117.034672,-20.4181 116.90916,-20.5028 116.80981,-20.48007 116.61657,-20.556108 116.543913,-20.644727 116.47817,-20.643537 116.421063,-20.792254 116.233086,-20.844179 116.22258,-20.859262 116.19423,-20.971186 115.887534,-20.971095 115.873621,-20.86966 115.694862,-20.919629 115.555664,-21.022957 115.394131,-21.129022 115.356979

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.

Department of Agriculture Water and the Environment
GPO Box 858
Canberra City ACT 2601 Australia
+61 2 6274 1111

Australian Government

Department of Agriculture,
Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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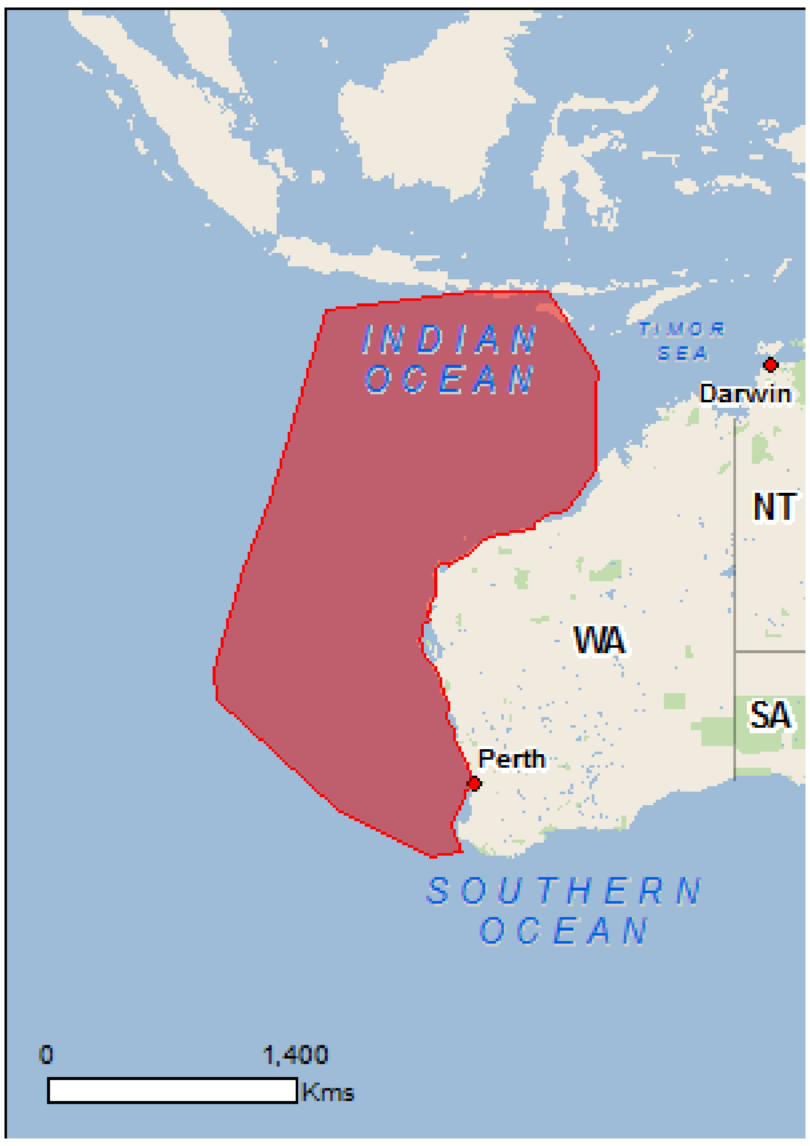
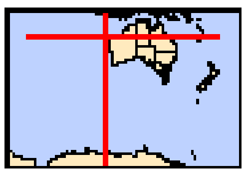


This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates
Buffer: 0.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	4
National Heritage Places:	7
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	121
Listed Migratory Species:	104

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:	13
Commonwealth Heritage Places:	7
Listed Marine Species:	188
Whales and Other Cetaceans:	44
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	31

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	66
Regional Forest Agreements:	None
Invasive Species:	54
Nationally Important Wetlands:	13
Key Ecological Features (Marine)	18

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
Australian Convict Sites (Fremantle Prison Buffer Zone)	WA	Buffer zone
Australian Convict Sites (Fremantle Prison)	WA	Declared property
Shark Bay, Western Australia	WA	Declared property
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
Shark Bay, Western Australia	WA	Listed place
The Ningaloo Coast	WA	Listed place
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place
Historic		
Batavia Shipwreck Site and Survivor Camps Area 1629 - Houtman Abrolhos	WA	Listed place
Dirk Hartog Landing Site 1616 - Cape Inscription Area	WA	Listed place
Fremantle Prison (former)	WA	Listed place
HMAS Sydney II and HSK Kormoran Shipwreck Sites	EXT	Listed place

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west
South-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
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris_melanops		
Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area

Name	Status	Type of Presence
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	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 tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	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	Roosting known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Foraging, feeding or related behaviour known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	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

Name	Status	Type of Presence
		area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Malurus leucopterus edouardi White-winged Fairy-wren (Barrow Island), Barrow Island Black-and-white Fairy-wren [26194]	Vulnerable	Species or species habitat likely to occur within area
Malurus leucopterus leucopterus White-winged Fairy-wren (Dirk Hartog Island), Dirk Hartog Black-and-White Fairy-wren [26004]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Turnix varius scintillans Painted Button-quail (Houtman Abrolhos) [82451]	Vulnerable	Species or species habitat likely to occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Nannatherina balstoni Balston's Pygmy Perch [66698]	Vulnerable	Species or species habitat likely to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Insects		
Hesperocolletes douglasi Douglas' Broad-headed Bee, Rottnest Bee [66734]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia lesueur Barrow and Boodie Islands subspecies Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Species or species habitat known to occur within area
Bettongia lesueur lesueur Burrowing Bettong (Shark Bay), Boodie [66659]	Vulnerable	Species or species habitat known to occur within area
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat known to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isoodon auratus barrowensis Golden Bandicoot (Barrow Island) [66666]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes conspicillatus conspicillatus Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus Central Australian subspecies Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within area
Lagorchestes hirsutus bernieri Rufous Hare-wallaby (Bernier Island) [66662]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus dorreae Rufous Hare-wallaby (Dorre Island) [66663]	Vulnerable	Species or species habitat known to occur within area
Lagostrophus fasciatus fasciatus Banded Hare-wallaby, Merrnine, Marnine, Munning [66664]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Breeding known to occur within area
Osphranter robustus isabellinus Barrow Island Wallaroo, Barrow Island Euro [89262]	Vulnerable	Species or species habitat likely to occur within area
Parantechinus apicalis Dibbler [313]	Endangered	Species or species habitat known to occur within area
Perameles bougainville bougainville Western Barred Bandicoot (Shark Bay) [66631]	Endangered	Species or species habitat known to occur within area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area
Pseudomys fieldi Shark Bay Mouse, Djoongari, Alice Springs Mouse [113]	Vulnerable	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat known to occur within area
Other		
Idiosoma nigrum Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider [66798]	Vulnerable	Species or species habitat known to occur within area
Kumonga exleyi Cape Range Remipede [86875]	Vulnerable	Species or species habitat known to occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Androcalva bivillosa Straggling Androcalva [87807]	Critically Endangered	Species or species habitat likely to occur within area
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat likely to occur within area
Beyeria lepidopetala Small-petalled Beyeria, Short-petalled Beyeria [18362]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Caladenia barbarella Small Dragon Orchid, Common Dragon Orchid [68686]	Endangered	Species or species habitat may occur within area
Caladenia bryceana subsp. cracens Northern Dwarf Spider-orchid [64556]	Vulnerable	Species or species habitat known to occur within area
Caladenia elegans Elegant Spider-orchid [56775]	Endangered	Species or species habitat known to occur within area
Caladenia hoffmanii Hoffman's Spider-orchid [56719]	Endangered	Species or species habitat known to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat may occur within area
Chorizema varium Limestone Pea [16981]	Endangered	Species or species habitat known to occur within area
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Drakaea concolor Kneeling Hammer-orchid [56777]	Vulnerable	Species or species habitat known to occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area
Drummondita ericoides Morseby Range Drummondita [9193]	Endangered	Species or species habitat may occur within area
Eucalyptus argutifolia Yanchep Mallee, Wabling Hill Mallee [24263]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus beardiana Beard's Mallee [18933]	Vulnerable	Species or species habitat may occur within area
Eucalyptus cuprea Mallee Box [56773]	Endangered	Species or species habitat likely to occur within area
Hemiandra gardneri Red Snakebush [7945]	Endangered	Species or species habitat likely to occur within area
Hypocalymma angustifolium subsp. Hutt River (S.Patrick 2982) [85023]	Endangered	Species or species habitat known to occur within area
Lechenaultia chlorantha Kalbarri Leschenaultia [16763]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Macarthuria keigheryi Keighery's Macarthuria [64930]	Endangered	Species or species habitat likely to occur within area
Marianthus paralius [83925]	Endangered	Species or species habitat known to occur within area
Minuria tridens Minnie Daisy [13753]	Vulnerable	Species or species habitat known to occur within area
Pityrodia augustensis Mt Augustus Foxglove [4962]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis sinuata Northampton Midget Greenhood, Western Swan Greenhood [84991]	Endangered	Species or species habitat known to occur within area
Stachystemon nematophorus Three-flowered Stachystemon [81447]	Vulnerable	Species or species habitat known to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area
Wurmbea tubulosa Long-flowered Nancy [12739]	Endangered	Species or species habitat may occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Ctenotus lancelini Lancelin Island Skink [1482]	Vulnerable	Species or species habitat known to occur within area
Ctenotus zastictus Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat 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	Foraging, feeding or related behaviour likely to occur within area
Lerista nevinae Nevin's Slider [85296]	Endangered	Species or species habitat known to occur

Name	Status	Type of Presence
		within area
Liasis olivaceus barroni		
Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat known to occur within area
Liopholis pulchra longicauda		
Jurien Bay Skink, Jurien Bay Rock-skink [83162]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population)		
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Glyphis garricki		
Northern River Shark, New Guinea River Shark [82454]	Endangered	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

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna grisea		
Sooty Shearwater [82651]		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
Diomedea amsterdamensis		
Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur

Name	Threatened	Type of Presence
		within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Foraging, feeding or related behaviour known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Congregation or aggregation 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
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely 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*	Breeding known 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	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		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	Foraging, feeding or related behaviour known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour 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

Name	Threatened	Type of Presence
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
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat 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 may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Foraging, feeding or related behaviour 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
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat 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

Name	Threatened	Type of Presence
		habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area

Name	Threatened	Type of Presence
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Defence - ARTILLERY BARRACKS - FREMANTLE
Defence - CAMPBELL BARRACKS - SWANBOURNE
Defence - EAST FREMANTLE SMALL CRAFT BASE
Defence - EXMOUTH ADMIN & HF TRANSMITTING
Defence - EXMOUTH VLF TRANSMITTER STATION
Defence - LANCELIN TRAINING AREA
Defence - LEARMONTH - AIR WEAPONS RANGE
Defence - LEARMONTH RADAR SITE - TWIN TANKS EXMOUTH
Defence - LEARMONTH RADAR SITE - VLAMING HEAD EXMOUTH
Defence - LEEUWIN BARRACKS - EAST FREMANTLE
Defence - PRESTON POINT TRAINING DEPOT
Defence - SWANBOURNE RIFLE RANGE

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Lancelin Defence Training Area	WA	Listed place
Learmonth Air Weapons Range Facility	WA	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		
Artillery Barracks	WA	Listed place
HMAS Sydney II and HSK Kormoran Shipwreck Sites	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		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus		
Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba		
Sanderling [875]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Foraging, feeding or related behaviour known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur

Name	Threatened	Type of Presence
		within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may 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
Larus pacificus Pacific Gull [811]		Breeding known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Pelagodroma marina White-faced Storm-Petrel [1016]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding likely to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Foraging, feeding or related behaviour known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Puffinus assimilis Little Shearwater [59363]		Breeding known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat may occur within area
Puffinus huttoni Hutton's Shearwater [1025]		Foraging, feeding or related behaviour known

Name	Threatened	Type of Presence
		to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Congregation or aggregation known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Stiltia isabella Australian Pratincole [818]		Species or species habitat 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
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		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 subelongatus West Australian Seahorse [66722]		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
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		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
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat likely to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	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 pooleorum Shark Bay Seasnake [66061]		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	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known 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

Name	Status	Type of Presence
		area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Hyperoodon planifrons Southern Bottlenose Whale [71]		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
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may 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
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat may occur within area

Name	Status	Type of Presence
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]		Foraging, feeding or related behaviour known to occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tasmacetus shepherdi Shepherd's Beaked Whale, Tasman Beaked Whale [55]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Abrolhos	Habitat Protection Zone (IUCN IV)
Abrolhos	Multiple Use Zone (IUCN VI)
Abrolhos	National Park Zone (IUCN II)
Abrolhos	Special Purpose Zone (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)
Carnarvon Canyon	Habitat Protection Zone (IUCN IV)
Dampier	Habitat Protection Zone (IUCN IV)

Name	Label
Dampier	Multiple Use Zone (IUCN VI)
Dampier	National Park Zone (IUCN II)
Eighty Mile Beach	Multiple Use Zone (IUCN VI)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Jurien	National Park Zone (IUCN II)
Jurien	Special Purpose Zone (IUCN VI)
Kimberley	Multiple Use Zone (IUCN VI)
Mermaid Reef	National Park Zone (IUCN II)
Montebello	Multiple Use Zone (IUCN VI)
Ningaloo	National Park Zone (IUCN II)
Ningaloo	Recreational Use Zone (IUCN IV)
Perth Canyon	Habitat Protection Zone (IUCN IV)
Perth Canyon	Multiple Use Zone (IUCN VI)
Perth Canyon	National Park Zone (IUCN II)
Shark Bay	Multiple Use Zone (IUCN VI)
South-west Corner	Multiple Use Zone (IUCN VI)
South-west Corner	National Park Zone (IUCN II)
South-west Corner	Special Purpose Zone (Mining
Two Rocks	Multiple Use Zone (IUCN VI)
Two Rocks	National Park Zone (IUCN II)

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Airlie Island	WA
Barrow Island	WA
Bedout Island	WA
Bernier And Dorre Islands	WA
Bessieres Island	WA
Boodie, Double Middle Islands	WA
Boullanger, Whitlock, Favourite, Tern And Osprey Islands	WA
Bundegi Coastal Park	WA
Cape Range	WA
Dirk Hartog Island	WA
Escape Island	WA
Freycinet, Double Islands etc	WA
Gnandaroo Island	WA
Houtman Abrolhos Islands	WA
Jurabi Coastal Park	WA
Kalbarri	WA
Koks Island	WA
Lancelin And Edwards Islands	WA
Little Rocky Island	WA
Locker Island	WA
Lowendal Islands	WA
Montebello Islands	WA
Muiron Islands	WA
Murujuga	WA
Nambung	WA
Nilgen	WA
North Sandy Island	WA
North Turtle Island	WA
Part Murchison house	WA
Port Gregory	WA
Rottnest Island	WA
Round Island	WA
Serrurier Island	WA
Southern Beekeepers	WA
Swan River	WA
Tamala Pastoral Lease (Part)	WA
Tent Island	WA
Unnamed WA26400	WA
Unnamed WA34039	WA

Name	State
Unnamed WA36907	WA
Unnamed WA36909	WA
Unnamed WA36910	WA
Unnamed WA36913	WA
Unnamed WA36915	WA
Unnamed WA37338	WA
Unnamed WA37383	WA
Unnamed WA37500	WA
Unnamed WA40322	WA
Unnamed WA40828	WA
Unnamed WA40877	WA
Unnamed WA41080	WA
Unnamed WA44665	WA
Unnamed WA44667	WA
Unnamed WA44672	WA
Unnamed WA44682	WA
Unnamed WA44688	WA
Unnamed WA48205	WA
Unnamed WA48858	WA
Unnamed WA49994	WA
Utcha Well	WA
Victor Island	WA
Wanagarren	WA
Wedge Island	WA
Weld Island	WA
Y Island	WA
Zuytdorp	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		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		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
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pavo cristatus Indian Peafowl, Peacock [919]		Species or species habitat likely to occur within area
Phasianus colchicus Common Pheasant [920]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		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

Name	Status	Type of Presence
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus declinatus Bridal Veil, Bridal Veil Creeper, Pale Berry Asparagus Fern, Asparagus Fern, South African Creeper [66908]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may 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
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		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
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands

[Resource Information]

Name	State
Bundera Sinkhole	WA
Cape Range Subterranean Waterways	WA
Exmouth Gulf East	WA
Hutt Lagoon System	WA
Lake MacLeod	WA
Lake Thetis	WA
Learmonth Air Weapons Range - Saline Coastal Flats	WA
Leslie (Port Hedland) Saltfields System	WA
Mermaid Reef	EXT
Murchison River (Lower Reaches)	WA
Rottnest Island Lakes	WA
Shark Bay East	WA
Swan-Canning Estuary	WA

Key Ecological Features (Marine)

[Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Canyons linking the Argo Abyssal Plain with the	North-west
Canyons linking the Cuvier Abyssal Plain and the	North-west
Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west

Name	Region
Exmouth Plateau	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west
Seringapatam Reef and Commonwealth waters in	North-west
Wallaby Saddle	North-west
Ancient coastline at 90-120m depth	South-west
Cape Mentelle upwelling	South-west
Commonwealth marine environment surrounding	South-west
Commonwealth marine environment within and	South-west
Naturaliste Plateau	South-west
Perth Canyon and adjacent shelf break, and other	South-west
Western demersal slope and associated fish	South-west
Western rock lobster	South-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

-29.896803 114.704135,-30.194572 114.960758,-30.206103 114.947786,-30.340882 115.07632,-31.129164 115.426465,-32.041065 115.787296,-32.058469 115.74161,-32.242134 115.349593,-32.465243 115.253202,-33.639313 114.567849,-34.580167 115.083999,-34.846946 115.109472,-35.008999 113.554198,-32.965323 108.817295,-28.265737 102.726417,-26.916618 102.617634,-22.225353 104.062842,-18.915065 105.348063,-9.5594913 108.29387,-8.6833364 115.869937,-8.6996219 119.46756,-11.68693 121.535376,-12.609779 122.035017,-13.631736 122.009082,-17.453604 121.899699,-19.33408 120.579234,-19.509612 120.197618,-19.595843 119.683247,-20.02629 118.835385,-20.310761 118.831299,-20.491022 117.916153,-20.627446 117.201362,-20.74645 116.55339,-20.990881 116.174392,-21.442581 115.549037,-21.992728 114.563056,-21.995553 114.544378,-22.037999 114.532483,-22.04371 114.496077,-22.013875 114.423243,-22.018213 114.394559,-22.012776 114.072599,-22.137539 113.935966,-22.321572 113.874621,-22.433621 113.815166,-22.595151 113.75178,-22.798953 113.870866,-23.463995 113.862841,-23.735254 113.627274,-23.929547 113.527526,-23.993971 113.510227,-24.179569 113.487384,-24.234647 113.469115,-24.480025 113.441677,-24.614063 113.561424,-24.808531 113.199467,-25.187487 113.145696,-25.255575 113.113415,-25.351773 113.099082,-25.441258 113.060941,-26.260543 113.327588,-26.660293 113.6274,-27.044665 113.910213,-27.345429 114.07963,-27.533882 114.144352,-28.403173 114.500092,-29.097287 114.332377,-29.525631 114.738954,-29.896803 114.704135

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.

Department of Agriculture Water and the Environment
GPO Box 858
Canberra City ACT 2601 Australia
+61 2 6274 1111

Appendix E – Spill Modelling Results

The following tables provide the spill modelling results for a surface and subsurface LOWC from:

- Yoorn-1 (GHD, 2020)

Modelling Results for Surface Release Scenario of Loss of Well Control for Yoorn-1:

Receptor	Receptor type	Minimum time to contact (Hours)							Maximum Hydrocarbon Concentration							Maximum oil ashore (m^3)	Max length of oiled shoreline (km)
		Moderate Exposure Values				High Exposure Values			Moderate Exposure Values				High Exposure Values				
		Shoreline accumulation (100 g/m²)	Surface hydrocarbons (10 g/m²)	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m²)	Surface hydrocarbons (50 g/m²)	Dissolved aromatics (400 ppb)	Shoreline accumulation (100 g/m²)	Surface hydrocarbons (10 g/m²) *	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m²)	Surface hydrocarbons (50 g/m²) *	Dissolved aromatics (400 ppb)	Shoreline accumulation	Shoreline accumulation (100 g/m²)
Seringapatam Reef	Intertidal	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Scott Reef South	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Clerke Reef MP	Emergent	1,355	NC	NC	NC	NC	NC	NC	263.4	NC	NC	NC	NC	NC	NC	2.2	8.5
Imperieuse Reef MP	Emergent	1,044	NC	NC	NC	NC	NC	NC	138.3	NC	NC	NC	NC	NC	NC	1.2	4.2
Port Hedland-Eighty Mile Beach	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Karratha-Port Hedland	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Dampier Archipelago	Emergent	216	NC	NC	NC	NC	NC	NC	631.8	NC	NC	NC	NC	NC	NC	9.0	17.0
Rankin Bank	Submerged	NC	NC	NC	938	NC	NC	NC	NC	NC	NC	104.3	NC	NC	NC	NC	NC
Northern Islands Coast	Emergent	1,699	NC	NC	NC	NC	NC	NC	208.2	NC	NC	NC	NC	NC	NC	1.8	4.2
Montebello Islands	Emergent	8	14	8	8	8	54	28	41,239.3	39.7	453.9	618.3	41,239.3	72.0	1,302.8	2,163.6	38.2
Lowendal Islands	Emergent	53	50	48	48	53	NC	NC	26,588.9	13.2	156.5	266.5	26,588.9	NC	NC	225.9	4.2
Barrow Island	Emergent	75	124	350	82	75	NC	NC	22,373.6	13.2	229.2	276.2	22,373.6	NC	NC	496.9	59.5
Barrow-Montebello Surrounds	Intertidal	NC	12	8	8	NC	172	34	NC	37.9	967.8	493.4	NC	58.8	1,323.0	NC	NC
Thevenard Islands	Emergent	178	NC	NC	NC	NC	NC	NC	684.3	NC	NC	NC	NC	NC	NC	5.8	8.5
Southern Islands Coast	Emergent	143	NC	NC	266	143	NC	NC	4,003.3	NC	NC	163.1	4,003.3	NC	NC	52.5	12.7
Muiron Islands	Emergent	169	NC	NC	458	169	NC	NC	6,542.8	NC	NC	134.2	6,542.8	NC	NC	86.7	12.7
Exmouth Gulf Coast	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Ningaloo Coast North	Emergent	174	NC	NC	188	175	NC	NC	1,973.7	NC	NC	175.8	1,973.7	NC	NC	68.9	80.7
Ningaloo Coast South	Emergent	985	NC	NC	NC	NC	NC	NC	108.5	NC	NC	NC	NC	NC	NC	0.9	4.2
Carnarvon – Inner Shark Bay	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Outer Shark Bay Coast	Emergent	1,235	NC	NC	NC	NC	NC	NC	121.0	NC	NC	NC	NC	NC	NC	1.0	4.2

Receptor	Receptor type	Minimum time to contact (Hours)							Maximum Hydrocarbon Concentration							Maximum oil ashore (m^3)	Max length of oiled shoreline (km)
		Moderate Exposure Values				High Exposure Values			Moderate Exposure Values				High Exposure Values				
		Shoreline accumulation (100 g/m^2)	Surface hydrocarbons (10 g/m^2)	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m^2)	Surface hydrocarbons (50 g/m^2)	Dissolved aromatics (400 ppb)	Shoreline accumulation (100 g/m^2)	Surface hydrocarbons (10 g/m^2) *	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m^2)	Surface hydrocarbons (50 g/m^2) *	Dissolved aromatics (400 ppb)	Shoreline accumulation	Shoreline accumulation (100 g/m^2)
Zuytdorp Cliffs - Kalbarri	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Kalbarri - Geraldton	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Abrolhos Islands Wallabi Group	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Abrolhos Islands Pelsaert Group	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Indonesia East	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Jurien Bay - Yanchep	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Perth Southern Coast	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Bedout Island	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Montebello AMP	Submerged	NC	2	2	2	NC	6	2	NC	54.9	971.6	723.4	NC	116.9	1,941.3	NC	NC
Outer Ningaloo Coast North	Intertidal	NC	NC	NC	446	NC	NC	NC	NC	NC	NC	146.6	NC	NC	NC	NC	NC
Rowley Shoals surrounds	Submerged	1,143	NC	NC	NC	NC	NC	NC	304.2	NC	NC	NC	NC	NC	NC	NC	NA
Outer NW Ningaloo	Submerged	NC	NC	NC	234	NC	NC	NC	NC	NC	NC	263.2	NC	NC	NC	NC	NC
Offshore Ningaloo	Submerged	NC	NC	116	52	NC	NC	NC	NC	NC	308.9	441.2	NC	NC	NC	NC	NC
Northern Islands Coast	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Mermaid Reef AMP	Intertidal	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Glomar Shoals	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Middle Islands Coast	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Outer Abrolhos Islands - Shoals	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Perth Canyon AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Two Rocks AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Dampier AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Jurien AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Shark Bay AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Eighty Mile Beach AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Rowley Shoals Surrounds	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Deep Geographe - Augusta	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
South-west corner AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

Receptor	Receptor type	Minimum time to contact (Hours)							Maximum Hydrocarbon Concentration							Maximum oil ashore (m^3)	Max length of oiled shoreline (km)
		Moderate Exposure Values				High Exposure Values			Moderate Exposure Values				High Exposure Values				
		Shoreline accumulation (100 g/m²)	Surface hydrocarbons (10 g/m²)	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m²)	Surface hydrocarbons (50 g/m²)	Dissolved aromatics (400 ppb)	Shoreline accumulation (100 g/m²)	Surface hydrocarbons (10 g/m²) *	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m²)	Surface hydrocarbons (50 g/m²) *	Dissolved aromatics (400 ppb)	Shoreline accumulation	Shoreline accumulation (100 g/m²)
Offshore Geographe – Augusta 2	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Abrolhos West	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Outer Abrolhos NW	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Nearshore Abrolhos	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Offshore Abrolhos – Perth North	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Offshore Perth South - Geographe	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC = No Contact

Modelling Results for Subsea Release Scenario of Loss of Well Control for Yoorn-1:

Receptor	Receptor type	Minimum time to contact (Hours)							Maximum Hydrocarbon Concentration							Maximum oil ashore (m^3)	Max length of oiled shoreline (km)
		Moderate Exposure Values				High Exposure Values			Moderate Exposure Values				High Exposure Values				
		Shoreline accumulation (100 g/m²)	Surface hydrocarbons (10 g/m²)	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m²)	Surface hydrocarbons (50 g/m²)	Dissolved aromatics (400 ppb)	Shoreline accumulation (100 g/m²)	Surface hydrocarbons (10 g/m²) *	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m²)	Surface hydrocarbons (50 g/m²) *	Dissolved aromatics (400 ppb)	Shoreline accumulation	Shoreline accumulation (100 g/m²)
Seringapatam Reef	Intertidal	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Scott Reef South	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Clerke Reef MP	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Imperieuse Reef MP	Emergent	1,617	NC	NC	NC	NC	NC	NC	214.6	NC	NC	NC	NC	NC	NC	1.8	4.2
Port Hedland-Eighty Mile Beach	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Karratha-Port Hedland	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Dampier Archipelago	Emergent	525	NC	NC	NC	NC	NC	NC	361.7	NC	NC	NC	NC	NC	NC	6.2	17.0
Rankin Bank	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

Receptor	Receptor type	Minimum time to contact (Hours)							Maximum Hydrocarbon Concentration							Maximum oil ashore (m^3)	Max length of oiled shoreline (km)
		Moderate Exposure Values				High Exposure Values			Moderate Exposure Values				High Exposure Values				
		Shoreline accumulation (100 g/m^2)	Surface hydrocarbons (10 g/m^2)	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m^2)	Surface hydrocarbons (50 g/m^2)	Dissolved aromatics (400 ppb)	Shoreline accumulation (100 g/m^2)	Surface hydrocarbons (10 g/m^2) *	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m^2)	Surface hydrocarbons (50 g/m^2) *	Dissolved aromatics (400 ppb)	Shoreline accumulation	Shoreline accumulation (100 g/m^2)
Northern Islands Coast	Emergent	680	NC	NC	NC	NC	NC	NC	286.6	NC	NC	NC	NC	NC	NC	2.5	8.5
Montebello Islands	Emergent	18	NC	12	12	18	NC	16	30,541.7	NC	817.1	723.1	30,541.7	NC	2,315.1	1,036.5	38.2
Lowendal Islands	Emergent	63	NC	86	78	63	NC	NC	4,484.2	NC	95.5	190.6	4,484.2	NC	NC	38.1	4.2
Barrow Island	Emergent	72	NC	1,214	80	72	NC	NC	5,132.6	NC	99.3	213.7	5,132.6	NC	NC	87.3	42.5
Barrow-Montebello Surrounds	Intertidal	NC	NC	8	8	NC	NC	16	NC	NC	943.8	957.0	NC	NC	2,390.1	NC	NC
Thevenard Islands	Emergent	213	NC	NC	NC	NC	NC	NC	182.9	NC	NC	NC	NC	NC	NC	1.6	4.2
Southern Islands Coast	Emergent	157	NC	NC	416	311	NC	NC	1,763.7	NC	NC	114.8	1,763.7	NC	NC	18.7	12.7
Muiron Islands	Emergent	174	NC	NC	836	278	NC	NC	2,884.9	NC	NC	127.7	2,884.9	NC	NC	38.6	12.7
Exmouth Gulf Coast	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Ningaloo Coast North	Emergent	176	NC	NC	492	NC	NC	NC	637.9	NC	NC	125.1	NC	NC	NC	22.6	51.0
Ningaloo Coast South	Emergent	1,832	NC	NC	NC	NC	NC	NC	140.0	NC	NC	NC	NC	NC	NC	1.2	4.2
Carnarvon – Inner Shark Bay	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Outer Shark Bay Coast	Emergent	1,581	NC	NC	NC	NC	NC	NC	186.4	NC	NC	NC	NC	NC	NC	1.6	4.2
Zuytdorp Cliffs - Kalbarri	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Kalbarri - Geraldton	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Abrolhos Islands Wallabi Group	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Perth Southern Coast	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Abrolhos Islands Pelsaert Group	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Indonesia East	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Jurien Bay - Yanchep	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Bedout Island	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Outer Abrolhos Islands - Shoals	Submerged	NC	NC	NC	1682	NC	NC	NC	NC	NC	NC	98.6	NC	NC	NC	NC	NC
Montebello AMP	Submerged	NC	32	2	2	NC	NC	2	NC	10.6	1,733.9	1,765.4	NC	NC	2,736.1	NC	NC
Outer Ningaloo Coast North	Intertidal	NC	NC	NC	418	NC	NC	NC	NC	NC	NC	162.5	NC	NC	NC	NC	NC
Rowley Shoals surrounds	Submerged	1,334	NC	NC	NC	NC	NC	NC	323.7	NC	NC	NC	NC	NC	NC	NC	NA
Outer NW Ningaloo	Submerged	NC	NC	NC	416	NC	NC	NC	NC	NC	NC	125.8	NC	NC	NC	NC	NC

Receptor	Receptor type	Minimum time to contact (Hours)							Maximum Hydrocarbon Concentration							Maximum oil ashore (m^3)	Max length of oiled shoreline (km)
		Moderate Exposure Values				High Exposure Values			Moderate Exposure Values				High Exposure Values				
		Shoreline accumulation (100 g/m^2)	Surface hydrocarbons (10 g/m^2)	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m^2)	Surface hydrocarbons (50 g/m^2)	Dissolved aromatics (400 ppb)	Shoreline accumulation (100 g/m^2)	Surface hydrocarbons (10 g/m^2) *	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m^2)	Surface hydrocarbons (50 g/m^2) *	Dissolved aromatics (400 ppb)	Shoreline accumulation	Shoreline accumulation (100 g/m^2)
Offshore Ningaloo	Submerged	NC	NC	118	118	NC	NC	810	NC	NC	626.5	639.5	NC	NC	626.5	NC	NC
Mermaid Reef AMP	Intertidal	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Glomar Shoals	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Middle Islands Coast	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Outer Abrolhos Islands - Shoals	Submerged	NC	NC	NC	2,344.1	NC	NC	NC	NC	NC	NC	104.5	NC	NC	NC	NC	NC
Perth Canyon AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Two Rocks AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Dampier AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Jurien AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Shark Bay AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Eighty Mile Beach AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Rowley Shoals Surrounds	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Deep Geographe - Augusta	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
South-west corner AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Offshore Geographe – Augusta 2	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Abrolhos West	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Outer Abrolhos NW	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Nearshore Abrolhos	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Offshore Abrolhos – Perth North	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Offshore Perth South - Geographe	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

NC= No Contact

The following tables provide the spill modelling results for an MOD release from:

- Yoorn-1 (GHD, 2019)

Modelling Results for Surface Release of MDO – Yoorn-1:

Receptor	Receptor type	Minimum time to contact (Hours)							Maximum Hydrocarbon Concentration							Maximum oil ashore (m^3)	Maximum length of oiled shoreline (km)
		Moderate Exposure Values				High Exposure Values			Moderate Exposure Values				High Exposure Values				
		Shoreline accumulation (100 g/m^2)	Surface hydrocarbons (10 g/m^2)	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m^2)	Surface hydrocarbons (50 g/m^2)	Dissolved aromatics (400 ppb)	Shoreline accumulation (100 g/m^2)	Surface hydrocarbons (10 g/m^2) *	Dissolved aromatics (50 ppb)	Entrained hydrocarbons (100 ppb)	Shoreline accumulation (1000g/m^2)	Surface hydrocarbons (50 g/m^2) *	Dissolved aromatics (400 ppb)	Shoreline accumulation (100 g/m^2)	Shoreline accumulation (100 g/m^2)
Dampier Archipelago	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Glomar Shoals	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Montebello Islands	Emergent	12	8	8	8	16	12	NC	18,935.2	259.6	290.3	344.2	18,935.2	259.6	NC	221.5	14.1
Lowendal Islands	Emergent	36	32	32	32	99	32	NC	3,743.8	153.8	257.9	293.2	3,743.8	153.8	NC	10.6	2.8
Barrow Island	Emergent	57	58	58	58	60	98	NC	18,890.3	77.5	96.7	340.7	18,890.3	87.0	NC	130.0	11.3
Muiron Islands	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Ningaloo Coast North	Emergent	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Barrow-Montebello Surrounds	Intertidal	NC	8	6	6	NC	10	NC	NC	264.9	354.4	864.3	NC	264.9	NC	NC	NC
Dampier AMP	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Montebello AMP	Submerged	NC	2	2	2	NC	2	14	NC	283.8	544.7	1,153.9	NC	283.8	609.6	NC	NC
Outer NW Ningaloo	Submerged	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Offshore Ningaloo	Submerged	NC	43	42	42	NC	NC	NC	NC	60.0	79.8	212.2	NC	NC	NC	NC	NC

NC= No Contact

Appendix F – Stakeholder Consultation

STAKEHOLDER CONSULTATION

Yoorn-1 Exploration Drilling

Environment Plan

STAKEHOLDER CONSULTATION

Consultation, Santos

From: Consultation, Santos
Sent: Tuesday, 26 October 2021 1:38 PM
Cc: Consultation, Santos
Subject: UPDATE: Santos Consultation - WA-499-P, WA-208-P and WA-546-P Exploration Drilling Environment Plan
Attachments: Santos Consultation UPDATE WA-499-P, WA-208-P & WA-546-P EP.pdf

Good afternoon

I refer to Consultation material sent to you on 21 July 2021 (below) in relation to Santos' proposed WA-499-P, WA-208-P and WA-546-P Exploration Drilling Environment Plan. Under this Plan, Santos proposes to drill three exploration wells in petroleum exploration permits WA-499-P, WA-208-P and WA 546-P. The permits are in Commonwealth waters located approximately 103 kilometres, 87 km and 87 km respectively offshore from Dampier in Western Australia. As part of the preparatory work required to safely undertake the drilling, a site survey is also required to assess the shallow seabed soils suitability to provide a safe foundation for a Jack Up Mobile Offshore Drilling Unit (MODU).

The attached document contains **updated** information on the proposed exploration drilling program including an indication of notional locations for exploration wells: Yoorn-1, Parnassus-1 and Jelen-1 and the proposed site survey operational area.

The only **updates** to the proposed activities are as follows:

- The operational areas for the Parnassus-1 and Jelen-1 survey and exploration drilling activities, originally proposed as two separate operational areas (4 km2 each), have been combined into one operational area (26.76km2 in size) to allow for vessel turn-arounds during the survey and to cover relief well locations.
- The size of the Yoorn-1 operational area is reduced to show the notional location of the exploration well and the area that drilling activities will occur within proposed under this EP. The Yoorn-1 survey was addressed under a separate EP (Yoorn-1 Geophysical Survey EP) accepted by NOPSEMA on 3 June 2020.

The notional location for the three exploration wells remains unchanged.

If you require additional information or wish to provide any comments, please contact Santos on the contact details below. Santos will endeavour to address all feedback prior to the EP being submitted for assessment.

Kind regards

[redacted]
Santos Limited, Level 7 100 St Georges Tce, Perth WA 6000
[redacted]
https://www.santos.com/

From: Consultation, Santos
Sent: Wednesday, 21 July 2021 10:22 AM
Cc: Consultation, Santos <Offshore.consultation@santos.com>
Subject: Santos Consultation - WA-499-P, WA-208-P and WA-546-P Exploration Drilling Environment Plan

Good morning,

Santos is preparing an Environment Pan (EP) to drill three exploration wells in petroleum exploration permits WA-499-P, WA-208-P and WA 546-P. The permits are in Commonwealth waters located approximately 103 kilometres, 87 km and 87 km respectively offshore from Dampier in Western Australia. As part of the preparatory work required to safely undertake the drilling, a site survey is also required to assess the shallow seabed soils suitability to provide a safe foundation for a Jack Up Mobile Offshore Drilling Unit (MODU).

The plan is being prepared in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R) for assessment by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

This notice marks the start of consultation by Santos with stakeholders to help guide preparation of the WA-499-P, WA-208-P and WA-546-P Exploration Drilling EP. The attached document contains information on the proposed exploration drilling program including an indication of notional locations for exploration wells: Yoorn-1, Parnassus-1 and Jelen-1 and the proposed site survey operational area.

If you wish to comment on Santos' proposed WA-499-P, WA-208-P and WA-546-P Exploration Drilling EP, or if you require additional information, please contact Santos on the contact details below. Santos will endeavour to address all feedback prior to the EP being submitted for assessment. Your feedback **by 27 August 2021** would be welcomed.

We look forward to hearing from you.

Kind regards

[redacted]
Santos Limited, Level 7 100 St Georges Tce, Perth WA 6000
[redacted] [redacted]
https://www.santos.com/

Santos

Santos Consultation

26 October 2021

Dear Commercial Fishing Licence Holder

UPDATE: Santos Consultation: WA-499-P, WA-208-P and WA-546-P Exploration Drilling Program

I refer to Consultation material sent to you on 22 July 2021 in relation to Santos' proposed WA-499-P, WA-208-P and WA-546-P Exploration Drilling Environment Plan. Under this Plan, Santos proposes to drill three exploration wells in petroleum exploration permits WA-499-P, WA-208-P and WA 546-P. The permits are in Commonwealth waters located approximately 103 kilometres, 87 km and 87 km respectively offshore from Dampier in Western Australia. As part of the preparatory work required to safely undertake the drilling, a site survey is also required to assess the shallow seabed soils suitability to provide a safe foundation for a Jack Up Mobile Offshore Drilling Unit (MODU).

The attached document contains **updated** information on the proposed exploration drilling program including an indication of notional locations for exploration wells: Yoorn-1, Parnassus-1 and Jelen-1 and the proposed site survey operational area.

The only **updates** to the proposed activities are as follows:

- The operational areas for the Parnassus-1 and Jelen-1 survey and exploration drilling activities, originally proposed as two separate operational areas (4 km2 each), have been combined into one operational area (26.76km2 in size) to allow for vessel turn-arounds during the survey and to cover relief well locations.
- The size of the Yoorn-1 operational area is reduced to show the notional location of the exploration well and the area that drilling activities will occur within proposed under this EP. The Yoorn-1 survey was addressed under a separate EP (Yoorn-1 Geophysical Survey EP) accepted by NOPSEMA on 3 June 2020.

The notional location for the three exploration wells remains unchanged.

If you require additional information or wish to provide any comments, please contact Santos on the contact details below. Santos will endeavour to address all feedback prior to the EP being submitted for assessment.

Kind regards

[redacted]

Level 7 100 St Georges Tce, Perth WA 6000

[redacted]

Santos Ltd
ABN 80 007 550 923
Santos Centre
60 Flinders Street
Adelaide South Australia 5000

GPO Box 2455
Adelaide South Australia 5001
Telephone: +61 8 8116 5000
www.santos.com

Santos

22 July 2021

Dear Commercial Fishing Licence Holder

Re: Santos Consultation: WA-499-P, WA-208-P and WA-546-P Exploration Drilling Program

Santos is preparing an Environment Pan (EP) to drill three exploration wells in petroleum exploration permits WA-499-P, WA-208-P and WA 546-P. The permits are in Commonwealth waters located approximately 103 kilometres, 87 km and 87 km respectively offshore from Dampier in Western Australia. As part of the preparatory work required to safely undertake the drilling, a site survey is also required to assess the shallow seabed soils suitability to provide a safe foundation for a Jack Up Mobile Offshore Drilling Unit (MODU).

The plan is being prepared in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R) for assessment by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

This notice marks the start of consultation by Santos with stakeholders to help guide preparation of the WA-499-P, WA-208-P and WA-546-P Exploration Drilling EP. The attached document contains information on the proposed exploration drilling program including an indication of notional locations for exploration wells: Yoorn-1, Parnassus-1 and Jelen-1 and the proposed site survey operational area.

If you wish to comment on Santos' proposed WA-499-P, WA-208-P and WA-546-P Exploration Drilling EP, or if you require additional information, please contact Santos on the contact details below. Santos will endeavour to address all feedback prior to the EP being submitted for assessment. Your feedback by **27 August 2021** would be welcomed.

Yours sincerely

[redacted]

PO Box 5624, Perth, 6831

Telephone: [redacted]

Email: [redacted]

From: Consultation, Santos
To: Consultation, Santos
Bcc: [redacted]
[redacted] [redacted] Update - Changes to Exploration Drilling Program in Commonwealth waters
Date: Wednesday, 9 March 2022 3:54:00 PM

Santos Stakeholder Update

Changes to Exploration Drilling Program in Commonwealth waters

Overview

In July 2021, Santos advised stakeholders of its plans to drill three exploration wells across three permitted areas located in Commonwealth waters and asked for stakeholder feedback on the proposed program.

At that time, Santos advised that it planned to drill Yoorn-1 (WA-499-P), Parnassus-1 (WA-208-P) and Jelen-1 (WA-546-P) wells located approximately 103 km, 87 km and 87 km respectively offshore from Dampier, Western Australia.

Santos now advises that it now plans to drill only the Yoorn-1 exploration well. The site survey required to assess the suitability of seabed soils was completed in October 2021.

A summary of revised activities follows:

Activity Name	Yoorn-1 Exploration Drilling Program	
Activity Summary		
Estimated Start Date and Duration	The activity is planned to commence in a window between Q2-2022 and Q4 2022. Santos expects the Jack Up to be on location for up to 70 days for the Yoorn-1 well dependant on operational down time and weather delays.	
Permit Number	WA-499-P	
Location	103 km offshore from Dampier	
Approximate Water Depth	Approx. 40 to 50m	
Approximate well location	**Latitude**	**Longitude**
	20° 20′ 36.7″ S	115° 47′ 12.3″ E
Exclusion Zone	500 m around MODU at all times	
Nearest Proximity to Key Regional Features		
	Barrow Island	49.9 km SW
	Varanus Island (Santos Operated)	40.2 km SW
	Closest Montebello Island	21.4 km WSW
	Dampier	102.8 km SE
	Onslow	159.5 km SW
	Closest Mainland Port	69.6 km SE (Cape Preston)
	Montebello Marine Park (Australian Marine Park)	0 km (intersects)

	Montebello Islands Marine Park (State)	15.5 km SW
	Barrow Island Marine Management Area (State)	31.3 km SW
	Barrow Island Marine Park (State)	61.6 km SW
	Dampier Marine Park (Australia Marine Park)	109.4 km SE

-

Santos will reflect changes to the program communicated to stakeholders in July 2021 in its Environmental Plan (EP) for this activity.

Please let us know if you require any additional information.

Consultation Adviser
Santos
PO Box 5624, Perth, 6831
Ph: (08) 6218 7095
Email: Offshore.Consultation@santos.com

Santos Consultation

10 March 2021

Dear Fishery Licence Holder

In July 2021, Santos advised stakeholders of its plans to drill three exploration wells across three permitted areas located in Commonwealth waters and asked for stakeholder feedback on the proposed program.

At that time, Santos advised that it planned to drill Yoorn-1 (WA-499-P), Parnassus-1 (WA-208-P) and Jelen-1 (WA-546-P) wells located approximately 103 km, 87 km and 87 km respectively offshore from Dampier, Western Australia.

Santos now advises that it now plans to drill only the Yoorn-1 exploration well (see attached location map). The site survey required to assess the suitability of seabed soils was completed in October 2021.

Location:	103 km offshore from Dampier
Water Depth:	Approx. 40 to 50m
Activity Duration:	The activity is planned to commence in a window between Q2-2022 and Q4 2022. Santos expects the Jack Up Mobile Offshore Drilling Unit (MODU) to be on location for up to 70 days for the Yoorn-1 well dependant on operational down time and weather delays.
Support Vessels:	A Jack-up MODU supported by up to four support vessels will undertake the drilling activities.
Exclusion Zone:	A temporary 500 m Petroleum Safety Zone (PSZ) around the MODU (for duration of drilling activities).

We have endeavoured where possible to reduce duplication of advice to licence holders but in some cases, this has been unavoidable as we need to contact licence holders across multiple fisheries, these being the Pilbara Line, Pilbara Trap, Pilbara Crab, Mackerel (Area 2), Nickol Bay Prawn, WA Sea Cucumber and Onslow Prawn fisheries.

Please be in contact via the phone or email details below if you have any questions on any of the activities outlined in the attached Consultation Information.

Kind regards

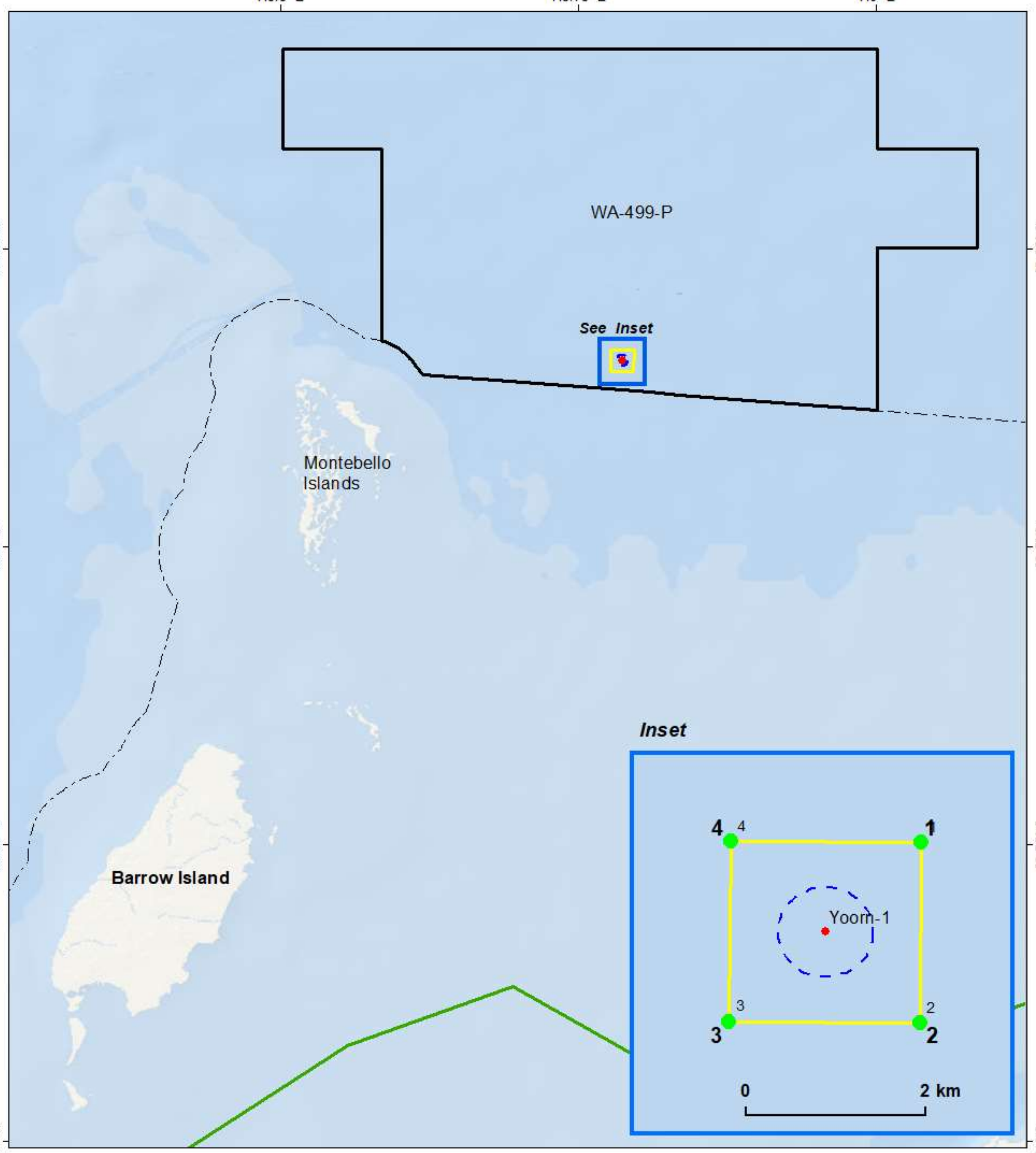
[redacted]

Santos Limited,

Level 7 100 St Georges Tce, Perth WA 6000

t: +61 8 6218 7095

e: offshore.consultation@Santos.com



Well Location	Petroleum Title	SOURCE: ESRI 2020; NOPTA 2021
Petroleum Safety Zones (500 m radius)		0 3.5 7 nm / 0 5 10 km
Operational Areas		DATE: 28/10/2021 · SCALE @ A4: 1:593,394 · Drawn: AC
MEVA		MXD: P100216_S00_Loc_Yoom_RevB.mxd · Check: NK
Coastal Waters		CRS: GCS GDA 1994 · Approve: DM

From:	Consultation, Santos
To:	Consultation, Santos
Bcc:	[redacted]
Subject:	Santos Stakeholder Update - Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters
Date:	Thursday, 31 March 2022 8:14:00 AM
Attachments:	image003.emz image008.png

Santos Stakeholder Update

Changes to Activity Duration period for Exploration Drilling Program in Commonwealth waters

Overview

In early March 2022, Santos advised stakeholders of changes to the scope of a planned three-well exploration drilling program located in Commonwealth waters, and of its decision to proceed only with drilling Yoorn-1 located in permit area (WA-499-P) with an expected activity duration of up to 70 days from commencement.

Santos now advises that it has revaluated the expected duration of the activity and extended the timeframe to be up to **100 days** from the commencement of the activity.

There are no other changes to the information provided to stakeholders on 10 March 2022, which is listed below. Location map is attached.

A summary of the activities follows:

Activity Name	Yoorn-1 Exploration Drilling Program	
Activity Summary		
Estimated Start Date and Duration	The activity is planned to commence in a window between Q2-2022 and Q4 2022. Santos expects the Jack Up to be on location for up to 100 days for the Yoorn-1 well dependant on operational down time and weather delays.	
Permit Number	WA-499-P	
Location	103 km offshore from Dampier	
Approximate Water Depth	Approx. 40 to 50m	
Approximate well location	**Latitude**	**Longitude**
	20° 20' 36.7" S	115° 47' 12.3" E
Exclusion Zone	500 m around MODU at all times	
Nearest Proximity to Key Regional Features		
	Barrow Island	49.9 km SW
	Varanus Island (Santos Operated)	40.2 km SW
	Closest Montebello Island	21.4 km WSW
	Dampier	102.8 km SE
	Onslow	159.5 km SW
	Closest Mainland Port	69.6 km SE (Cape Preston)
	Montebello Marine Park (Australian Marine Park)	0 km (intersects)
	Montebello Islands Marine Park (State)	15.5 km SW
	Barrow Island Marine Management Area (State)	31.3 km SW

	Barrow Island Marine Park (State)	61.6 km SW
	Dampier Marine Park (Australia Marine Park)	109.4 km SE

Please let us know if you require any additional information.

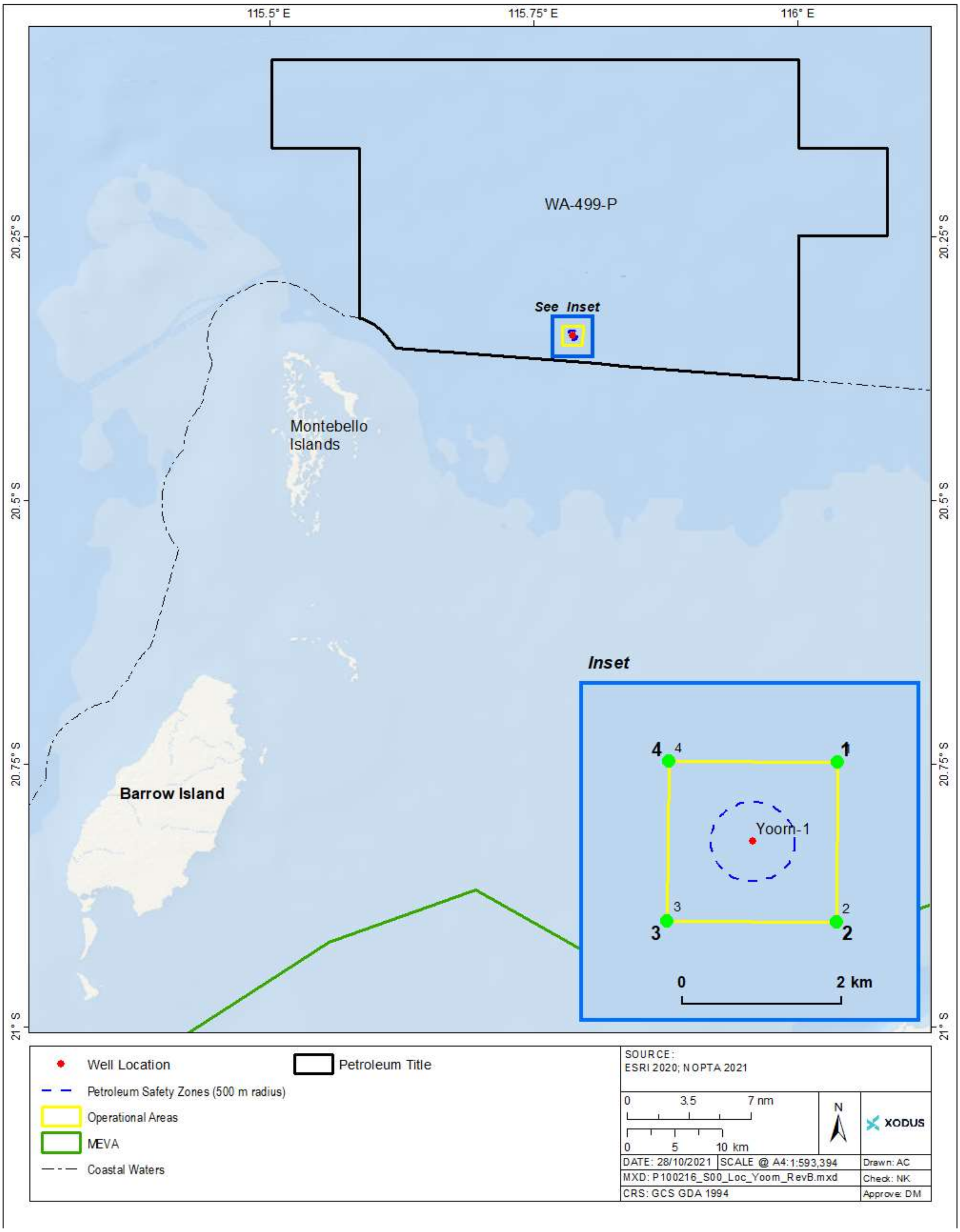
Santos

[redacted]onmental Stakeholder Advisor

As a service provider to

Santos Limited, 100 St Georges Terrace Perth WA 6000
Offshore.consultation@santos.com

https://www.santos.com/


115.5° E
115.75° E
116° E
20.25° S
20.5° S
20.75° S
21° S
WA-499-P
See Inset
Montebello Islands
Barrow Island
Inset
4
1
Yoorn-1
3
2
0
2 km
Well Location
Petroleum Title
Petroleum Safety Zones (500 m radius)
Operational Areas
MEVA
Coastal Waters
SOURCE:
ESRI 2020; NOPTA 2021
0 3.5 7 nm
0 5 10 km
N
XODUS
DATE: 28/10/2021
SCALE @ A4:1:593,394
Drawn: AC
MXD: P100216_S00_Loc_Yoom_RevB.mxd
Check: NK
CRS: GCS GDA 1994
Approve: DM

Santos Consultation

31 March 2022

Update to expected duration of exploration drilling program

Dear Fishery Licence Holder

In early March 2022, Santos advised stakeholders of changes to the scope of a planned three-well exploration drilling program located in Commonwealth waters, and of its decision to proceed only with drilling Yoorn-1 located in permit area (WA-499-P) with an expected activity duration of up to 70 days from commencement.

Santos now advises that it has revaluated the expected duration of the activity and extended the timeframe to be up to 100 days from the commencement of the activity.

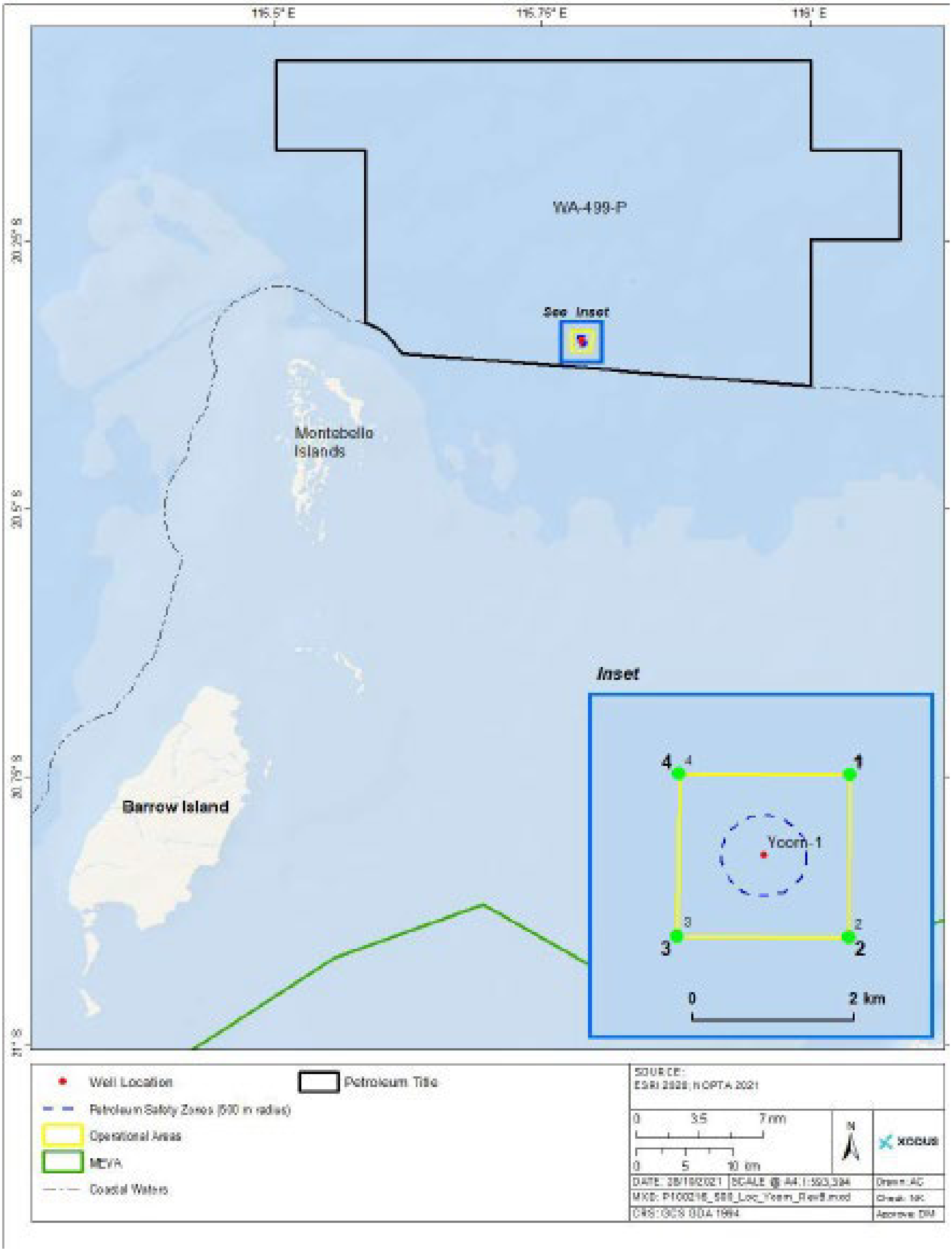
There are no other changes to the information provided to stakeholders on 10 March 2022, which is listed below. Location map is attached.

Location:	103 km offshore from Dampier
Water Depth:	Approx. 40 to 50m
Activity Duration:	The activity is planned to commence in a window between Q2-2022 and Q4 2022. Santos expects the Jack Up Mobile Offshore Drilling Unit (MODU) to be on location for up to 100 days for the Yoorn-1 well dependant on operational down time and weather delays.
Support Vessels:	A Jack-up MODU supported by up to four support vessels will undertake the drilling activities
Exclusion Zone:	A temporary 500 m Petroleum Safety Zone (PSZ) around the MODU (for duration of drilling activities).

Please be in contact via the phone or email details below if you have any questions on any of the activities outlined in the attached Consultation Information.

Kind regards

[redacted]
Santos Limited,
Level 7 100 St Georges Tce, Perth WA 6000
t: +61 8 6218 7095
e: offshore.consultation@Santos.com


116.5° E
116.75° E
116° E
20.25° S
20.5° S
20.75° S
WA-499-P
See Inset
Montebello Islands
Barrow Island
Inset
4
1
3
2
Yoorn-1
0
2 km
Well Location
Petroleum Title
Petroleum Safety Zones (500 m radius)
Operational Areas
MEVA
Coastal Waters
SOURCE:
ESRI 2020; NOPTA 2021
0
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Santos

STAKEHOLDER CONSULTATION

Consultation Material

STAKEHOLDER CONSULTATION
OCTOBER 2021 UPDATE

Santos

WA-499-P, WA-208-P and WA-546-P

Exploration Drilling Program

Overview

Santos proposes to drill three exploration wells in petroleum exploration permits WA-499-P, WA-208-P and WA 546-P. The permits are in Commonwealth waters located approximately 103 kilometres, 87 km and 87 km respectively offshore from Dampier in Western Australia. As part of the preparatory work required to safely undertake the drilling, a site survey is required to assess the shallow seabed soils suitability to provide a safe foundation for a Jack Up Mobile Offshore Drilling Unit (MODU).

The proposed exploration wells will target the Biggada hydrocarbon prospect and the Lengendre hydrocarbon prospect.

Figure 1 provides an indication of notional locations for exploration wells: Yoorn-1, Parnassus-1 and Jelen-1 and the proposed site survey operational area.

Before Santos can undertake the site survey and then drill the exploration well, the company must prepare, and have accepted, an Environment Plan for the site surveys and the exploration wells. Before Santos can submit the EP for assessment, it must have consulted with relevant stakeholders.

The EP will be developed and implemented in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R) for acceptance by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

Effective 25 April 2019, exploration drilling environment plans submitted to NOPSEMA must be published on their website for a 30-day public comment period. Santos anticipates that the EP will be available for public comment in Q4 of 2021. Additional information on the public comment period can be found at https://info.nopsema.gov.au/home/open_for_comment.

While this process provides for increased transparency and an opportunity for the public to provide input to the environmental management of the proposed exploration drilling activity, all stakeholders are encouraged to review the consultation material contained in this document and to respond to Santos prior to the public comment period.

Activity description

Site Survey

The vessel-based activity will be undertaken using geophysical survey techniques and will include surveying a 1-km x 1-km grid at the proposed exploration well locations, plus potential survey tie-in lines extending from the proposed well location to other sites with known geological information.

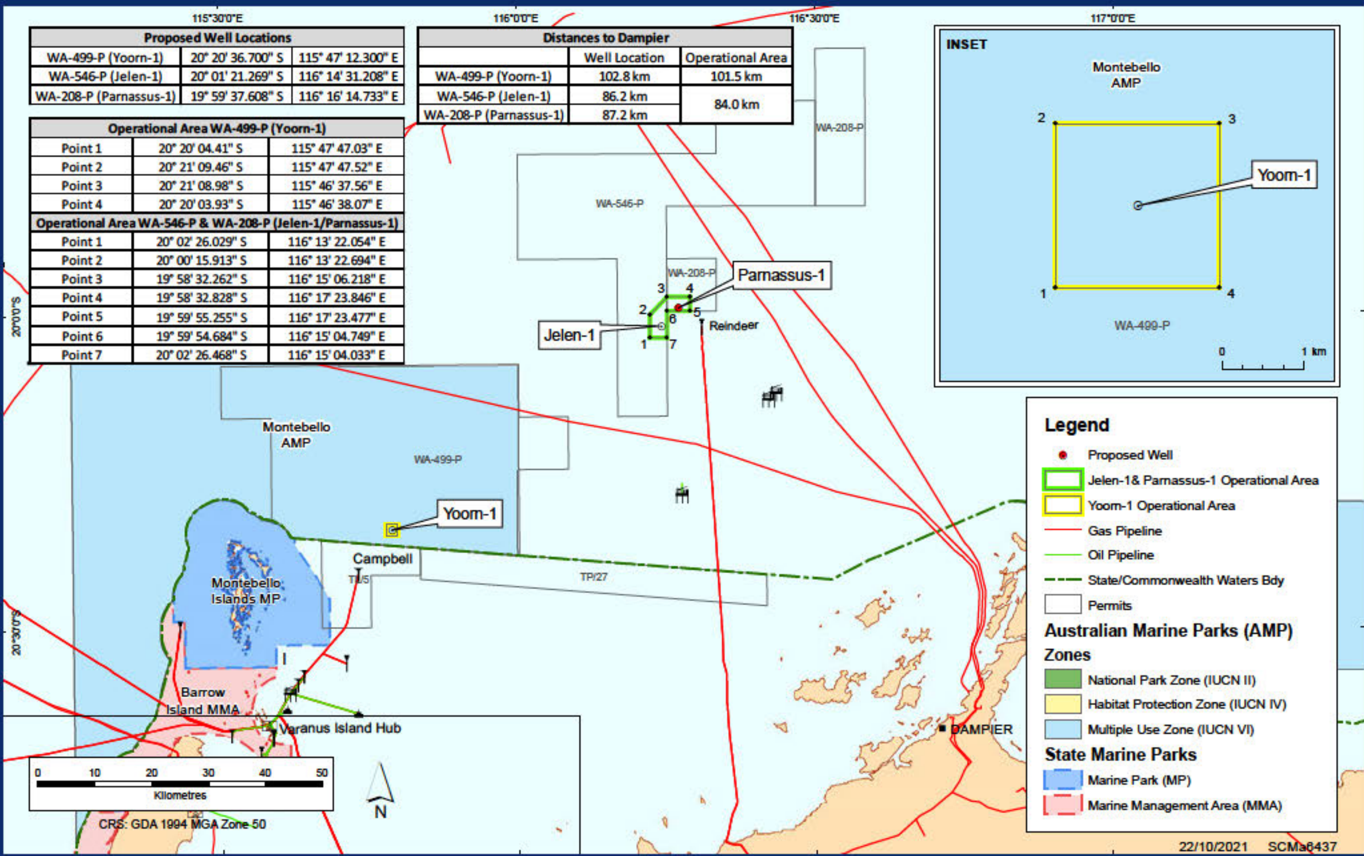
The survey will involve the following:

+ Acquisition of multi-beam echo sounding (MBES) and side-scan sonar (SSS) data to define the bathymetry / seafloor morphology (e.g. depth, bedform character) and confirm the absence of debris or other anomalous seabed features.
+ Identification of any hazards that may impact the location of a Jack up rig, through sub-bottom profiling (SBP), including shallow gas, lateral variability in layer properties, adverse near-seabed stratigraphy, anomalous layers of hard/soft formations, localised/regional outcrops or sub-crops, mobile bedforms, and impediments to providing adequate foundations for supporting the rig when it is elevated above the water.
+ Grab sampling or drop cores for ground-truthing the surficial geophysics and to support MODU spud-can penetration assessments.

Data acquired from the site surveys will subsequently be processed to generate site survey reports for use in drilling the wells. This data is required no less than six months prior to drilling to inform planning for drilling the wells.

Note, the survey EP for WA-499-P (Yoorn-1) was accepted by NOPSEMA on 3 June 2020 under a separate EP (Yoorn-1 Geophysical Survey Environment Plan). The information on the Yoorn-1 survey has been included below for completeness.

Figure 1: Yoorn-1, Jelen-1 and Parnassus-1 location map



Proposed Well Locations		
WA-499-P (Yoorn-1)	20° 20' 36.700" S	115° 47' 12.300" E
WA-546-P (Jelen-1)	20° 01' 21.269" S	116° 14' 31.208" E
WA-208-P (Parnassus-1)	19° 59' 37.608" S	116° 16' 14.733" E

Operational Area WA-499-P (Yoorn-1)		
Point 1	20° 20' 04.41" S	115° 47' 47.03" E
Point 2	20° 21' 09.46" S	115° 47' 47.52" E
Point 3	20° 21' 08.98" S	115° 46' 37.56" E
Point 4	20° 20' 03.93" S	115° 46' 38.07" E

Operational Area WA-546-P & WA-208-P (Jelen-1/Parnassus-1)		
Point 1	20° 02' 26.029" S	116° 13' 22.054" E
Point 2	20° 00' 15.913" S	116° 13' 22.694" E
Point 3	19° 58' 32.262" S	116° 15' 06.218" E
Point 4	19° 58' 32.828" S	116° 17' 23.846" E
Point 5	19° 59' 55.255" S	116° 17' 23.477" E
Point 6	19° 59' 54.684" S	116° 15' 04.749" E
Point 7	20° 02' 26.468" S	116° 15' 04.033" E

Distances to Dampier		
	Well Location	Operational Area
WA-499-P (Yoorn-1)	102.8 km	101.5 km
WA-546-P (Jelen-1)	86.2 km	84.0 km
WA-208-P (Parnassus-1)	87.2 km	

SITE SURVEY ACTIVITY DETAILS	
Permit number	WA-499-P, WA-208-P and WA 546-P.
Water depth	Approx. 40 m to 50 m.
Exclusion zone	No exclusion zone is established around vessel during the site survey.

Location

	Points	Latitude (GDA 94)	Longitude (GDA 94)
Operational area WA-499-P (Yoorn-1)	Point 1	20° 20' 04.41" S	115° 47' 47.03" E
	Point 2	20° 21' 09.46" S	115° 47' 47.52" E
	Point 3	20° 21' 08.98" S	115° 46' 37.56" E
	Point 4	20° 20' 03 93" S	115° 46' 38.07" E
Operational area WA-546-P & WA-208-P (Jelen-1/Parnassus-1)	Point 1	20° 02' 26.029" S	116° 13' 22.054" E
	Point 2	20° 00' 15.913" S	116° 13' 22.694" E
	Point 3	19° 58' 32.262" S	116° 15' 06.218" E
	Point 4	19° 58' 32.828" S	116° 17' 23.846" E
	Point 5	19° 59' 55.255" S	116° 17' 23.477" E
	Point 6	19° 59' 54.684" S	116° 15' 04.749" E
	Point 7	20° 02' 26.468" S	116° 15' 04.033" E

Equipment	A single survey vessel will be utilised to undertake the activity. Approx. 60 m long, multi-purpose support vessel.
Description of natural environment	The survey activity for Yoorn-1, Parnassus-1 and Jelen-1 overlaps the Northwest Shelf Provincial Bioregion (based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4.0).
Timing and duration	The survey activity for WA-499-P is planned to take place in a window in Q1-Q2 2022 and a window between Q2 and Q4 in 2022 for WA-546-P and WA-208-P. Allowing for potential down time, for example due to weather, the activity may extend to up to 10 days. Activities will be undertaken 24 hours per day.

Nearest proximity to key regional features

Regional Feature	WA-499-P	WA-546-P	WA-208-P
Barrow Island	49.9 km SW	108.7 km SW	113.1 km SW
Varanus Island	40.2 km SW	97.9 km SW	102.3 km SW
Closest Montebello Island	21.0 km W	80.0 km SW	84.3 km SW
Dampier	102.8 km SE	86.2 km SE	87.2 km SE
Onslow	159.5 km SW	213.9 km SW	218.3 km SW
Closest mainland point	69.6 km SE (Cape Preston)	81.5 km SE (Burrup Peninsula)	81.7 km SE (Burrup Peninsula)
Montebello Marine Park (Australian Marine Park)	0 km (intersects)	26.2 km SW	30.0 km SW
Montebello Islands Marine Park (State)	15.5 km SW	74.3 km SW	78.5 km SW
Barrow Island Marine Management Area (State)	31.3 km SW	90.2 km SW	94.5 km SW
Barrow Island Marine Park (State)	61.9 km SW	120.8 km SW	125.2 km SW
Dampier Marine Park (Australia Marine Park)	109.4 km E	69.0 km SE	67.9 km SE

Worst case hydrocarbon spill scenario	329 m^3 marine diesel from a vessel collision.
Response tier required	In the event of a diesel spill, a Tier 3 response would be implemented as defined in the activity-specific Oil Pollution Emergency Plan.

Santos has conducted the following assessment of potential environmental risks and impacts from the survey activity.

POTENTIAL RISKS AND IMPACTS	
Potential risks and/or impacts	**Management Measures**
Interaction with other commercial fishers and other marine users	• If requested, relevant stakeholders will be notified prior to the commencement and on cessation of the survey. • Relevant maritime notices issued. • A visual and radar watch will be maintained on the vessel bridge at all times. • Santos will not restrict commercial fishing access to the operational area and is committed to concurrent operations. • Survey vessel will be prohibited from recreational fishing within the operational area.
Acoustic disturbance to marine fauna	• Monitoring of the surrounding environment for marine fauna is undertaken from the vessel bridge. • Survey vessel complies with Santos WA's Protected Marine Fauna Interaction and Sighting Procedure, which includes the following controls: - Vessel will not travel at greater than 6 knots within 300 m of a whale. - Vessel will not approach within 100 m of a whale.
Light emissions	• Survey vessel navigation lighting and equipment is compliant with SOLAS/AMSA Marine Orders.
Atmospheric emissions	• Survey vessel marine diesel (fuel oil) sulphur content is compliant with MARPOL/AMSA Marine Order.
Seabed disturbance	• No vessel anchoring, unless in an emergency. • Objects dropped overboard are recovered (where possible) to mitigate the environmental consequences from objects remaining in the marine environment.
Operational vessel discharges	• Routine vessel discharge (sewage, bilge water, food waste) will meet legal requirements. • Deck cleaning products will not be harmful to the marine environment.
Biosecurity risk management	• Vessel is managed to low risk in accordance with the Santos Invasive Marine Species Management Plan prior to movement/transit into or within the invasive marine species management zone, which requires: - assessment of applicable vessels using the DPIRD Vessel Check Tool; and - the management of immersible equipment to low risk.
Spill response operations	• In the event of a hydrocarbon spill, the Oil Pollution Emergency Plan requirements are implemented to mitigate environmental impacts.

Exploration drilling

The proposed drilling activity is summarised below.

EXPLORATION DRILLING ACTIVITY DETAILS				
Permit number	WA-499-P, WA 546-P and WA 208-P.			
Water depth	Approx. 40 m to 50 m.			
Exclusion zone	500 m around MODU at all times.			
Location		Latitude (GDA 94)	Longitude (GDA 94)	
	WA-499-P (Yoorn-1)	20° 20' 36.700" S	115° 47' 12.300" E	
	WA 546-P (Jelen-1)	20° 01' 21.269" S	116° 14' 31.208" E	
	WA 208-P (Parnassus-1)	19° 59' 37.608" S	116° 16' 14.733" E	
Equipment	Jack up rig with support vessels and helicopters.			
Description of natural environment	The activity for Yoorn-1, Parnassus-1 and Jelen-1 overlaps the Northwest Shelf Provincial Bioregion (based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4.0).			
Timing and duration	The activity is planned to commence in a window between Q2-2022 and Q4 2022. Santos expects the Jack Up to be on location for up to 70 days for the Yoorn-1 well and approximately 60 days per well for the Parnassus and Jelen wells, dependant on operational down time and weather delays.			
Nearest proximity to key regional features	Regional Feature	WA-499-P	WA-546-P	WA-208-P
	Barrow Island	48.5 km SW	105 9 km SW	105 9 km SW
	Varanus Island (Santos operated)	38.8 km SW	95.1 km SW	95.1 km SW
	Closest Montebello Island	19.7 km W	77.3 km SW	77.3 km SW
	Dampier	101.5 km SE	84.0 km SE	84.0 km SE
	Onslow	158.1 km SW	211.2 km SW	211.2 km SW
	Closest Mainland Point	68.2 km SE (Cape Preston)	79.5 km SE (Burrup peninsula)	79.5 km SE Burrup peninsula)
	Montebello Marine Park (Australian Marine Park)	0 km (intersects)	23.8 km SW	23.8 km SW
	Montebello Islands Marine Park (State)	14.2 km SW	71.5 km SW	71.5 km SW
	Barrow Island Marine Management Area (State)	29.9 km SW	87.3 km SW	87.3 km SW
	Barrow Island Marine Park (State)	60.4 km SW	117 9 km SW	117 9 km SW
	Dampier Marine Park (Australia Marine Park)	108.3 km E	65.9 km SE	65.9 km SE
Hydrocarbon type	Gas condensate.			
Worst case hydrocarbon spill scenario	317,750 m^3 condensate loss of well control.			
Oil spill response level required	In the event of a hydrocarbon spill, a Level 1, 2 or 3 response would be implemented as defined in the activity-specific Oil Pollution Emergency Plan.			

Santos has conducted the following assessment of potential environmental risks and impacts from the drilling activity.

POTENTIAL RISKS AND IMPACTS	
Potential risks and/or impacts	**Management Measures**
Interaction with commercial fishers and other marine users	· If requested, relevant stakeholders will be notified prior to commencement and on cessation of the activity. · Relevant maritime notices issued. · A 500 m radius exclusion zone will be in place around the MODU for the duration of the activity · A visual and radar watch will be maintained on the support vessel bridge at all times. · Recreational fishing will be prohibited during the activity.
Hydrocarbon release	· NOPSEMA-accepted MODU safety case and Santos Well Operations Management Plan (WOMP) in place. · Prior to exploration drilling there will be a relief well plan in place. · Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment. · Appropriate spill response plans (OPEP), equipment and materials will be in place and maintained.
Drilling discharge	· Drilling and cement chemicals potentially discharged to sea are Gold/Silver/D or E rated through OCNS, or PLONOR substances listed by OSPAR, or have a completed Santos risk assessment so that only environmentally acceptable products are used. · Only water-based drilling fluid systems will be used.
Marine fauna interactions	· Implementation of EPBC Regulations (Part 8) for interacting with cetaceans to minimise the disturbance to fauna caused by marine vessels and helicopters.
Light emissions	· MODU/vessels navigation lighting and equipment are compliant with SOLAS/AMSA Marine Orders.
Atmospheric emissions	· MODU/vessels marine diesel (fuel oil) sulphur content is compliant with MARPOL/AMSA Marine Order.
Seabed disturbance	· Site survey prior to MODU arrival to identify and avoid any environmentally sensitive seabed features. · No vessel anchoring, unless in an emergency. · Objects dropped overboard are recovered (where possible) to mitigate the environmental consequences from objects remaining in the marine environment.
Operational MODU and vessel discharges	· Routine MODU and vessel discharge (sewage, bilge water, food waste) will meet legal requirements. · Deck cleaning products will not be harmful to the marine environment.
Biosecurity risk management	· MODU and vessels are managed to low risk in accordance with the Santos Invasive Marine Species Management Plan prior to movement/transit into or within the invasive marine species management zone, which requires: - assessment of applicable MODU/vessels using the DPIRD Vessel Check Tool; and - the management of immersible equipment to low risk.
Spill response operations	· In the event of a hydrocarbon spill, the Santos WA OPEP requirements are implemented to mitigate environmental impacts.

Consultation

If you wish to comment on Santos' WA-499-P, WA-208-P and WA-546-P Exploration Drilling Program, or if you require additional information, please contact Santos on the contact details below.

Santos
PO Box 5624, Perth, 6831
[redacted]

STAKEHOLDER CONSULTATION

Santos

WA-499-P, WA-208-P and WA-546-P

Exploration Drilling Program

Overview

Santos proposes to drill three exploration wells in petroleum exploration permits WA-499-P, WA-208-P and WA 546-P. The permits are in Commonwealth waters located approximately 103 kilometres, 87 km and 87 km respectively offshore from Dampier in Western Australia. As part of the preparatory work required to safely undertake the drilling, a site survey is required to assess the shallow seabed soils suitability to provide a safe foundation for a Jack Up Mobile Offshore Drilling Unit (MODU).

The proposed exploration wells will target the Biggada hydrocarbon prospect and the Lengendre hydrocarbon prospect.

Figure 1 provides an indication of notional locations for exploration wells: Yoorn-1, Parnassus-1 and Jelen-1 and the proposed site survey operational area.

Before Santos can undertake the site survey and then drill the exploration well, the company must prepare, and have accepted, an Environment Plan for the site surveys and the exploration wells. Before Santos can submit the EP for assessment, it must have consulted with relevant stakeholders.

The EP will be developed and implemented in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R) for acceptance by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

Effective 25 April 2019, exploration drilling environment plans submitted to NOPSEMA must be published on their website for a 30-day public comment period. Santos anticipates that the EP will be available for public comment in Q4 of 2021. Additional information on the public comment period can be found at https://info.nopsema.gov.au/home/open_for_comment.

While this process provides for increased transparency and an opportunity for the public to provide input to the environmental management of the proposed exploration drilling activity, all stakeholders are encouraged to review the consultation material contained in this document and to respond to Santos prior to the public comment period.

Activity Description

Site Survey

The vessel-based activity will be undertaken using geophysical survey techniques and will include surveying a 1-km x 1-km grid at the proposed exploration well locations, plus potential survey tie-in lines extending from the proposed well location to other sites with known geological information.

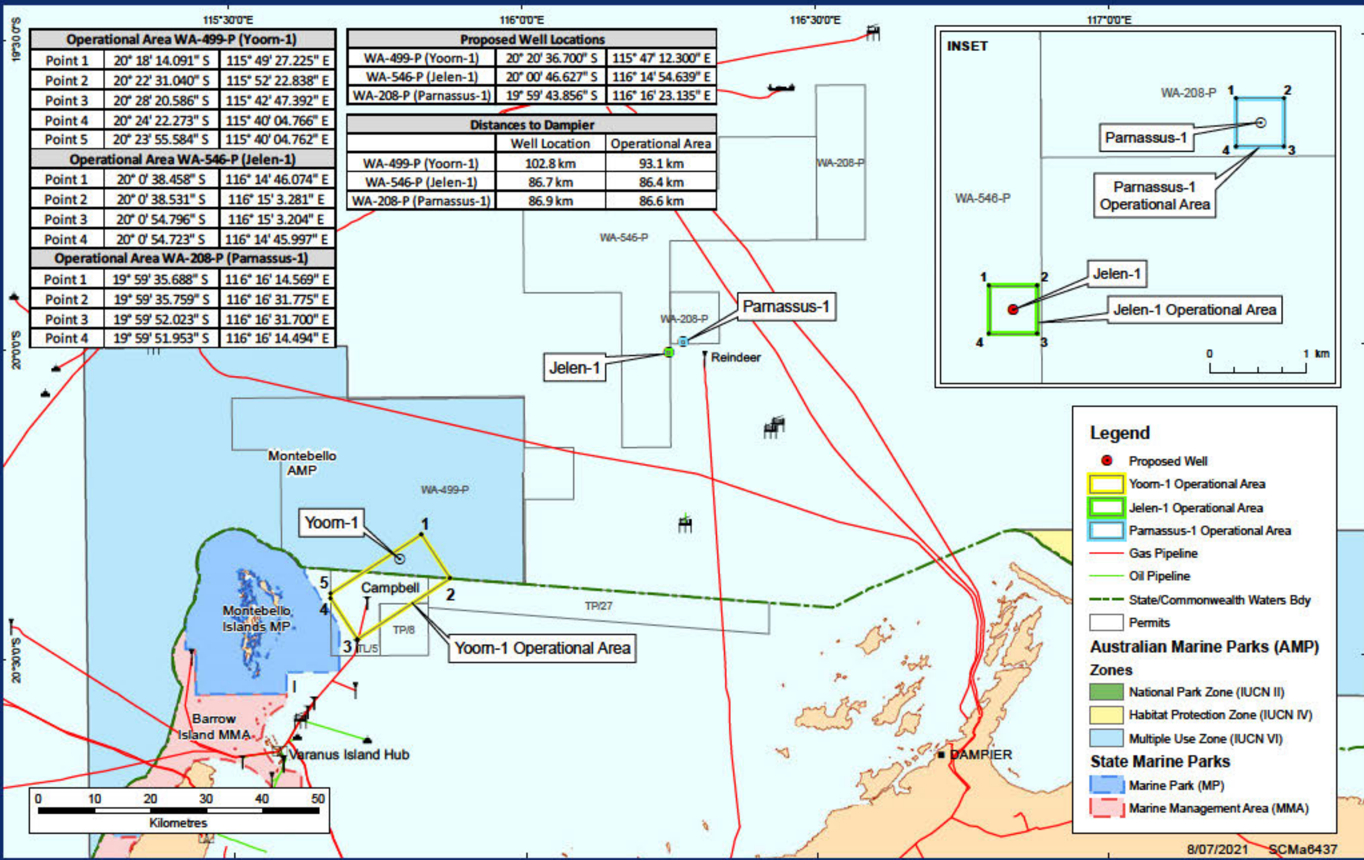
The survey will involve the following:

+ Acquisition of multi-beam echo sounding (MBES) and side-scan sonar (SSS) data to define the bathymetry / seafloor morphology (e.g. depth, bedform character) and confirm the absence of debris or other anomalous seabed features.
+ Identification of any hazards that may impact the location of a Jack up rig, through sub-bottom profiling (SBP), including shallow gas, lateral variability in layer properties, adverse near-seabed stratigraphy, anomalous layers of hard/soft formations, localised/regional outcrops or sub-crops, mobile bedforms, and impediments to providing adequate foundations for supporting the rig when it is elevated above the water.
+ Grab sampling or drop cores for ground-truthing the surficial geophysics and to support MODU spud-can penetration assessments.

Data acquired from the site surveys will subsequently be processed to generate site survey reports for use in drilling the wells. This data is required no less than six months prior to drilling to inform planning for drilling the wells.

Note, the survey EP for WA-499-P (Yoorn-1) was accepted by NOPSEMA on 3 June 2020 under a separate EP (Yoorn-1 Geophysical Survey Environment Plan). The information on the Yoorn-1 survey has been included below for completeness.

Figure 1: Yoorn-1, Jelen-1 and Parnassus-1 Location Map



Operational Area WA-499-P (Yoorn-1)		
Point 1	20° 18' 14.091" S	115° 49' 27.225" E
Point 2	20° 22' 31.040" S	115° 52' 22.838" E
Point 3	20° 28' 20.586" S	115° 42' 47.392" E
Point 4	20° 24' 22.273" S	115° 40' 04.766" E
Point 5	20° 23' 55.584" S	115° 40' 04.762" E
Operational Area WA-546-P (Jelen-1)		
Point 1	20° 0' 38.458" S	116° 14' 46.074" E
Point 2	20° 0' 38.531" S	116° 15' 3.281" E
Point 3	20° 0' 54.796" S	116° 15' 3.204" E
Point 4	20° 0' 54.723" S	116° 14' 45.997" E
Operational Area WA-208-P (Parnassus-1)		
Point 1	19° 59' 35.688" S	116° 16' 14.569" E
Point 2	19° 59' 35.759" S	116° 16' 31.775" E
Point 3	19° 59' 52.023" S	116° 16' 31.700" E
Point 4	19° 59' 51.953" S	116° 16' 14.494" E

Proposed Well Locations		
WA-499-P (Yoorn-1)	20° 20' 36.700" S	115° 47' 12.300" E
WA-546-P (Jelen-1)	20° 00' 46.627" S	116° 14' 54.639" E
WA-208-P (Parnassus-1)	19° 59' 43.856" S	116° 16' 23.135" E

Distances to Dampier		
	Well Location	Operational Area
WA-499-P (Yoorn-1)	102.8 km	93.1 km
WA-546-P (Jelen-1)	86.7 km	86.4 km
WA-208-P (Parnassus-1)	86.9 km	86.6 km

SITE SURVEY ACTIVITY DETAILS

Permit number	WA-499-P, WA-208-P and WA 546-P.
Water depth	Approx. 40 m to 50 m.
Exclusion zone	No exclusion zone is established around vessel during the site survey.

Location

	Points	Latitude (GDA 94)	Longitude (GDA 94)
Operational area WA-499-P (Yoorn-1)	Point 1	20º 18' 14.091" S	115º 49' 27.225" E
	Point 2	20º 22' 31.040" S	115º 52' 22.838" E
	Point 3	20º 28' 20.586" S	115º 42' 47.392" E
	Point 4	20º 24' 22.273" S	115º 40' 04.766" E
	Point 5	20º 23' 55.584" S	115º 40' 04.762" E
Operational area WA-546-P (Jelen-1)	Point 1	20º 0' 38.458" S	116º 14' 46.074" E
	Point 2	20º 0' 38.531" S	116º 15' 3.281" E
	Point 3	20º 0' 54.796" S	116º 15' 3.204" E
	Point 4	20º 0' 54.723" S	116º 14' 45.997" E
Operational area WA-208-P (Parnassus-1)	Point 1	19º 59' 35.688" S	116º 16' 14.569" E
	Point 2	19º 59' 35.759" S	116º 16' 31.775" E
	Point 3	19º 59' 52.023" S	116º 16' 31.700" E
	Point 4	19º 59' 51.953" S	116º 16' 14.494" E

Equipment	A single survey vessel will be utilised to undertake the activity. Approx. 60 m long, multi-purpose support vessel.
Description of natural environment	The survey activity for Yoorn-1, Parnassus-1 and Jelen-1 overlaps the Northwest Shelf Provincial Bioregion (based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4.0).
Timing and duration	The survey activity for WA-499-P is planned to take place in a window in Q1-Q2 2022 and a window between Q2 and Q4 in 2022 for WA-546-P and WA-208-P. Allowing for potential down time, for example due to weather, the activity may extend to up to 10 days. Activities will be undertaken 24 hours per day.

Nearest proximity to key regional features

Regional Feature	WA-499-P	WA-546-P	WA-208-P
Barrow Island	34.3 km SW	109.6 km SW	112.8 km SW
Varanus Island	24.1 km SW	98.8 km SW	102.0 km SW
Closest Montebello Island	6.9 km W	80.9 km SW	84.1 km SW
Dampier	93.1 km SE	86.4 km SE	86.6 km SE
Onslow	143.3 km SW	214.9 km SW	217.9 km SW
Closest mainland point	61.3 km SE (Cape Preston)	81.4 km SE (Burrup Peninsula)	81.0 km SE (Burrup Peninsula)
Montebello Marine Park (Australian Marine Park)	0 km (intersects)	26.8 km SW	29.8 km SW
Montebello Islands Marine Park (State)	1.3 km W	75 km SW	78.2 km SW
Barrow Island Marine Management Area (State)	15.8 km SW	91 km SW	94.2 km SW
Barrow Island Marine Park (State)	46.5 km SW	121.7 km SW	124.9 km SW
Dampier Marine Park (Australia Marine Park)	100.6 km E	68.5 km SW	67.2 km SE

Worst case hydrocarbon spill scenario	329 m^3 marine diesel from a vessel collision.
Response tier required	In the event of a diesel spill, a Tier 3 response would be implemented as defined in the activity-specific Oil Pollution Emergency Plan.

Santos has conducted the following assessment of potential environmental risks and impacts from the survey activity.

POTENTIAL RISKS AND IMPACTS	
Potential risks and/or impacts	**Management Measures**
Interaction with other commercial fishers and other marine users	• If requested, relevant stakeholders will be notified prior to the commencement and on cessation of the survey. • Relevant maritime notices issued. • A visual and radar watch will be maintained on the vessel bridge at all times. • Santos will not restrict commercial fishing access to the operational area and is committed to concurrent operations. • Survey vessel will be prohibited from recreational fishing within the operational area.
Acoustic disturbance to marine fauna	• Monitoring of the surrounding environment for marine fauna is undertaken from the vessel bridge. • Survey vessel complies with Santos WA's Protected Marine Fauna Interaction and Sighting Procedure, which includes the following controls: - Vessel will not travel at greater than 6 knots within 300 m of a whale. - Vessel will not approach within 100 m of a whale.
Light emissions	• Survey vessel navigation lighting and equipment is compliant with SOLAS/AMSA Marine Orders.
Atmospheric emissions	• Survey vessel marine diesel (fuel oil) sulphur content is compliant with MARPOL/AMSA Marine Order.
Seabed disturbance	• No vessel anchoring, unless in an emergency. • Objects dropped overboard are recovered (where possible) to mitigate the environmental consequences from objects remaining in the marine environment.
Operational vessel discharges	• Routine vessel discharge (sewage, bilge water, food waste) will meet legal requirements. • Deck cleaning products will not be harmful to the marine environment.
Biosecurity risk management	• Vessel is managed to low risk in accordance with the Santos Invasive Marine Species Management Plan prior to movement/transit into or within the invasive marine species management zone, which requires: - assessment of applicable vessels using the DPIRD Vessel Check Tool; and - the management of immersible equipment to low risk.
Spill response operations	• In the event of a hydrocarbon spill, the Oil Pollution Emergency Plan requirements are implemented to mitigate environmental impacts.

Exploration Drilling

The proposed drilling activity is summarised below.

EXPLORATION DRILLING ACTIVITY DETAILS				
Permit number	WA-499-P, WA 546-P and WA 208-P.			
Water depth	Approx. 40 m to 50 m.			
Exclusion zone	500 m around MODU at all times.			
Location		Latitude (GDA 94)	Longitude (GDA 94)	
	Indicative well location (Yoorn-1)	20° 20' 36.7" S	115° 47' 12.3" E	
	Indicative well location (Jelen-1)	20° 00' 46.627" S	116° 14' 54.639" E	
	Indicative well location (Parnassus-1)	19° 59' 43.856" S	116° 16' 23.135" E	
Equipment	Jack up rig with support vessels and helicopters.			
Description of natural environment	The activity for Yoorn-1, Parnassus-1 and Jelen-1 overlaps the Northwest Shelf Provincial Bioregion (based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4.0).			
Timing and duration	The activity is planned to commence in a window between Q2-2022 and Q4 2022. Santos expects the Jack Up to be on location for up to 70 days for the Yoorn-1 well and approximately 60 days per well for the Parnassus and Jelen wells, dependant on operational down time and weather delays.			
Nearest proximity to key regional features	Regional Feature	WA-499-P	WA-546-P	WA-208-P
	Barrow Island	49.9 km SW	109.9 km SW	113.1 km SW
	Varanus Island (Santos operated)	40.2 km SW	99.2 km SW	102.4 km SW
	Closest Montebello Island	21.4 km WSW	81.2 km SW	84.4 km SW
	Dampier	102.8 km SE	86.7 km SE	86.9 km SE
	Onslow	159.5 km SW	214.9 km SW	218.2 km SW
	Closest Mainland Point	69.6 km SE (Cape Preston)	81.8 km (Burrup peninsula)	81.4 km Burrup peninsula)
	Montebello Marine Park (Australian Marine Park)	0 km (intersects)	27.1 km SW	30.2 km SW
	Montebello Islands Marine Park (State)	15.5 km SW	75.4 km SW	78.6 km SW
	Barrow Island Marine Management Area (State)	31.3 km SW	91.4 km SW	94.6 km SW
	Barrow Island Marine Park (State)	61.6 km SW	122 km SW	125.2 km SW
	Dampier Marine Park (Australia Marine Park)	109.4 km SE	68.8 km SE	67.6 km SE
Hydrocarbon type	Gas condensate.			
Worst case hydrocarbon spill scenario	317,750 m^3 condensate loss of well control.			
Oil spill response level required	In the event of a hydrocarbon spill, a Level 1, 2 or 3 response would be implemented as defined in the activity-specific Oil Pollution Emergency Plan.			

Santos has conducted the following assessment of potential environmental risks and impacts from the drilling activity.

POTENTIAL RISKS AND IMPACTS	
Potential risks and/or impacts	**Management Measures**
Interaction with commercial fishers and other marine users	• If requested, relevant stakeholders will be notified prior to commencement and on cessation of the activity. • Relevant maritime notices issued. • A 500 m radius exclusion zone will be in place around the MODU for the duration of the activity • A visual and radar watch will be maintained on the support vessel bridge at all times. • Recreational fishing will be prohibited during the activity.
Hydrocarbon release	• NOPSEMA-accepted MODU safety case and Santos Well Operations Management Plan (WOMP) in place. • Prior to exploration drilling there will be a relief well plan in place. • Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment. • Appropriate spill response plans (OPEP), equipment and materials will be in place and maintained.
Drilling discharge	• Drilling and cement chemicals potentially discharged to sea are Gold/Silver/D or E rated through OCNS, or PLONOR substances listed by OSPAR, or have a completed Santos risk assessment so that only environmentally acceptable products are used. • Only water-based drilling fluid systems will be used.
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Operational MODU and vessel discharges	• Routine MODU and vessel discharge (sewage, bilge water, food waste) will meet legal requirements. • Deck cleaning products will not be harmful to the marine environment.
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Spill response operations	• In the event of a hydrocarbon spill, the Santos WA OPEP requirements are implemented to mitigate environmental impacts.

Consultation

If you wish to comment on Santos' WA-499-P, WA-208-P and WA-546-P Exploration Drilling Program, or if you require additional information, please contact Santos on the contact details below. Santos would appreciate your feedback by **27 August 2021**.

Santos
PO Box 5624, Perth, 6831
[redacted]

Santos

STAKEHOLDER CONSULTATION

Consultation Maps

Proposed Well Locations		
WA-499-P (Yoorn-1)	20° 20' 36.700" S	115° 47' 12.300" E
WA-546-P (Jelen-1)	20° 01' 21.269" S	116° 14' 31.208" E
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Distances to Dampier		
	Well Location	Operational Area
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Point 2	20° 21' 09.46" S	115° 47' 47.52" E
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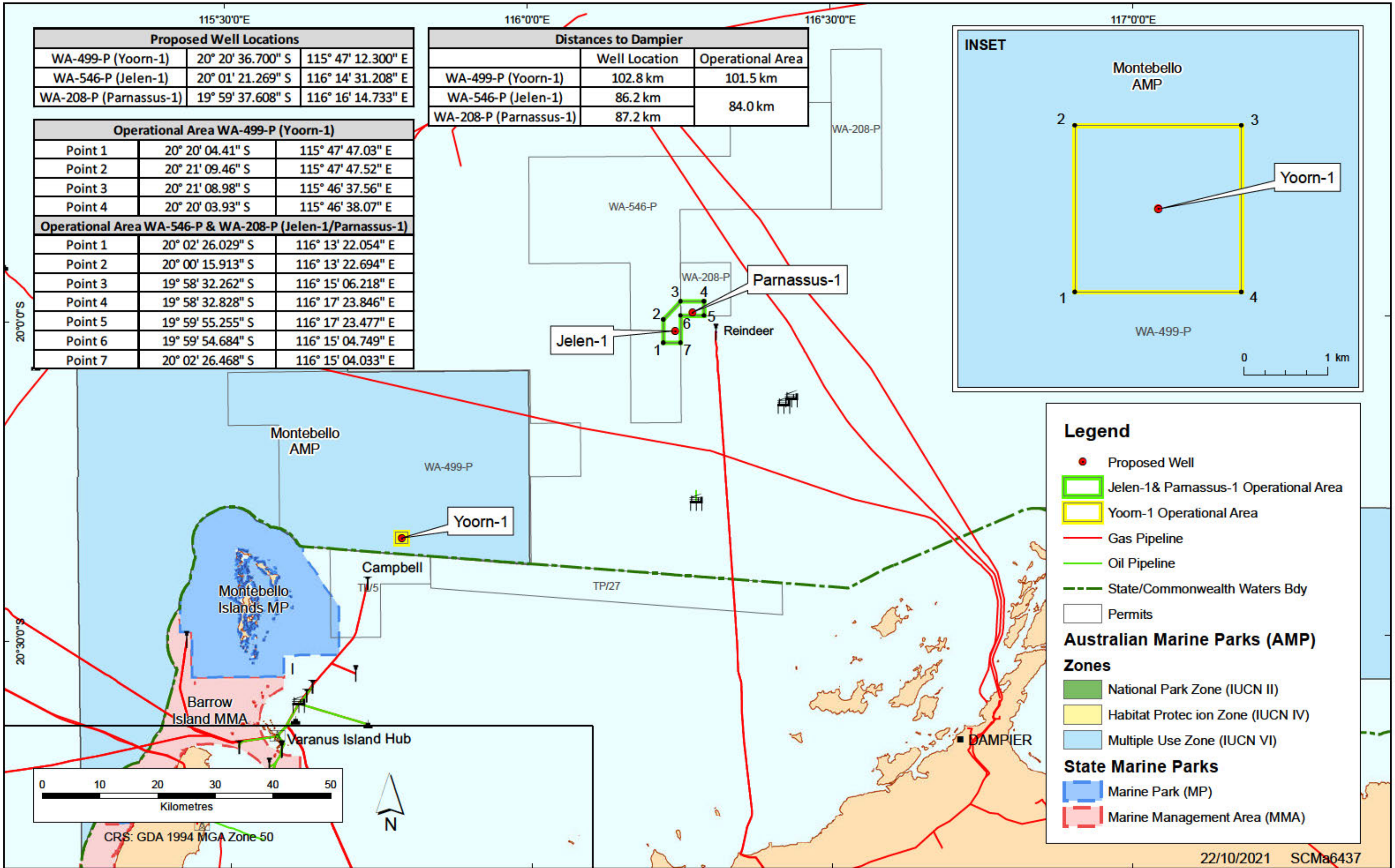

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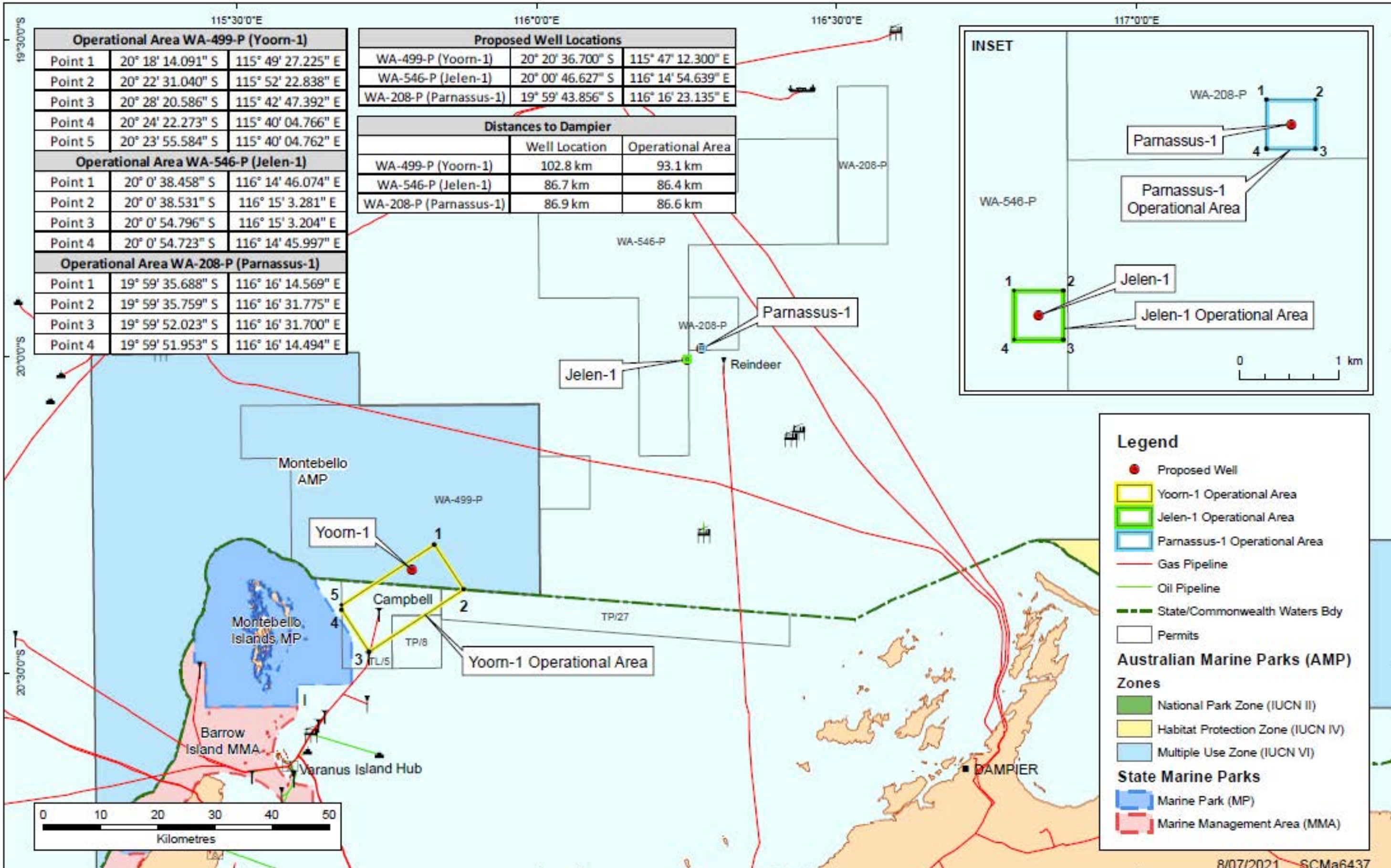
YOORN-1, JELEN-1 & PARNASSUS-1
LOCATION MAP



Operational Area WA-499-P (Yoorn-1)		
Point 1	20° 18' 14.091" S	115° 49' 27.225" E
Point 2	20° 22' 31.040" S	115° 52' 22.838" E
Point 3	20° 28' 20.586" S	115° 42' 47.392" E
Point 4	20° 24' 22.273" S	115° 40' 04.766" E
Point 5	20° 23' 55.584" S	115° 40' 04.762" E
Operational Area WA-546-P (Jelen-1)		
Point 1	20° 0' 38.458" S	116° 14' 46.074" E
Point 2	20° 0' 38.531" S	116° 15' 3.281" E
Point 3	20° 0' 54.796" S	116° 15' 3.204" E
Point 4	20° 0' 54.723" S	116° 14' 45.997" E
Operational Area WA-208-P (Parnassus-1)		
Point 1	19° 59' 35.688" S	116° 16' 14.569" E
Point 2	19° 59' 35.759" S	116° 16' 31.775" E
Point 3	19° 59' 52.023" S	116° 16' 31.700" E
Point 4	19° 59' 51.953" S	116° 16' 14.494" E

Proposed Well Locations		
WA-499-P (Yoorn-1)	20° 20' 36.700" S	115° 47' 12.300" E
WA-546-P (Jelen-1)	20° 00' 46.627" S	116° 14' 54.639" E
WA-208-P (Parnassus-1)	19° 59' 43.856" S	116° 16' 23.135" E

Distances to Dampier	Well Location	Operational Area
WA-499-P (Yoorn-1)	102.8 km	93.1 km
WA-546-P (Jelen-1)	86.7 km	86.4 km
WA-208-P (Parnassus-1)	86.9 km	86.6 km

Santos

YOORN-1, JELEN-1 & PARNASSUS-1
LOCATION MAP

Appendix G – Santos Environment Consequence Descriptors

Consequence Level		I	II	III	IV	V	VI
Acceptability		Acceptable	Acceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable
Severity Description		**Negligible** ***No impact or negligible impact.***	**Minor** ***Detectable but insignificant change to local population, industry or ecosystem factors. Localised effect.***	**Moderate** ***Significant impact to local population, industry or ecosystem factors.***	**Major** ***Major long-term effect on local population, industry or ecosystem factors.***	**Severe** ***Complete loss of local population, industry or ecosystem factors AND/OR extensive regional impacts with slow recovery.***	**Critical** ***Irreversible impact to regional population, industry or ecosystem factors.***
Environmental Receptors	**Fauna** In particular, EPBC Act listed threatened/migratory fauna or *WA Biodiversity Conservation Act 2016* specially protected fauna	Short-term behavioural impacts only to small proportion of local population and not during critical lifecycle activity. No decrease in local population size. No reduction in area of occupancy of species. No loss/disruption of habitat critical to survival of a species. No disruption to the breeding cycle of any individual. No introduction of disease likely to cause a detectable population decline.	Detectable but insignificant decrease in local population size (excluding protected species). Insignificant reduction in area of occupancy of species. Insignificant loss/disruption of habitat critical to survival of a species. Insignificant disruption to the breeding cycle of local population.	Significant decrease in local population size but no threat to overall population viability. Significant behavioural disruption to local population. Significant disruption to the breeding cycle of a local population. Significant reduction in area of occupancy of species. Significant loss of habitat critical to survival of a species. Modify, destroy, remove, isolate or decrease availability of quality of habitat to the extent that a significant decline in local population is likely. Introduce disease likely to cause a significant population decline.	Long-term decrease in local population size and threat to local population viability. Major disruption to the breeding cycle of local population. Major reduction in area of occupancy of species. Fragmentation of existing population. Major loss of habitat critical to survival of a species. Modify, destroy, remove, isolate or decrease availability of quality of habitat to the extent that a long-term decline in local population is likely. Introduce disease likely to cause a long-term population decline.	Complete loss of local population. Complete loss of habitat critical to survival of local population. Widespread (regional) decline in population size or habitat critical to regional population.	Complete loss of regional population. Complete loss of habitat critical to survival of regional population.
	Physical environment/habitat Includes: air quality; water quality; benthic habitat (biotic/abiotic), particularly habitats that are rare or unique; habitat that represents a Key Ecological Feature[1]; habitat within a protected area; habitats that include benthic primary producers[2] and/or epi-fauna[3]	No or negligible reduction in physical environment/habitat area/function.	Detectable but localised and insignificant loss of area/function of physical environment/habitat. Rapid recovery evident within approximately two years (two-season recovery).	Significant loss of area and/or function of local physical environment/habitat. Recovery over the medium term (two to ten years).	Major, large-scale loss of area and/or function of physical environment/local habitat. Slow recovery over decades.	Extensive destruction of local physical environment/habitat with no recovery. Long-term (decades) and widespread loss of area or function of primary producers on a regional scale.	Complete destruction of regional physical environment/habitat with no recovery. Complete loss of area or function of primary producers on a regional scale.

[1] As defined by the Department of Agriculture, Water and Environment (DAWE)
[2] Benthic photosynthetic organisms such as seagrass, algae, hard corals and mangroves
[3] Fauna attached to the substrate including sponges, soft corals and crinoids.

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Acceptability		Acceptable	Acceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable
Severity Description		**Negligible** ***No impact or negligible impact.***	**Minor** ***Detectable but insignificant change to local population, industry or ecosystem factors. Localised effect.***	**Moderate** ***Significant impact to local population, industry or ecosystem factors.***	**Major** ***Major long-term effect on local population, industry or ecosystem factors.***	**Severe** ***Complete loss of local population, industry or ecosystem factors AND/OR extensive regional impacts with slow recovery.***	**Critical** ***Irreversible impact to regional population, industry or ecosystem factors.***
	Threatened ecological communities (EPBC Act listed ecological communities)	No decline in threatened ecological community population size, diversity or function. No reduction in area of threatened ecological community. No introduction of disease likely to cause decline in threatened ecological community population size, diversity or function.	Detectable but insignificant decline in threatened ecological community population size, diversity or function. Insignificant reduction in area of threatened ecological community.	Significant decline in threatened ecological community population size, diversity or function. Significant reduction in area of threatened ecological community. Introduction of disease likely to cause significant decline in threatened ecological community population size, diversity or function.	Major, long-term decline in threatened ecological community population size, diversity or function. Major reduction in area of threatened ecological community. Fragmentation of threatened ecological community. Introduce disease likely to cause long-term decline in threatened ecological community population size, diversity or function.	Extensive, long-term decline in threatened ecological community population size, diversity or function. Complete loss of threatened ecological community.	Complete loss of threatened ecological community with no recovery.
	Protected areas Includes: World Heritage Properties; Ramsar wetlands; Commonwealth/National Heritage Areas; Land/Marine Conservation Reserves	No or negligible impact on protected area values. No decline in species population within protected area. No or negligible alteration, modification, obscuring or diminishing of protected area values.*	Detectable but insignificant impact on one of more of protected area's values. Detectable but insignificant decline in species population within protected area. Detectable but insignificant alteration, modification, obscuring or diminishing of protected area values*	Significant impact on one of more of protected area's values. Significant decrease in population within protected area. Significant alteration, modification, obscuring or diminishing of protected area values.	Major long-term effect on one of more of protected area's values. Long-term decrease in species population contained within protected area and threat to that population's viability. Major alteration, modification, obscuring or diminishing of protected area values.	Extensive loss of one or more of protected area's values. Extensive loss of species population contained within protected area.	Complete loss of one or more of protected area's values with no recovery. Complete loss of species population contained within protected area with no recovery.
	Socio-economic receptors Includes: fisheries (commercial and recreational); tourism; oil and gas; defence; commercial shipping	No or negligible loss of value of the local industry. No or negligible reduction in key natural features or populations supporting the activity.	Detectable but insignificant short-term loss of value of the local industry. Detectable but insignificant reduction in key natural features or population supporting the local activity.	Significant loss of value of the local industry. Significant medium-term reduction of key natural features or populations supporting the local activity.	Major long-term loss of value of the local industry and threat to viability. Major reduction of key natural features or populations supporting the local activity.	Shutdown of local industry or widespread major damage to regional industry. Extensive loss of key natural features or populations supporting the local industry.	Permanent shutdown of local or regional industry. Permanent loss of key natural features or populations supporting the local or regional industry.