

CHAPTER 10, APPENDIX A

PROPOSED BROWSE TO NWS PROJECT EISG/ESD



EIS Guidelines / Environmental Scoping Document

Browse to North West Shelf Project (EPBC 2018/8319, EPA 2191)

*Under Environment Protection and Biodiversity
Conservation Act 1999 (Cwlth)*

and

Part 4 of the Environmental Protection Act 1986 (WA)

July 2019

Rev 2

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1. INTRODUCTION

1.1 Background

1.1.1 Overview of Browse to North West Shelf Project

The Browse Joint Venture (BJV) propose to develop the Brecknock, Calliance and Torosa fields (collectively known as the Browse resources) using two 1100 Million standard cubic feet per day (MMscfd) (annual daily export average) Floating Production Storage and Offloading (FPSO) facilities. The FPSO facilities will be supplied by a subsea production system and will transport gas to existing North West Shelf (NWS) Project infrastructure via a ~85 km spur line and a ~900 km Browse Trunkline (BTL), which will tie in near the existing North Rankin Complex (NRC) (note NRC is owned by North West Shelf Joint Venture (NWS JV).

Woodside Energy Ltd (Woodside) is Operator for and on behalf of the BJV (Woodside Browse Pty Ltd, Shell Australia Pty Ltd (Shell), BP Developments Australia Pty Ltd (BP), Japan Australia LNG Pty Ltd (MIMI Browse) and PetroChina International Investment (Australia) Pty Ltd (PetroChina)).

In September 2018, the proposed Browse to NWS Project entered Concept Definition phase. The proposed Browse to NWS Project is predominately based on proven technologies, including:

- two floating production storage and offloading (FPSO) facilities delivering around 11.4 Mtpa of LNG/LPG and domestic gas; and
- an approximately 900 km pipeline to existing NWS infrastructure.

Optimisation studies and other assessments are ongoing, which may result in changes being made to the reference case.

1.1.2 Project History

Woodside has conducted multiple 'Concept Select' phases for the Browse reservoirs; and has undertaken various studies to characterise the environment and understand the impacts and risks associated with the various development concepts. Details of these studies are included in **Table 5** and **Table 11**. These studies have informed the environmental approvals process for two previous development concepts being:

- The James Price Point (JPP) development concept in 2010 which was progressed through both State and Commonwealth environmental approvals (upstream: EPBC 2008/4111, downstream: referral and request that the proposal be declared a derived proposal under Ministerial Statement 917).
- The FLNG development concept which was referred under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (EPBC 2013/7079) and received approval in August 2015. Note that the portion of the FLNG development concept that lies in State waters (the Torosa Subsea Development) was also referred to the Western Australian Environmental Protection Authority (WA EPA) under the Environmental Protection Act 1986 (EP Act) in December 2014 and was determined to not require assessment by the WA EPA in February 2015.

Over a 7-month period between September 2016 and April 2017, the BJV completed a development concept narrowing process with the aim of having 'line of sight to at least one globally competitive and investable development concept which all stakeholders can support'.

Since April 2017, this development concept has been progressed through the Concept Select phase. Engineering and technical studies appropriate for the Concept Select phase have confirmed the preliminary feasibility of the Browse to NWS development concept which is the

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subject of this Environmental Impact Statement Guidelines (EISG) / Environmental Scoping Document (ESD).

1.1.3 Environmental Assessment Process

1.1.3.1 Environmental Referrals

The Proposed Action was referred to the Department of the Environment and Energy (DoEE) under the EPBC Act in October 2018. On 22 February 2019, the DoEE advised Woodside that the delegate for the Minister for the Environment had determined that the Proposed Action is a controlled action and requires assessment and approval under the EPBC Act before it can proceed. This assessment would be by Environmental Impact Statement. The following controlling provisions were identified in the decision notice:

- National heritage values of a National Heritage place
- Listed threatened species and communities
- Listed migratory species
- Commonwealth marine area, the protected matter being the environment generally.

The Western Australian (WA) State waters component of the proposed Browse to NWS Project was referred to the WA Environmental Protection Authority (EPA) under the EP Act in October 2018. On 22 January 2019, the WA EPA determined that the Proposal requires assessment under Section 39 of the EP Act and set a Public Environmental Review (PER) level of assessment.

The determination identified the following WA EPA Environmental Factors as being relevant for the Proposal within State waters.

- Benthic Communities and Habitats
- Marine Environmental Quality
- Marine Fauna
- Air Quality.

The determination requires Woodside to prepare an Environmental Scoping Document (ESD) and set a public review period for the Environmental Review Document (ERD) of 6 weeks.

1.1.3.2 Assessment Process

The assessment of the Proposed Action under the EPBC Act and EP Act is planned to be undertaken as a coordinated assessment between the DoEE and WA EPA. The National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) will be engaged to provide technical advice to the DoEE in relation to the assessment.

This approach includes the following:

- Simultaneous referrals for the Proposed Action/Proposal under the EPBC Act and EP Act, which was completed in October 2018.
- The development of an EIS Guidelines (EISG) / ESD (this document) which describes the proposed content of an Environment Impact Statement/Environmental Review Document (EIS/ERD). This EISG/ESD will be issued to DoEE and EPA for review and endorsement.
- The development of a single draft EIS/ERD document that is issued to DoEE and EPA for comment on adequacy and approval, prior to release for public comment.
- The preparation of a single final EIS/ERD document. The final EIS/ERD will be submitted to the DoEE and WA EPA for assessment and to be published.

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- Decision on the acceptability of the Proposed Action by the Commonwealth and State.

The environmental assessment process including expected timeframes is provided in **Table 1**. Timeframe and schedule will be documented in a DoEE issued Client Service Charter.

Table 1 Environmental Assessment Process

Stage	Action	Timeframe/Schedule
Pre-referral	Project definition meeting between Woodside, WA EPA and DoEE	Completed
Referral	Simultaneous referrals for the Proposed Action under the EP Act and EPBC Act	Completed: 17 October 2018
	Agency and public comment on referrals and Woodside response	Completed: January 2019
	Level of Assessment set by DoEE	Completed: 22 February 2019
	Level of Assessment set by WA EPA	Completed: 22 January 2019
Scoping	Woodside prepare draft EISG/ESD in consultation with DoEE, WA EPA and NOPSEMA	Completed: 3 May 2019
	DoEE and WA EPA approves EISG/ESD	Target: June 2019
Draft EIS/ERD	Woodside prepare draft EIS/ERD	Target: Mid 2019
	DoEE (in consultation with NOPSEMA) and WA EPA review draft EIS/ERD for adequacy	
	Woodside revise EIS/ERD and resubmit	
	DoEE (in consultation with NOPSEMA) and WA EPA approve release of draft EIS/ERD	
	Public comment on draft EIS/ERD	DoEE = 4 weeks EPA = 6 weeks
Final EIS/ERD	Woodside address public comments and prepare final EIS/ERD	
	DoEE and WA EPA review final EIS/ERD for adequacy	
	Woodside revise EIS/ERD and resubmit	
	DoEE (in consultation with NOPSEMA) and WA EPA approve release of final EIS/ERD	
Evaluation of Project Proposal	DoEE (in consultation with NOPSEMA) and WA EPA assess final EIS/ERD and prepare draft assessment reports and recommendations	
	Woodside review draft assessment reports and recommendations	
	DoEE (in consultation with NOPSEMA) and WA EPA assess final EIS/ERD and prepare final assessment reports and recommendations	
	Relevant Ministers make decision on project approval	Target: Q2 2020

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Subsequent to a favourable decision on the acceptability of the proposed Browse to NWS Project, and prior to any development activity occurring in Commonwealth waters, Environment Plans (EPs) including Oil Pollution Emergency Plan (OPEP) will be developed for approval by NOPSEMA in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.

1.2 Purpose of the EISG/ESD

The EISG/ESD has been jointly developed by Woodside, the DoEE and the WA EPA to address assessment requirements specified in the EPBC Act and EP Act. In general, the EISG/ESD aims to describe the proposed content of the EIS/ERD and set the scope of studies required to allow assessment and decision on the appropriateness of the proposed Browse to NWS Project.

In relation to the EP Act, the purpose of the EISG/ESD is to define the form, content, timing and procedure of the ERD, required by s. 40(3) of the EP Act. The EPA requires that proponents use the ESD template for all proponent prepared ESDs, which is fulfilled in Section 3.

1.3 Scope of the combined EIS/ERD

A combined EIS/ERD document is proposed to meet Commonwealth and State requirements respectively. However, with respect to the WA EPA's assessment under the EP Act, the scope of the Proposal is infrastructure and related activities within State waters.

The scope of the combined EIS/ERD document is limited to construction and operation of the upstream component of the proposed Browse to NWS Project including:

- development drilling, completion and well unload activities (drilling and completion) of the Brecknock, Calliance and Torosa reservoirs
- installation and commissioning of subsea infrastructure, including anchors and mooring lines, umbilicals, flowlines, flexible risers, and manifolds
- installation and commissioning of the Browse Trunkline (BTL) and inter-field spur line including tie-in to existing NWS Project infrastructure near NRC
- installation, hook-up and commissioning of the FPSO facilities
- operation of the subsea infrastructure, including wells/wellheads, umbilicals, flowlines, risers, and manifolds, including inspection, maintenance and repair activities
- operation of the FPSO facilities, including condensate stabilisation, storage and offtake, gas processing (CO₂ and water removal and gas compression) and export
- transmission of gas from the FPSO facilities to the NWS Project infrastructure tie in point
- inspection, maintenance and repair activities
- decommissioning of subsea infrastructure (including well plug and abandonment), BTL, inter-field spur line and FPSO facilities at the end of reservoir field life (approximately 50 years).

The transportation and processing of Browse resources from the tie in point near NRC will be undertaken via the use of existing NWS Project infrastructure, which are the subject of different joint venture arrangements. These activities are covered by separate referrals submitted by the NWS JV under the EP Act (Assessment number 2186) and EPBC Act (EPBC 2018/8335). The relationship between these activities will be explained in the EIS/ERD.

The Proposed Action will involve vessel and helicopter movements in order to support the offshore facilities; however, it is not dependent on the development of new onshore infrastructure in order to proceed.

As the location(s) for supply chain and logistics support infrastructure are not yet determined, vessel and helicopter movements from a range of potential locations to the proposed Browse to

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NWS Project are being considered similar to the previously approved FLNG concept. Existing infrastructure and related services will be utilised.

1.4 EISG/ESD structure

To demonstrate assessment requirements specified by the DoEE and WA EPA for the preparation of an EISG/ESD have been addressed, and to facilitate review, this EISG/ESD has been divided in three parts:

- Section 2 - PART A Description of Proposed Action
- Section 3 - PART B Specific content of the combined EIS/ERD
- Section 4 - PART C State ESD.

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2. PART A: DESCRIPTION OF PROPOSED ACTION

2.1 Proposed Project Area

The Browse hydrocarbon resource is located in the Brecknock, Calliance and Torosa reservoirs approximately 425 km north of Broome and approximately 290 km off the Kimberley coastline.

The Project area consists of:

- the proposed Browse Development Area comprising the Brecknock, Calliance and Torosa fields, the FPSO facilities and the subsea production systems, including wells. The proposed Browse Development Area is approximately 2,897 ha in size
- the pipeline corridor within which the proposed BTL and inter-field spur line will be located from the proposed Browse Development Area to the tie in point near NRC. The pipeline corridor is approximately 985 ha in size and lies entirely within Commonwealth waters.

The total size of the Project Area is approximately 3,827 ha (noting that approximately 55 ha of the pipeline corridor lies within the proposed Browse Development Area).

The Browse Development Area consists of seven petroleum retention leases under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGGS Act), the *State Petroleum (Submerged Lands) Act 1982* (PSL Act) and the *Petroleum and Geothermal Energy Resources Act 1967* (WA). Five of the leases (WA-28-R, WA-29-R, WA-30-R, WA-31-R and WA-32-R) are located in Commonwealth waters. Two leases (TR/5 and R2) are within the State jurisdiction.

The pipeline corridor runs approximately ~900 km south west from the Calliance/Brecknock FPSO facility to the tie-in point with the NWS Project infrastructure near NRC. The pipeline corridor also includes a ~85 km inter-field spur line connecting the Torosa FPSO to the Calliance/Brecknock FPSO.

2.2 Key Characteristic of proposed Browse to NWS Project

2.2.1 Overview

The proposed Browse to NWS Project comprises subsea infrastructure and two FPSO facilities connected to existing NWS Project infrastructure via a ~900 km trunkline. To achieve optimal hydrocarbon recovery, it is anticipated that in the order of 13 wells are required for Ready for Start-up (RFSU) of the two FPSO facilities, and up to 49 wells are currently anticipated over field life. Indicative numbers of wells are presented in **Table 2**. The number and locations of the wells are subject to detailed design and refinement. The final number and approximate locations of the development wells and an appropriate project-specific assessment of impacts will be presented in the EIS/ERD.

Seabed disturbance within the Project area is expected to be approximately 1,200 ha of the approximately 3,900 ha Project area (210 ha for subsea infrastructure and moorings plus 985 ha for the proposed BTL and inter-field spur line). These values are subject to refinement during the design process.

The proposed Browse Development Area is shown in **Figure 1**. The BTL and inter-field spur line route are shown in **Figure 2**.

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Table 2 Proposed Development Components

Component	State waters*	Overall development*
Development well count (up to)	21	49 (including 20 wells at Calliance, 22 wells at Torosa and 7 wells at Brecknock)
Subsea infrastructure	Wellheads, manifolds, flowlines and umbilicals, (seabed disturbance approximately 20 ha)	Wellheads, manifolds, flowlines, umbilicals, risers, anchors and moorings (seabed disturbance approximately 210 ha)
Surface facilities	None	Two ~1100 MMscf/d (annual daily average) FPSO facilities
Browse Trunkline (BTL)	None	~900 km 42" diameter trunkline with adequate capacity for export of 1,800 MMscf/d (maximum of 2,150 MMscf/d)*.
Inter-field spur line	None	~85 km 34" diameter spur line with adequate capacity for export of up to 1100 MMscf/d (annual daily average).

*Subject to detailed design and refinement

2.2.2 Development Infrastructure

The proposed Browse to NWS Project comprises of the key infrastructure components listed in Section 1.2, and described in detail below.

Wells

It is anticipated that the proposed Browse to NWS Project will require drilling and completion of up to 49 production wells at the Brecknock, Calliance and Torosa reservoirs over the life of the Project. Production wells will be drilled from a number of central drill centres. The number and location of these wells and drill centres will depend on reservoir target areas, seabed bathymetry and features to optimise reservoir recovery. Up to an estimated 21 of the production wells will be located within State waters.

Subsea Infrastructure and Flexible Risers

The wells at each drill centre will be connected to manifolds to allow reservoir fluids to be carried from the wells to the manifolds. The manifolds connect the wells to corrosion resistant alloy (CRA) flowlines that are routed back to the FPSO facilities. Connection between the flowlines and the FPSO facilities is achieved using flexible risers through a Flowline End Termination (FLET) or riser base manifold. Other subsea infrastructure includes the FPSO anchors and mooring lines and potentially permanent moorings for support vessels.

Each of the subsea infrastructure types described above will be located in both State and Commonwealth waters except for the flexible risers, mooring turrets and permanent FPSO mooring anchors which are only located in Commonwealth waters.

FPSO Facilities

Two FPSO facilities are proposed for the development. The FPSO facilities will have ship-shaped hulls ((nominally 335 m (up to 370 m) long x 67 m wide x 35 m deep)) with approximately 1,000,000 barrels' effective condensate storage. The FPSO facilities will be permanently moored on location by mooring turrets. The FPSO facilities will be located in Commonwealth waters.

BTL and Inter-Field Spur Line

An approximately 85 km 34" inter-field spur line will connect the Torosa FPSO facility to the 42" trunkline near Calliance/Brecknock FPSO. Gas will be exported from the FPSO facilities via the 42" carbon steel BTL that runs approximately 900 km south west from the Calliance/Brecknock FPSO facility to the tie-in point with the NWS Project infrastructure near NRC.

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The entire length of the inter-field spur line and BTL will be located in Commonwealth waters.

2.2.3 Development Activities

Development Drilling

It is anticipated that a mobile offshore drilling unit (MODU), which is either moored or dynamically positioned, will be used to drill and complete the wells. A moored MODU is anticipated to be moored using anchors, suction piles or driven piles, similar but most likely smaller, than those used for the FPSO facilities. Production wells will be drilled to depths of between 3,500 and 4,500 m beneath sea level to intersect the reservoirs. Once the reservoir is reached, the well may be drilled at inclination (up to horizontally) to optimise the length of the well within the reservoir and the recovery of reservoir fluids. Wireline logging activities may be undertaken for formation evaluation during drilling. This may include Vertical Seismic Profiling (VSP) or other logging activities, which may contain radioactive sources.

Installation of Subsea Umbilicals, Risers and Flowlines (SURF)

Subsea infrastructure required for start-up will be installed prior to the arrival of the FPSO facilities, with further infrastructure installed throughout the life of the proposed development, as required. Subsea infrastructure such as manifolds, flowlines, umbilicals, mooring systems and risers will be transported to site by a combination of installation vessels and cargo barges. Subsea installation of equipment will be performed by specialist DP vessels. Subsea equipment will typically be lowered into place from a vessel with a crane. Up to 20 piles may be installed to secure the riser bases, if required. Installation and hook up of the equipment on the seabed is typically achieved using submersible Remotely Operated Vehicles (ROVs). The ROVs will also aid in commissioning processes.

Seabed preparation works may be required to position flowlines on a level surface, to provide stability to the subsea gathering system. Seabed preparation works will most likely be undertaken using ploughing and/or mass flow excavation techniques. Protection and additional stabilisation methods, such as trenching and rock placement, may also be required to limit potential damage to flowlines and subsea infrastructure.

Installation of FPSO facilities

A turret mooring system will be installed for each FPSO facility using a DP installation vessel. The configuration is expected to comprise three groups of six mooring lines per group (pending completion of mooring analysis), arranged around the turret. The turret mooring system will include a non-rotating component to support the mooring lines, risers and umbilicals. This configuration allows the facility to freely weathervane with prevailing metocean conditions. Once on location, each FPSO facility will be connected to the mooring system.

The mooring lines will be preferentially secured to the seabed by suction piles. The suction piles will typically be 6 m to 10 m in diameter, and up to 30 m in length, with each weighing approximately 450 tonnes.

Installation of BTL and Inter-Field Spur Line

The BTL and inter-field spur line will be installed via a pipelay vessel. Sections of pipe will be welded together on the vessel before being laid directly onto the sea floor from the stern of the vessel. Typically, these vessels are held in place via DP systems or conventional mooring systems. Initiation anchors may be required temporarily at each end of the pipeline to support installation. The pipeline pieces will typically be manufactured overseas and transported directly to the pipelay vessel by barge.

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Commissioning

Once installation and hook up of subsea infrastructure is complete, the subsea infrastructure will be subject to pre-commissioning, which is required to test the integrity of the subsea infrastructure. This will be conducted using hydrotest fluids, whereby the flowline pressure will be monitored to detect leaks. Fluids will then be left in place to provide corrosion protection prior to the introduction of reservoir fluids. Hydrotest fluid will either be discharged to sea at depth or returned to the FPSO facilities and discharged overboard. Hydrotesting will also be conducted on the BTL and inter-field spur line. The majority of the BTL hydrotest water will be discharged directly to sea at the Brecknock/Calliance FPSO, while the hydrotest water from the inter-field spur line will be discharged directly to sea at the Torosa FPSO.

As the FPSO facilities will be constructed at an existing fabrication yard overseas, pre-commissioning of the facilities will be preferentially carried out at the yard, and may include checking, inspection, cleaning, tightness testing, drying and inerting and first fill of process chemicals and adsorbents for the gas treatment system.

2.2.4 Operations

Extraction

During operations, hydrocarbons extracted from the reservoirs will flow via christmas trees and manifolds through the flowlines to the FPSO facilities. The flow rate of hydrocarbons will be controlled by subsea choke valves at the wellheads. Subsea hydraulic control fluids will be used to operate the choke valves.

Processing

Processing on the FPSO facilities topsides commences with the reservoir fluids being separated into a gas stream and a liquid stream (condensate and process water (PW)). The condensate and PW are then further separated with the PW sent for treatment prior to discharge overboard.

The condensate stream is stabilised and sent to compartmentalised condensate storage tanks prior to offloading. The gas will be sent to an acid gas removal unit (AGRU) for treatment. It will then be dehydrated, cooled and compressed prior to export to the NWS infrastructure via the BTL.

Condensate Offload

Up to 50,000 bbls of condensate will be produced daily. Condensate will be loaded on to condensate tankers using flexible hoses every two to four weeks (depending on the production rate), resulting in approximately 12 to 24 oil tanker movements a year per FPSO facility. The oil tankers will then transport the condensate to market.

Gas Export

Transport of the dry gas to the NWS Project onshore processing facility will be via the inter-field spur line and BTL to the NWS infrastructure at NRC. Transportation of the Browse resources from the tie in point near NRC using existing third party trunkline infrastructure and processing of the gas onshore is outside the scope of the Proposed Action. Liquids will not be present in the inter-field spur line and BTL.

2.2.5 Inspection, Maintenance and Repairs

The facility subsea infrastructure is designed to require only minor degrees of intervention. Inspection and maintenance is undertaken to ensure the integrity of the infrastructure and identify any problems before they present a risk of loss of containment. Intervention may be required to repair identified problems. Subsea activities can be broadly categorised into the following groups:

- Inspection - the process of physical verification and assessment of components in order to detect changes to its as-installed state in comparison to previous or baseline inspections.

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Typical subsea inspection activities may include visual inspection, cathodic protection (CP) surveys, side scan sonar / multi-beam echo sounding, photogrammetry, process composition testing, corrosion probes, corrosion mitigation checks, metocean and seismic monitoring, cathodic protection testing and non-destructive measurement / testing, which may be supported by ROV or diver.

- Maintenance - required at regular and/or planned intervals to prevent deterioration or failure of equipment, or to maintain performance or reliability before failure or unacceptable deteriorations occurs. Maintenance activities may include cycling of valves, and leak and pressure testing.
- Repair - activities required when a subsea system or component is degraded, damaged or has deteriorated to a level outside of acceptance limits as defined by design codes. Damage sustained may not necessarily pose an immediate threat to continued system integrity, but may present an elevated level of risk to safety, health and environment or production reliability. Repair activities may also be associated with response to an emergency scenario.

2.2.6 Decommissioning

At the end of the Development life, the facilities will be decommissioned in accordance with all applicable existing legislation and good oilfield practice at the time. Decommissioning will occur once the Brecknock, Calliance and Torosa reservoirs have reached the end of their economic life and may occur in stages. This will likely include well suspension and plugging and abandoning wells.

2.2.7 Communications

Due to the distance of the proposed Browse to NWS Project from the mainland, a reliable high-speed communication network will be required between facilities offshore and the mainland. The network will be supplied by connection to an existing fibre optic cable.

2.2.8 Support Activities and Helicopters

The drilling and completion, installation and commissioning phases will be supported by barges, tugs, survey vessels, supply vessels (thereafter referred to as support vessels) and installation and pipelay vessels. Vessel requirements during the decommissioning phase are unknown at this stage due to uncertainty regarding the methodology to be applied, but it can be expected that decommissioning will use similar vessels to those engaged for installation activities.

The operations phase will require a small number of vessels in attendance in the vicinity of the FPSO facilities for transporting personnel, stores and equipment on a routine basis. The supply vessels will travel between the supply chain and logistics support facility (or facilities) and the FPSO facilities, while tugs will travel to the facility to support offloading as required.

Transfer to offshore facilities will be via helicopter or vessel. It is anticipated that up to two personnel transfers a week per FPSO facility will be required during normal operations. In times of high activity such as crew changes, shutdowns and major maintenance, it is anticipated that there could be two to three flights per day, or equivalent vessel transfers, per facility.

2.2.9 Development Schedule

Subject to all necessary joint venture and regulatory approvals being obtained and appropriate commercial arrangements being finalised, the indicative timeframes for the proposed Browse to NWS Project are as follows:

- commencement of construction and drilling and completion activities from approximately 2021 – 2022,
- followed by installation and commissioning activities,

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- RFSU and commencement of operations occurring in the mid-2020s, and
- operations continuing for up to 50 years.

Following operations, decommissioning activities will be carried out as part of the Proposed Action.

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3. PART B: SPECIFIC CONTENT OF THE EIS/ERD

3.1 Information and Advice Related to the Preparation of an EIS/ERD

3.1.1 The Objectives of the EIS/ERD

Environmental impact assessment depends on adequately defining those elements of the environment that may be affected by a proposed development, and on identifying the significance, risks and consequences of the potential impacts of the Proposed Action at a local, regional and national level. The EIS/ERD will be a significant source of information on which the public and government decision-makers will assess the potential environmental impacts of the Proposed Action.

It is expected that additional ecological and socio-economic investigations will be required to be undertaken to provide sufficient information for the EIS/ERD. The nature and level of investigations will be related to the likely extent and gravity of the potential impacts (likelihood, consequence, magnitude, extent and scale of impacts, including worst case scenarios). All relevant impacts of the Proposed Action on MNES and the State waters proposal on WA EPA environmental factors are to be investigated and analysed, and commitments to avoid, mitigate and offset any adverse impacts are to be detailed in the EIS/ERD.

The aims of the EIS/ERD and public review process are:

- to provide a source of information from which interested individuals and groups may gain an understanding of the Proposed Action, the need for the Proposed Action, the alternatives, the environment which it could potentially affect, the impacts that may occur and the measures proposed to be taken to avoid or minimise these impacts
- to provide a forum for public consultation and informed comment on the Proposed Action
- to provide a framework in which decision-makers can consider the environmental aspects of the Proposed Action including biophysical, cultural, social, heritage, economic, technical and other factors (as applicable).

The EIS/ERD will discuss compliance with the objectives of the EPBC Act, EP Act and the principles of ecologically sustainable development, as set out in the EPBC Act. The EIS/ERD will also identify and address, as fully as possible, all matters relevant to the Proposed Action and State waters proposal and their potential impacts.

The EIS/ERD will provide a description of the existing environment in the area affected by the Proposed Action and any decommissioning of existing infrastructure, construction, operations and future decommissioning proposed. All potential impacts and risks on the environment are to be investigated and analysed. The EIS/ERD will present an evaluation of the potential environmental impacts using an accepted risk-based methodology and describe proposed measures to avoid, minimise or offset the expected, likely, or potential impacts. Any prudent and feasible alternatives will be discussed in detail and the reasons for selection of the preferred option will be clearly given. The State waters proposal will be similarly assessed.

3.1.2 General Advice

The EIS/ERD will be a stand-alone document. It will contain sufficient information from studies and/or investigations undertaken to avoid the need to refer to previous or supplementary reports. Headers and/or footers will be used to denote which section the page relates to (i.e. based on the table of contents).

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The EIS/ERD will enable interested stakeholders and the assessing agencies to understand the environmental consequences of the proposed development. Information provided in the EIS/ERD will be objective, clear, succinct and, where appropriate, be supported by maps, plans, diagrams or other descriptive detail. The body of the EIS/ERD is to be written in a style that is easily understood by a member of the public. Technical jargon will be avoided wherever possible and a full glossary included. Cross-referencing will be used to avoid unnecessary duplication of text.

If it is necessary to make use of material that is considered to be of a confidential nature, the proponent will consult with the DoEE and WA EPA on the preferred presentation of that material, before submitting it for approval for publication.

Detailed technical information, studies or investigations necessary to support the main text will be included as appendices issued with the EIS/ERD. Any additional supporting documentation and relevant studies, reports or literature not normally available to the public from which information has been extracted will be made available at appropriate locations during the period of public display of the EIS/ERD.

Where specific information requirements are set out within this EISG/ESD, they should be read as a requirement for as much detail as is appropriate and reasonably available at this stage of planning. The EIS/ERD will clearly identify any gaps in the information presented and include discussion on the effect of these gaps on the overall results of the assessment and possible methods for addressing them.

An executive summary will be provided and made available as a stand-alone document for public information.

The EIS/ERD will state the criteria adopted in assessing the Proposed Action and its potential impacts, such as: compliance with relevant legislation, policies, standards and best practice; community acceptance; maximisation of environmental benefits (if any); and minimisation of risks and harm. The State waters proposal will be similarly assessed.

Any and all unknown variables or assumptions made in the assessment will be clearly stated and qualified. The extent to which the limitations, if any, of available information may influence the conclusions of the environmental assessment will be discussed.

Woodside will ensure that the personnel providing information to address this EIS/ERD have the relevant qualifications and experience in their relevant fields.

The EIS/ERD will comprise three elements:

- a) The executive summary
- b) The main text of the document, written in a clear and concise manner so as to be readily understood by a member of the public.
- c) Appendices containing a copy of this EISG/ESD and detailed technical information which may include other sensitive commercial or cultural information (if required).

The EIS/ERD will be written so that any conclusions reached can be independently assessed. To this end all sources will be appropriately referenced.

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3.2 Invitation to make a submission

The draft EIS/ERD will include an invitation to make a submission including:

1. details on how and when public submissions will be addressed in the assessment and decision-making process
2. how submissions can be made
3. what form submissions should take
4. when submissions should be made.

3.3 Executive Summary

An executive summary that outlines the key findings of the EIS/ERD will be provided. The executive summary will briefly:

1. state the background and the need for the Proposed Action and State waters proposal.
2. discuss alternatives to the Proposed Action, State waters proposal and the reasons for selecting the preferred option and rejecting alternatives
3. summarise the installation, operational and decommissioning activities associated with putting the Proposed Action and State waters proposal into practice
4. state the proposed schedule for key activities and the expected duration of the Proposed Action and State waters proposal
5. provide an overview of the existing regional and local environments, summarising the features of the physical, biological, social and economic environment relating to the Proposed Action, State waters proposal and associated activities with each
6. describe the expected, likely and potential impacts of the Proposed Action and State waters proposal on the environment during the installation, operational and decommissioning phases
7. summarise the environmental protection measures and safeguards, monitoring and decommissioning procedures to be implemented for the Proposed Action and State waters proposal
8. provide an outline of the environmental record of Woodside.

3.4 General Information

The EIS/ERD should provide the background of the proposed Browse to NWS Project including:

1. the title of the action
2. the full name and postal address of the designated proponent
3. a clear outline of the objective of the action
4. the location of the action
5. the background to the development of the action
6. how the action relates to any other actions (of which the proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action
7. the current status of the action
8. the consequences of not proceeding with the action
9. a brief explanation of the scope, structure and legislative basis of the EIS/ERD

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10. the specific EPBC Act MNES and WA EPA Environmental factors affected by the action
11. a description of government planning policies and statutory controls which will influence the proposed Browse to NWS Project. All applicable jurisdictions and areas of responsible authorities within the area will be listed and shown on maps at appropriate scales.

3.5 Description of the Action

3.5.1 Development Description

All installation, operational, IMR and decommissioning components of the action will be described in sufficient detail to understand the Proposed Action and State waters proposal and assist in determining the associated potential environmental impacts. This will include the location (including coordinates) of all works to be undertaken, structures to be built or elements of the action that may have relevant impacts (on MNES and/or WA EPA Environmental Factors) and other social or economic impacts. In addition, proposed safeguards and mitigation measures to deal with relevant impacts of the action will be included.

The description of the action will also include details on how the works are to be undertaken (including all stages of development and their timing) and design parameters for those aspects of the structures or elements of the action, including how the operation is to be managed, that may have relevant impacts and other social or economic impacts.

The description will include the use of aerial photographs, maps, figures and diagrams, where appropriate. A general location map will be provided that illustrates the existing and proposed infrastructure and will include the location of known potential future expansions or new developments in the vicinity. Reference will be made to detailed technical information in appendices where relevant.

The description will also include any other requirements for approval or conditions that apply, or that Woodside reasonably believes are likely to apply, to the Proposed Action or State waters proposal.

3.5.2 Feasible Alternatives

Any feasible alternatives to the action to the extent reasonably practicable, including:

1. if relevant, the alternative of taking no action and/or part of the Proposed Action and State waters proposal
2. a comparative description of the adverse and beneficial impacts of each alternative on MNES and WA Environmental Factors
3. sufficient detail to make clear why any alternative is preferred to another and if approval is being sought for feasible alternatives as part of this assessment process.

Short, medium and long-term advantages and disadvantages of the options will be discussed.

3.5.3 Social and Economic Matters

For the purpose of the assessment under the EPBC Act, information will be provided on the broader social and economic impacts (positive or negative) of the Proposed Action. Any information provided for this purpose will be in a separately identified section or appendix of the EIS/ERD. Such information provided may address:

1. the broader economic benefits of the Proposed Action going ahead versus alternatives
2. any effects on employment that may occur beyond the immediate scope of the Proposed Action (including versus alternatives). Any methodology used to calculate indirect effects associated with employment will be provided

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3. information on the amount of domestic and/or overseas investment for capital infrastructure (including versus alternatives)
4. any other social or economic issues that may relate directly or indirectly.

3.6 Stakeholder Engagement

The EIS/ERD will provide details of any consultation in relation to the Proposed Action and State waters proposal including:

1. consultation that has already taken place
2. documented response or results of the consultation that has taken place
3. any further proposed consultation.

Woodside will consult with relevant stakeholders in relation to the proposed Browse to NWS Project. These stakeholders include decision-making authorities, other relevant government agencies and authorities (local, state, and Commonwealth), the local community, local indigenous groups, academics, research authorities and environmental non-government organisations. The EIS/ERD will describe the consultation method adopted, existing stakeholder forums and skills and techniques used to ensure effective communication of the nature and detail of proposed Browse to NWS Project. This will include the means used to identify concerns and to gauge and progress mitigation strategies.

The assessment documentation must provide details of the potential indirect impacts of the proposed action on the (Indigenous rock art) values of the Dampier Archipelago (including the Burrup Peninsula) National Heritage Place, and the extent to which these values may potentially be impacted by the proposed action following any planned mitigations.

3.7 Description of the Environment

3.7.1 Overview

Section 528 of the EPBC Act defines the environment as including:

- (a) ecosystems and their constituent parts, including people and communities; and
- (b) natural and physical resources; and
- (c) the qualities and characteristics of locations, places and areas; and
- (d) the social, economic and cultural aspects of a thing mentioned in paragraph (a), (b) or (c).

Subsection 3(1) of the EP Act defines the environment as meaning "... living things, their physical, biological and social surroundings, and interactions between all of these"

The EIS/ERD will include a detailed description of the environment within the Project Area and the surrounding areas (including State waters) that may be affected by the Proposed Action.

The environment that may be affected (EMBA) by the proposed Browse to NWS Project, which is the largest spatial extent where unplanned events could have an environmental consequence on the surrounding environment will be described. The spatial areas of the defined EMBA and Project Area will be used to identify and describe all environmental values, including environmental and socio-economic, that are relevant to the project. The relevant receptors (based on the preliminary impact and risk assessment) and their relationship with the MNES categories and the WA EPA Factors are presented in **Table 3** and **Table 4** respectively.

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This EIS/ERD chapter will describe the following elements of the environment within the Project Area:

- Physical environment including
 - Climate and atmospheric characteristics
 - Oceanographic conditions, bathymetric and geotechnical information
 - Marine water and marine sediment characteristics
- Ecological environment including
 - An overall evaluation of the flora and fauna communities identified with reference to:
 - habitat values in a local, regional and national context
 - presence of endemic species
 - regional representation; conservation and biodiversity values
 - economic and cultural values of species
 - unique habitats.
 - Particular attention will be given to the conservation values within Scott Reef and surrounds (e.g. diverse aggregations of marine life, higher primary production relative to other parts of the regions, high species richness and heritage values) and their importance in a local, regional and national context as described in the Marine bioregional plan for the North-west Marine Region (Commonwealth of Australia 2012).
 - A broader description of the biodiversity and biogeography of the receiving environment, including the identification of sensitive environments along with key ecological relationships and interdependencies (e.g. coral spawning, fish spawning aggregations, flora and fauna relationships).
 - A description of listed threatened species and ecological communities (EPBC Act sections 18 & 18A), listed migratory species (EPBC Act sections 20 & 20A) and protected species under the Biodiversity Conservation Act 2016 that are likely to be present in the vicinity of the proposed Browse to NWS Project. Descriptions will include the predicted temporal and spatial variability in occurrence within the Project Area, known habitat utilisation or requirements and relevant identified threats to their survival. Details of the scope, timing and scientifically robust methodology for studies or surveys used to provide information on the listed species/communities/habitats at the site (and in areas that may be impacted by the project) will also be included. Species to be addressed in the EIS/ERD include, but are not be limited to the following. Additional EPBC Act listed threatened and listed migratory species will be considered following completion of the relevant modelling studies to be undertaken to determine the species that may be affected:
 - Pygmy blue whale (*Balaenoptera musculus brevicauda*)
 - Humpback whale (*Megaptera novaeangliae*)
 - Sei Whale (*Balaenoptera borealis*)
 - Fin Whale (*Balaenoptera physalus*)
 - Green Turtle (*Chelonia mydas*)
 - Loggerhead Turtle (*Caretta caretta*)
 - Leatherback Turtle (*Dermochelys coriacea*)
 - Hawksbill Turtle (*Eretmochelys imbricata*)

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- Olive Ridley Turtle (*Lepidochelys olicacea*)
- Flatback Turtle (*Natator depressus*)
- Common Noddy (*Anous stolidus*)
- Streaked Shearwater (*Calonectris leucomelas*)
- Lesser Frigatebird (*Fregeta ariel*)
- Little Tern (*Stenula albifrons*)
- Barn Swallow (*Hirundo rustica*)
- Common Sandpiper (*Actitis hypoleucos*)
- Green Sawfish (*Pristis zijsron*)
- Large Sawfish (*Pristis prisis*)
- Whale shark (*Rhincodon typus*).
- A description of the marine environment (EPBC Act sections 23 & 24A and EP Act) relevant to the action, including, but not limited to, habitat, species and values of listed Western Australian and Commonwealth Heritage places, Key Ecological Features (identified in the relevant Marine Bioregional Plan) and Western Australian and Commonwealth Marine Parks including:
 - distance from the Proposed Action
 - reserve characteristics
 - status
 - IUCN category
 - Conservation value
 - relevant management strategies
- Appropriate resources will be reviewed and cited throughout, including all relevant government issued conservation advice and recovery plans, and recent ecological studies where available (e.g. AIMS North West Shoals to Shore Research Program).
- The extent of existing disturbance to flora and fauna, and the incidence of introduced pest species will be discussed.
- Socio-economic environment including:
 - a description of all existing uses and users of the Project Area including discussion of scientific research, tourism, commercial, traditional and recreational fishing, military areas and shipping routes (where relevant)
 - a description of government planning policies and statutory controls which will influence the project, surrounding areas of future, planned and current use. All applicable jurisdictions and areas of responsible authorities within the area will be listed and shown on maps at appropriate scales
 - any places with known or anticipated heritage, social or cultural values, such that they have been recognised with listing or recording under relevant State or Commonwealth legislation or are anticipated to be listed under such legislation
 - a description of any historic shipwrecks within the area pursuant to the Commonwealth Underwater Cultural Heritage Act 2018 (which will replace the Historic *Shipwrecks Act 1976* on 01 July 2019) and State *Maritime Archaeology Act 1973*, including locations.

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3.7.2 Format of Chapter

The chapter will be set out in a format broadly similar to the following outline:

1. Existing Environment
 - 1.1. Receptor Group (e.g. Marine Fauna)
 - 1.1.1. Receptor (e.g. Marine Mammals)
 - 1.1.1.1. Background and Regional Overview
 - 1.1.1.2. Browse Development Area
 - 1.1.1.2.1. Scott Reef
 - 1.1.1.2.2. Remainder of area
 - 1.1.1.3. Trunkline and Inter field Spur-line Route

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3.7.3 Relevant Receptors in relation to MNES and WA EPA Factors

Table 3 indicates the relevant receptors for the Proposed Action (based on the preliminary impact and risk assessment) and their relationship to the MNES.

Table 3 Relevant Receptors in relation to Matters of National Environmental Significance

Matters of National Environmental Significance	Physical Receptors					Ecological Receptors												Socio-Economic Receptors										
	Marine Sediments	Marine Water quality	Air Quality	Ambient Light	Ambient Noise	Planktonic Communities	Epifauna and Infauna	Coral	Seagrass	Macroalgae	Saltmarsh	Mangroves	Seabirds and Migratory Shorebirds	Fish	Marine Mammals	Marine Reptiles	Key Ecological Features	Australian Marine Parks	State Marine Parks and Reserves	Commonwealth Managed Fisheries	State Managed Fisheries	Tourism and Recreation	Shipping	Industry	Settlements	Other Protected Places	Indigenous heritage	Marine Archaeology
National heritage values of a national Heritage place																												✓
Listed threatened species and communities													✓	✓	✓	✓												
Listed migratory species													✓	✓	✓	✓												
The Commonwealth marine area	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓

Table 4 indicate the relevant receptors for the State waters proposal (based on the preliminary impact and risk assessment) and their relationship to the WA Environmental Factors.

Table 4 Relevant Receptors in relation to WA EPA Environmental Factors

WA EPA Factors	Physical Receptors					Ecological Receptors												Socio-Economic Receptors										
	Marine Sediments	Marine Water quality	Air Quality	Ambient Light	Ambient Noise	Planktonic Communities	Epifauna and Infauna	Coral	Seagrass	Macroalgae	Saltmarsh	Mangroves	Seabirds and Migratory Shorebirds	Fish	Marine Mammals	Marine Reptiles	Key Ecological Features	Australian Marine Parks	State Marine Parks and Reserves	Commonwealth Managed Fisheries	State Managed Fisheries	Tourism and Recreation	Shipping	Industry	Settlements	Other Protected Places	Indigenous heritage	Marine Archaeology
Benthic Communities and Habitats	✓						✓	✓	✓	✓			✓	✓						✓								
Marine Environmental Quality	✓	✓				✓	✓	✓	✓	✓			✓	✓	✓	✓												
Marine Fauna				✓	✓								✓	✓	✓	✓												
Air Quality			✓																									

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3.7.4 Previous studies to characterise the existing environment

Information on the existing environment for the EIS/ERD will primarily be drawn from existing literature and studies previously completed by Woodside including long-term monitoring. Woodside has commissioned approximately 60 studies within the proposed Browse Development Area, Scott Reef and the broader region that span approximately two decades. Studies have included baseline and annual programs for humpback whale, turtle, other marine megafauna and fish species in the region, as well as long-term monitoring of coral and fish communities at Scott Reef.

These studies have enabled Woodside to build a comprehensive understanding of the environmental context of developing the Browse resources, to enable identification of the potential environmental impacts and development of the appropriate measures to manage and mitigate these.

Further, Woodside has continued to support the undertaking of studies and monitoring programs for species and communities that exhibit marked temporal changes in population dynamics or spatial distribution variability. For example, AIMS has continued to monitor annual changes in coral and fish communities at Scott Reef (dataset 1993-2018). These studies have identified dramatic changes to Scott Reef related to the impact from cyclones and thermal-induced bleaching.

For species or communities that are unlikely to have major changes in either population numbers, seasonality or distribution patterns Woodside will utilise historical Woodside datasets (supplemented with any additional non-Woodside studies) to describe current receptors and inform the impact assessment. **Table 5** outlines the previous studies undertaken to support the potential development of the Browse resource.

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Table 5 Previous studies undertaken to characterise the environment in relation to development of the Browse resource

A full index of previous Browse technical studies is available at <https://www.woodsides.com.au/our-business/burru-up-hub/index-of-previous-browse-studies>

Organisation	Study Name	Link to Report	Receptor
AIMS	The Status of Shallow-water Coral and Fish Communities at Scott Reef 2008	https://files.woodsides.com.au/our-business-and-files/burru-up-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f19---glimour-et-al.-2008---the-status-of-shallow-water-coral-and-fish-communities-at-scott-reef-2008_.pdf?sfvrsn=c2b428aa_2	Scott Reef and surrounds (Fish and Benthic Habitat)
	Technical Report - Project 3.1 Understanding Water Column and Pelagic Ecosystem Processes Affecting the Lagoon of South Reef, Scott Reef – 2009	https://files.woodsides.com.au/our-business-and-files/browse---documents-and-files/index-of-previous-browse-studies/f05---brinkman-et-al.-2009a---understanding-water-column-and-pelagic-ecosystem-processes-affecting-the-lagoon-of-south-reef---scott-reef_.pdf?sfvrsn=ba399510_2	Scott Reef and surrounds (Water Quality)
	Annual Report - Project 3.1 Understanding Water Column and Pelagic Ecosystem Processes Affecting the Lagoon of South Reef, Scott Reef – 2009	https://files.woodsides.com.au/our-business-and-files/browse---documents-and-files/index-of-previous-browse-studies/f06---brinkman-et-al.-2009b---understanding-water-column-and-pelagic-ecosystem-processes-affecting-the-lagoon-of-south-reef---scott-reef_.pdf?sfvrsn=ea38c18d_2	Scott Reef and surrounds (Water Quality)
	Final Report - Project 3.1. Understanding Water Column and Pelagic Ecosystem Processes Affecting the Lagoon of South Reef, Scott Reef	https://files.woodsides.com.au/our-business-and-files/browse---documents-and-files/index-of-previous-browse-studies/f07---brinkman-et-al.-2010---understanding-water-column-and-pelagic-ecosystem-processes-affecting-the-lagoon-of-south-reef---scott-reef_.pdf?sfvrsn=51b32988_2	Scott Reef and surrounds (Water Quality)
	Characterising the Genetic Connectivity and Photobiology of Deep Water Reef Building Corals at South Scott Reef, Western Australia – 2010	Relevant information is intended to be made publicly available for the EIS/ERD review	Scott Reef and surrounds (Fish and Benthic Habitat)
	Long-term Monitoring of Coral and Fish Communities at Scott Reef 2009	https://files.woodsides.com.au/our-business-and-files/browse---documents-and-files/index-of-previous-browse-studies/f22---glimour-et-al.-2010---long-term-monitoring-of-coral-and-fish-communities-at-scott-reef_.pdf?sfvrsn=e490e4fd_2	Scott Reef and surrounds (Fish and Benthic Habitat)
	Long-term Monitoring of Shallow-water Coral and Fish Communities at Scott Reef, Technical Report 2008 (2009)	https://files.woodsides.com.au/our-business-and-files/browse---documents-and-files/index-of-previous-browse-studies/f20---glimour-et-al.-2009a---long-term-monitoring-of-shallow-water-coral-and-fish-communities-at-scott-reef_.pdf?sfvrsn=d29a749_2	Scott Reef and surrounds (Fish and Benthic Habitat)
	Long-term Monitoring of Shallow-water Coral and Fish Communities at Scott Reef, Annual Report 2008 (2009)	https://files.woodsides.com.au/our-business-and-files/browse---documents-and-files/index-of-previous-browse-studies/f21---glimour-et-al.-2009b---long-term-monitoring-of-shallow-water-coral-and-fish-communities-at-scott-reef_.pdf?sfvrsn=3f4a6840_2	Scott Reef and surrounds (Fish and Benthic Habitat)
	Long-term Monitoring of Coral and Fish Communities at Scott Reef Annual Report 2010	https://files.woodsides.com.au/our-business-and-files/browse---documents-and-files/index-of-previous-browse-studies/f22---glimour-et-al.-2010---long-term-monitoring-of-coral-and-fish-communities-at-scott-reef_.pdf?sfvrsn=e490e4fd_2	Scott Reef and surrounds (Fish and Benthic Habitat)
	Long-term Monitoring of Shallow Water Coral and Fish Communities at Scott Reef 2011	https://files.woodsides.com.au/our-business-and-files/browse---documents-and-files/index-of-previous-browse-studies/f22---glimour-et-al.-2010---long-term-monitoring-of-coral-and-fish-communities-at-scott-reef_.pdf?sfvrsn=e490e4fd_2	Scott Reef and surrounds (Fish and Benthic Habitat)
	Long-term Monitoring of Shallow Water Coral and Fish Communities at Scott Reef 2011	https://files.woodsides.com.au/our-business-and-files/browse---documents-and-files/index-of-previous-browse-studies/f22---glimour-et-al.-2010---long-term-monitoring-of-coral-and-fish-communities-at-scott-reef_.pdf?sfvrsn=e490e4fd_2	Scott Reef and surrounds (Fish and Benthic Habitat)

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Organisation	Study Name	Link to Report	Receptor
		files/browse---documents-and-files/index-of-previous-browse-studies/23---gilmour-et-al.-2011---long-term-monitoring-of-shallow-water-coral-and-fish-communities-at-scott-reef_.pdf?svrsrc=4fbd8630_2	Benthic Habitat)
	Long-term Monitoring of Shallow Water Coral and Fish Communities at Scott Reef 2012	https://files.woodsides/docs/default-source/our-business---documents-and-files/burup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/24---gilmour-et-al.-2013a---long-term-monitoring-of-shallow-water-coral-and-fish-communities-at-scott-reef-2012_.pdf?svrsrc=be5660c0_2	Scott Reef and surrounds (Fish and Benthic Habitat)
	Long-term Monitoring of Shallow-water Coral and Fish Communities at Scott Reef 2014	Relevant information is intended to be made publicly available for the EIS/ERD review	Scott Reef and surrounds (Fish and Benthic Habitat)
	Long-term monitoring at Scott Reef and the Rowley Shoals 2017	Relevant information is intended to be made publicly available for the EIS/ERD review	Scott Reef and surrounds (Fish and Benthic Habitat)
	Migration Patterns of Whale Sharks: A Summary of 15 Satellite Tag Tracks from 2005 to 2008	https://files.woodsides/docs/default-source/our-business---documents-and-files/burup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/30---meek-an-amp-radford-2010---migration-patterns-of-whale-sharks-a-summary-of-15-satellite-tag-tracks-from-2005-to-2008_.pdf?svrsrc=1996a7e4_2	Whale sharks
Australian Marine Mammal Centre (AMMC)	Satellite Tracking of South-bound Female Humpback Whales in the Kimberley Region of Western Australia	Relevant information is intended to be made publicly available for the EIS/ERD review	Humpback whales
	Satellite tracking of northbound humpback whales (<i>Megaptera novaeangliae</i>) off Western Australia	Relevant information is intended to be made publicly available for the EIS/ERD review	Humpback whales
Centre for Marine Science and Technology (CMST) (Curtin University of Technology)	Woodsides Kimberley Sea Noise Logger Program, September 2008 to June 2009 - 2011	https://files.woodsides/docs/default-source/our-business---documents-and-files/burup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/29---mccauley-2011---woodsides-kimberley-sea-noise-logger-program-sept-2008-to-june-2009-whales-fish-and-mat-made-noise_.pdf?svrsrc=ba5f687_2	Underwater noise
Centre for Whale Research (CWR)	Humpback Whale Distribution and Abundance in the Near Shore SW Kimberley During Winter 2008 Using Aerial Surveys - 2008	Relevant information is intended to be made publicly available for the EIS/ERD review	Humpback whales
	Near-shore Vessel Surveys in the SW Kimberley Region During the Humpback Whale Southern Migration - 2008	Relevant information is intended to be made publicly available for the EIS/ERD review	Humpback whales
	Mega-Fauna Distribution and Relative Abundance in the Scott Reef and Southwest Kimberley Region During - 2008	Relevant information is intended to be made publicly available for the EIS/ERD review	Marine Fauna
	Cetacean Distribution and Oceanography in the Scott Reef/Browse Basin Project areas - 2008	Relevant information is intended to be made publicly available for the EIS/ERD review	Cetaceans
	Double, M. C., Andrews-Goff, V., Jenner, K. C. S., Jenner, M. N., Laverick, S. M., Branch, T. A., & Gales, N. J. (2014). Migratory movements of pygmy blue whales (<i>Balaenoptera musculus brevicauda</i>) between Australia and Indonesia as revealed by satellite telemetry. PLoS one, 9(4), e93578.	Relevant information is intended to be made publicly available for the EIS/ERD review	Pygmy Blue Whales
Charles Darwin University	Long Term Monitoring of the Marine Turtles of Scott Reef 2010	https://files.woodsides/docs/default-source/our-business---documents-and-files/burup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/26---guinea-2010---long-term-monitoring-of-the-marine-turtles-of-scott-reef-february-2010_.pdf?svrsrc=2339899b_2	Marine turtles
	Long Term Monitoring of the Marine Turtles of Scott Reef, February 2010 Field Survey Report	https://files.woodsides/docs/default-source/our-business---documents-and-files/burup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/26---guinea-2010---long-term-monitoring-of-the-marine-turtles-of-scott-reef-february-2010_.pdf?svrsrc=2339899b_2	Marine turtles
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Organisation	Study Name	Link to Report	Receptor
CSIRO	Characterising the Seabed Biodiversity and Habitats of the Deep Continental Shelf and Upper Slope off the Kimberly Coast, NW Australia – 2010	https://files.woodsides/docs/default-source/our-business--documents-and-files/burruhub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f33---williams-et-al-2010---characterising-the-seabed-biodiversity-and-habitats-of-the-deep-continental-shelf-and-upper-slope-off-the-kimberley-coast_.pdf?sfvrsn=165d1c_2	Satellite data study of oceanography and plankton
DHI	Hydrodynamic Model Validation at Scott Reef and Surrounds – 2009	https://files.woodsides/docs/default-source/our-business--documents-and-files/burruhub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f10---dhi-2009---browse-environmental-modelling-phase-1-hydrodynamic-model-validation-at-scott-reef-and-surrounds_.pdf?sfvrsn=7deb2a8b_2	Metocean
Fugro Survey Pty Ltd (Fugro)	Offshore Geophysical Surveys 2006: Volume 2A Browse Basin Survey Results	Relevant information is intended to be made publicly available for the EIS/ERD review	Hydrographic and geophysical surveys
Gardline Marine Services Pty Ltd (Gardline)	Browse LNG Development Environmental Survey - 2009	https://files.woodsides/docs/default-source/our-business--documents-and-files/burruhub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f18---gardline-2009---browse-lng-development-environmental-survey-june-to-july-2009-environmental-baseline-report_.pdf?sfvrsn=e9dc49c6_2	Water quality, sediment quality and benthic habitats
J P Kenny Pty Ltd (JP Kenny)	Channel Pipelines - Pipe Installation and Trenching Study - 2008	Relevant information is intended to be made publicly available for the EIS/ERD review	Sediment quality survey
MetOcean Engineers	Preliminary Metocean Conditions for the Browse Development (Prospective Production Facilities / Areas, Pipeline Routes / Shore Crossings and Flow-lines / Seabed Manifolds), Scott Reef Vicinity to Shore - 2005	Relevant information is intended to be made publicly available for the EIS/ERD review	Metocean data
RPS Environment and Planning Pty Ltd (RPS)	Marine Megafauna Report - 2009	https://files.woodsides/docs/default-source/our-business--documents-and-files/burruhub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f31---rps-2010a---marine-megafauna-report_.pdf?sfvrsn=9273be06_2	Marine mega fauna
	DFS 17 & DFS 20 MMF 2009 Humpback Whale Survey Report	https://files.woodsides/docs/default-source/our-business--documents-and-files/burruhub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f32---rps-2010b---humpback-whale-survey-report_.pdf?sfvrsn=ccb9973e_2	Humpback Whales
	Ecology of Marine Turtles of the Dampier Peninsula and the Lacepede Island Group - 2010	https://files.woodsides/docs/default-source/our-business--documents-and-files/burruhub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f33---rps-2010c---ecology-of-marine-turtles-of-the-dampier-peninsula-and-the-lacepede-island-group-2009-2010_.pdf?sfvrsn=ee0e3ba_2	Marine turtles
	Marine Megafauna Study - 2010	https://files.woodsides/docs/default-source/our-business--documents-and-files/burruhub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f34---rps-2011a---marine-megafauna-study-2010_.pdf?sfvrsn=1d2571ed_2	Marine Megafuna
	Marine Megafauna Survey Report 2011	https://files.woodsides/docs/default-source/our-business--documents-and-files/burruhub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f36---rps-2012---marine-megafauna-survey-report-2011_.pdf?sfvrsn=1970949f_2	Marine Megafuna
	Humpback Whale Survey Report - 2010	https://files.woodsides/docs/default-source/our-business--documents-and-files/burruhub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f32---rps-2010b---humpback-whale-survey-report_.pdf?sfvrsn=ccb9973e_2	Humpback Whales

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Organisation	Study Name	Link to Report	Receptor
	Turtle Supplementary Report - 2010	https://files.woodsides/default-source/our-business--documents-and-files/burruhub--documents-and-files/browse--documents-and-files/index-of-previous-browse-studies/f35---rps-2011c--turtle-supplementary-report-2010_.pdf?svrnt=637ead02_2	Marine Turtles
RPS MetOcean	Study of Meteorological Conditions for the Production Facility for Scott Reef Development - 2007	Relevant information is intended to be made publicly available for the EIS/ERD review	Metoccean conditions
	Detailed Metoccean Conditions for the Browse Development - 2008	Relevant information is intended to be made publicly available for the EIS/ERD review	
Sindair Knight Merz Ltd (SKM) ERM	Scott Reef Invasive Marine Species - 2008	https://files.woodsides/default-source/our-business--documents-and-files/burruhub--documents-and-files/browse--documents-and-files/index-of-previous-browse-studies/f37---skm-ltd-2009--scott-reef-invasive-marine-species-survey_.pdf?svrnt=7588df96_2	Nearshore benthic habitat
	Aerial survey of Inshore Marine Megafauna Along the Dampier Peninsula - 2009	Relevant information is intended to be made publicly available for the EIS/ERD review	Scott Reef IMS
	Scott Reef Green Turtle Satellite Tracking Report - 2011	https://files.woodsides/default-source/our-business--documents-and-files/burruhub--documents-and-files/browse--documents-and-files/index-of-previous-browse-studies/f27---guinea-2011---long-term-monitoring-of-the-marine-turtles-of-scott-reef-satellite-tracking-of-green-turtles-from-scott-reef_.pdf?svrnt=6d7a6bf_2	Marine Turtles
URS Australia Pty Ltd (URS)	Report on Environmental Surveys Undertaken at Scott Reef in February 2006	Relevant information is intended to be made publicly available for the EIS/ERD review	Scott Reef
	Scott Reef Environmental Survey 4: ROV Inspection of Deep Habitats in Scott Reef Lagoons - 2007	Relevant information is intended to be made publicly available for the EIS/ERD review	Scott Reef
	Scott Reef Environmental Survey 5: ROV Inspection of Deep Water Outer Reef Habitats - 2007	Relevant information is intended to be made publicly available for the EIS/ERD review	Scott Reef
	Scott Reef Environmental Surveys - 2007	Relevant information is intended to be made publicly available for the EIS/ERD review	Scott Reef
Western Australian Museum (WAM)	Marine Biodiversity Survey of Mermald Reef (Rowley Shoals), Scott and Seringapatam Reef - 2006	Relevant information is intended to be made publicly available for the EIS/ERD review	Ecology of Mermald, Scott and Seringapatam Reefs

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3.7.5 Summary of Workplan

Although the development concept for the Browse resources has changed to the proposed Browse to NWS Project concept, the environmental footprint of the facilities and subsea infrastructure (other than the BTL and inter-field spur line) is expected to be similar to that of the FLNG development concept where a significant amount of work has already been undertaken, especially around Scott Reef.

An overview of the current level of understanding and workplan for each relevant receptor is provided in **Table 6**. The studies outlined in **Table 6** would inform the design and implementation of any environmental monitoring programs that may be mandated as part of the assessment process. Woodside notes that should environmental monitoring be required to verify impact predictions during construction and/or operations, appropriate studies may be required to inform the baseline status of some environmental receptors prior to monitoring.

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Table 6 Existing Environment Workplan

Receptor Group	Receptor	Key Areas of Consideration	Assessment of Current Level of Understanding and information gaps	Environmental Studies Workplan
Physical	Marine sediments	Seabed in Browse Development Area, BTL corridor and surrounds	As there is likely to be little or no significant change to marine sediments within the Browse Development Area since previous studies were undertaken, Woodside will rely on historical datasets (~3 years collection period) to support existing environmental baseline knowledge. The basis for the baseline assessment of sediment quality values within the Browse Development Area are the findings from three principal surveys undertaken within the area (Brinkman et al., 2009a; Gardline Marine Services Pty Ltd, 2009a; URS Australia Pty Ltd, 2007). The most recent Gardline survey (2009) including sediment and analysis at 31 stations including seven at the Calliance field and eight at the Torosa field. The studies demonstrated that sediments within the Browse Development Area were generally classified as muddy sand with variable gravel components, with sediments at the Brecknock, Calliance and Torosa reservoirs generally soft silt and clay, with areas of sand and stiff, hard and/or cemented material (Fugro Survey Pty Ltd, 2006; Gardline Marine Services Pty Ltd, 2009a). No evidence of hydrocarbon contamination in sampled seabed sediments was reported in the Browse Development Area (Gardline Marine Services Pty Ltd, 2009a; URS Australia Pty Ltd, 2007). Gardline (2009a) reported that the concentration of total petroleum hydrocarbons (TPH) in all collected samples across the Browse Development Area was below the limits of detection (Gardline Marine Services Pty Ltd, 2009). With the exception of a slight exceedance in Ni concentrations at two locations and Hg concentrations at one location, metal concentrations (As, Cd, Cu, Cr, Co, Hg, Pb and Zn) in sampled sediments were below SQG-High trigger levels outlined in the revised Australian and New Zealand sediment quality guidelines (Simpson et al. 2013). The available studies and literature cited above provide a good understanding of the marine sediment quality within the Browse Development area. Given the nature of the marine sediments within the area and the lack of anthropogenic inputs, it is unlikely that there have been significant changes in the physical and chemical characteristics of the sediments. Consequently, these studies are deemed to provide a good understanding of the current marine sediment quality values within the Browse Development Area to support the impact assessment process for the project. In addition, such parameters will be used to support the interpretation of the discharge modelling results. However, there is currently a lack of specific information on marine sediment quality along the BTL route with current information limited to general regional values. As such an environmental survey is being undertaken to determine the sediment quality values along the proposed BTL route. This does not apply in the area near the NRC tie in point, where Woodside has a good understanding of marine sediment via studies undertaken in relation to existing Woodside assets and projects in the area. It also does not apply in the area adjacent to the Browse Development Area where studies have been undertaken in relation to the previously proposed pipeline route from Browse to James Price Point.	Literature review of Woodside information and publicly available information. Implementation of a marine environmental survey of the BTL corridor including sampling and characterisation of marine sediments.
Physical	Marine water quality	Browse Development Area and BTL corridor and surrounds	As there is likely to be little or no significant change to water quality within the Browse Development Area since previous studies were undertaken, Woodside will rely on historical datasets (~3 years collection period) to support existing environmental baseline knowledge. As with marine sediments, the basis for the baseline assessment of water quality values within the Browse Development Area are the findings from three principal surveys undertaken within the area (Brinkman et al., 2009a; Gardline Marine Services Pty Ltd, 2009a; URS Australia Pty Ltd, 2007). The most recent Gardline survey (2009) including water sampling and analysis at 34 stations including seven at the Calliance field and eight at the Torosa field. The studies reinforced the fact that given the distance from potential contamination sources or anthropogenic inputs, water quality within the Browse Development Area is typical of an unpolluted tropical offshore environment within the North West Marine Region (NWMR) with low turbidity, nutrient poor oceanic waters. The studies undertaken, in particular Gardline (2009), demonstrate the lack of anthropogenic contamination of the waters, with metal analyte levels below the limit of reporting (LoR), with concentrations of cobalt (Co), chromium (Cr), Cu, lead (Pb) and Ni at or below 0.001 mg/L. The available studies and literature cited above provide a good understanding of the marine water quality within the Browse Development area. Given the nature of the water quality and the lack of anthropogenic inputs, it is unlikely that there have been significant changes in the physical and chemical characteristics of the receiving environment. Consequently, these studies are deemed to provide a good understanding of the current marine water quality values within the Browse Development Area to support the impact assessment process for the project. In addition, such parameters will be used to support the interpretation of the discharge modelling results. However, there is currently a lack of specific information on marine water quality along the BTL route with current information limited to general regional values. As such an environmental survey is being undertaken to determine the baseline water quality values along the proposed BTL route. This does not apply in the area near the NRC tie in point, where Woodside has a good understanding of marine water quality via studies undertaken in relation to existing Woodside assets and projects in the area. It also does not apply in the area close the Browse Development Area where studies have been undertaken in relation to the previously proposed pipeline route from Browse to James Price Point.	Literature review of Woodside information and publicly available information. Implementation of a marine environmental survey of the BTL corridor including sampling and characterisation of marine water quality.

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Receptor Group	Receptor	Key Areas of Consideration	Assessment of Current Level of Understanding and information gaps	Environmental Studies Workplan
Physical	Air quality	Browse Development Area	route from Browse to James Price Point.	Literature review of Woodside information and publicly available information.
Physical	Ambient light	Browse Development Area and BTL corridor and surrounds	Woodside has sufficient information on ambient light in the Browse Development Area and BTL corridor on the basis that the area is offshore and remote from urban or industrial areas. Other than light emissions associated with the NRC facility, local light emissions via anthropogenic sources are limited to shipping.	Literature review of Woodside information and publicly available information.
Physical	Ambient noise	Browse Development Area and BTL corridor and surrounds	Woodside has sufficient information on ambient underwater noise in the Browse Development Area and BTL corridor on the basis that the area is offshore and remote from urban or industrial areas, with ambient noise characterised by natural ecological and hydrodynamic processes. In addition, noise monitoring program was implemented from September 2006 to May 2011 by Curtin (2011) which included deployment of sea noise loggers at 23 sites around Scott Reef. This programme was specifically designed to characterise the noise environment within and adjacent to the reef during ambient conditions and during a drilling programme within the Browse Development Area in 2008. Other than underwater noise emissions associated with the NRC facility, and shipping routes near the BTL route, local underwater noise emissions via anthropogenic sources are likely limited to occasional vessels.	Literature review of Woodside information and publicly available information.
Ecological	Planktonic communities	Browse Development Area and BTL corridor and surrounds	Three years of data (Brinkman et al. 2009a, 2009b, 2010) have been collected to understand seasonality and ecological drivers of the plankton communities within the Browse Development Area. There is unlikely to have been any significant changes to these processes since the study was undertaken. Consequently, it is determined that this data provides Woodside with a good baseline knowledge of planktonic communities within the Browse Development Area to support impact assessment process. Similarly, it is considered that there is sufficient understanding of planktonic communities within the broader NWMR, including along the BTL corridor from regional studies (Brewer et al. 2007).	Literature review of Woodside information and publicly available information.
Ecological	Epifauna and infauna	Browse Development Area and BTL corridor and surrounds	The available studies and literature provide a good understanding of the deep water epifauna and infauna communities within the Browse Development area. Given the nature of these communities and the lack of significant disturbances within the deeper waters of the Browse Development Area, it is unlikely that there have been significant changes in these communities since the studies were carried out. Consequently, these studies are deemed to provide a good understanding of these ecological values within the Browse Development Area to support the impact assessment process for the project. In addition, such parameters will be used to support the interpretation of the discharge modelling results. It is considered that there is sufficient understanding of epifauna and infauna assemblages along the BTL corridor which are expected to be typical of the offshore waters in the region as described in Williams et al. 2010. However additional information will be gained from the pipeline environmental survey.	Literature review of Woodside information and publicly available information. Implementation of a marine environmental survey of the BTL corridor including characterisation of infauna and epifauna assemblages.
Ecological	Coral	Browse Development Area including Scott Reef, Rowley Shoals	Major changes to coral in the Browse Development Area over recent years are possible due to cyclones and thermal-induced bleaching. As such Woodside will utilise ongoing long-term monitoring and research program (1994-2018), which provides current and historical data, to support existing environmental baseline knowledge. This, together with previous studies undertaken in the area including studies undertaken in relation to the previous Browse Development concepts, provides Woodside with a good understanding of coral communities in the Browse Development Area including Scott Reef. This includes habitat mapping of Scott Reef undertaken by Smith et al 2006. In addition, Woodside, in partnership with AIMS continues to undertake long term monitoring of shallow water corals at Scott Reef and Rowley Shoals (Gilmour et al 2018). Given the proposed water depths along the BTL it is not anticipated that any coral communities will be encountered. Nevertheless, the BTL environmental survey will investigate benthic habitats at selected sample locations along the trunkline route. Such locations have been chosen based on a number of criteria outlined in Section 3.7.6.	Literature review of Woodside information and publicly available information. Preparation of habitat maps with demonstrated ground truthing for areas where proposed infrastructure will be installed on the seabed within the Browse Development Area. Implementation of a marine environmental survey of the BTL corridor including benthic habitat characterisation (noting that due to water depths, it is considered highly unlikely that hard coral communities will occur along the BTL corridor).
Ecological	Seagrass	Browse Development Area including Scott Reef, Rowley Shoals	This does not apply in the area near the NRC tie in point, where Woodside has a good understanding of coral. It also does not apply in the area adjacent to the Browse Development Area where studies have been undertaken. Given the previous and ongoing benthic habitat studies undertaken in the area, Woodside has a good understanding of the status of seagrass communities within Scott Reef area. Given the proposed water depths along the BTL it is not anticipated that any seagrass communities will be encountered. Nevertheless, the BTL environmental survey will investigate benthic habitats at selected sample locations along the trunkline route. Such locations have been chosen based on a number of criteria outlined in Section 3.7.6. This does not apply in the area near the NRC tie in point, where Woodside has a good understanding of seagrass. It also does not apply in the area adjacent to the Browse Development Area where studies have been undertaken.	Literature review of Woodside information and publicly available information. Preparation of habitat maps with demonstrated ground truthing for areas where proposed infrastructure will be installed on the seabed within the Browse Development Area. Implementation of a marine environmental survey of the BTL corridor including benthic habitat characterisation (noting that due to water depths, it is considered highly unlikely that seagrass will occur along the BTL corridor).

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Receptor Group	Receptor	Key Areas of Consideration	Assessment of Current Level of Understanding and Information gaps	Environmental Studies Workplan
Ecological	Macroalgae	Browse Development Area including Scott Reef, Rowley Shoals	Woodside has a good understanding of macroalgae in the Browse Development Area including Scott Reef via previous studies undertaken in the area including studies undertaken in relation to the previous Browse Development concepts (e.g. Gardline 2009). Sufficient information on macroalgae at Rowley shoals exists in the literature (e.g. Gilmour et al. 2018) to support the impact assessment for the project. There is currently a lack of specific information on macroalgae along the BTL route although it is considered unlikely that they will occur due to the water depth. This does not apply in the area near the NRC tie in point, where Woodside has a good understanding of macroalgae. It also does not apply in the area adjacent to the Browse Development Area where studies have been undertaken.	Literature review of Woodside information and publicly available information. Preparation of habitat maps with demonstrated ground truthing for areas where proposed infrastructure will be installed on the seabed within the Browse Development Area. Implementation of a marine environmental survey of the BTL corridor including benthic habitat characterisation (noting that due to water depths, it is considered highly unlikely that macroalgae will occur along the BTL corridor).
Ecological	Seabirds and migratory shorebirds	Scott Reef, Rowley Shoals	The East Asian-Australasian Flyway (EAAF) is of most relevance to the Project Area and associated shorebird and seabird species. This flyway extends from north-eastern Asia and western Alaska in the north, to Australia and New Zealand in the south, encompassing 23 countries (Hansen et al., 2016). There are 37 species of shorebird and seabird which annually migrate to Australia using the EAAF (Hansen et al., 2016). Seabirds within the North West Marine Region (NWMR) consist of tropical and sub-tropical breeding species and non-breeding migratory species. Recent surveys around Ashmore Reef, Serangapatam Reef, Scott Reef and the wider Browse Basin region identified 26 species of seabird, including the brown booby, Abbott's booby, streaked shearwater and lesser frigatebird (Jerner et al., 2009; Milton, 1999; Smith et al., 2004; Jenner et al., 2009; WAM 2009). A number of offshore islands within the NWMR support breeding colonies of seabirds, with the islands at Ashmore Reef are regarded as supporting some of the most important seabird breeding colonies on the NWS. Due to the large geographical range of seabirds, there is potential that most species occurring within the wider NWMR may occur transitionally within the Project Area. An initial PMST search identified two species of threatened seabird as potentially occurring within the Development Area, the Abbott's booby (Endangered, Marine) and Australian lesser noddy (Vulnerable, Marine). In addition, six other species of listed marine and/or migratory seabird species were identified as having the potential to occur within and/or interact with the Proposed Action. As Scott Reef is the only emergent land mass within the immediate vicinity of the Development Area it may serve to provide nesting and / or roosting for migratory seabirds along the flyway. However, seabirds around Scott Reef are predominantly associated with Sandy Islet and occur in relatively small numbers in comparison to other key breeding and roosting sites within the region. Smith et al. (2004) recorded little tern (500 individuals), brown booby (6), ruddy turnstone (50), Australian lesser noddy (200) and the common noddy (30) during a survey at Scott Reef in 2003. More recent surveys at Scott Reef observed greater numbers of birds during spring than winter (Jerner et al., 2009), with seabird typically roosting on Sandy Islet at night and presumably foraging within the nearby and offshore waters during the day. Migratory shorebirds are occasionally observed in very low numbers at Scott Reef, with Sandy Islet potentially acting as a stopping point during the migration between the Northern Hemisphere and Australia (Commonwealth of Australia, 2008). Despite the fact that seabirds and shorebirds are regularly observed at Scott Reef, given the size of the available landmass at Sandy Islet, it is unlikely to be a critical location or support large numbers of migratory birds. Based on the available studies and literature, Woodside has a good understanding of the seabirds and shorebirds that may occur within the Development Area to support the impact assessment process for the project.	Literature review of Woodside information and publicly available information including a review of applicable State and Commonwealth guidance and conservation plans Protected Matters Search and SPRAT profile review of relevant species. Implementation of a marine environmental survey of the BTL corridor including the opportunist recording of marine megafauna.
Ecological	Fish	Browse Development Area including Scott Reef, Rowley Shoals, BTL Corridor	Woodside has a good understanding of fish that may occur at Scott Reef and Rowley Shoals via available literature and previous studies undertaken in the area (e.g. DEC 2007). In addition, Woodside, in partnership with AIMS continues to undertake long term monitoring of shallow water fish communities at Scott Reef. Fish that may occur along the BTL corridor are expected to be reflective of the open waters of the North-west Marine Region for which significant information is available in existing literature. With respect to the protected whale shark, Woodside previously studied migration patterns using tagging and tracking (Meekan et al 2010) with this information considered sufficient to inform the impact assessment.	Literature review of Woodside information and publicly available information including a review of applicable State and Commonwealth guidance and conservation plans Protected Matters Search and SPRAT profile review of relevant species. Implementation of a marine environmental survey of the BTL corridor including the opportunist recording of marine megafauna.
Ecological	Marine mammals	Browse Development Area including Scott Reef, BTL Corridor	A large number of surveys have been undertaken on marine mammals in relation to previous Browse Development concepts. These have included habitat association surveys (Sutton et al., 2018), long term sea noise logger deployment (McCauley 2011), aerial and vessel surveys (Jerner & Jerner 2009a, 2009b, RPS 2010a, 2010b, 2010c, 2011a, 2011b, 2011c) and satellite tagging (Double et al. 2010, 2012, 2014). An additional study was recently commissioned by Woodside in Q4 2017 to review the current state of knowledge for blue whales which may be affected by the Proposed Action, including reviewing current understanding of migration, foraging, distribution, and breeding behaviours, and identifying major knowledge gaps. Pygmy blue whales are recognised as a key species for consideration in the EIS/ERD. The Conservation Management Plan for Blue Whales (Commonwealth of Australia, 2015) documents a possible foraging area within the vicinity of Scott Reef which has been defined as a BIA for foraging. Unlike the Perth Canyon which is recognised as a seasonally important foraging area for pygmy blue whales, as shown by both visual and acoustic surveys (Balcazar et al., 2016; McCauley et al., 2000, 2004), there is no observational or recorded evidence to confirm Scott Reef is a feeding ground for this species. Rather, pygmy blue whales have been encountered	Literature review of Woodside information, including the recently completed study on the current state of knowledge for blue whales, and publicly available information including a review of applicable State and Commonwealth guidance and conservation plans Protected Matters Search and SPRAT profile review of relevant species. No further marine mammal specific surveys are considered necessary to inform the impact assessment. However, the implementation of a marine environmental survey of the BTL corridor will include the opportunist recording of marine mega fauna.
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Receptor Group	Receptor	Key Areas of Consideration	Assessment of Current Level of Understanding and information gaps	Environmental Studies Workplan
Ecological	Marine reptiles (turtles)	Browse Development Area including Scott Reef	during periods of elevated biomass at Scott Reef, and feeding has not been directly observed (Sutton et al., 2018). It is likely that pygmy blue whales feed opportunistically while migrating, however, Scott Reef is unlikely to represent critical habitat for pygmy blue whales. A literature review identified that there is no evidence of population increases in pygmy blue whales and as such Woodside will primarily rely on historical Woodside-funded datasets (~3 years collection period) and other recent non-Woodside datasets to support existing environmental baseline knowledge. Given potential for opportunistic foraging at Scott Reef, Woodside will describe Scott Reef and the surrounding area as a potential area of importance for the sub-species, including for opportunistic feeding, and undertake assessments of impacts and risk to PBW in this context. A literature review undertaken by WAMSI in 2018 highlights that only a small number of humpback whales utilise the Browse Development Area. As such, Woodside will primarily rely on historical Woodside-funded datasets (~3 years collection period) and other recent non-Woodside datasets to support existing environmental baseline knowledge for humpback whales.	Literature review of Woodside information and publicly available information including a review of applicable State and Commonwealth guidance and conservation plans. Protected Matters Search and SPRAT profile review of relevant species. No further marine reptile specific surveys are considered necessary to inform the impact assessment. However, the implementation of a marine environmental survey of the BTL corridor will include the opportunist recording of marine mega fauna.
Ecological	Marine reptiles (Sea snakes)	Browse Development Area including Scott Reef	Woodside has a good understanding with respect to the presence and behaviour of marine turtles in the Development Area. Sandy Islet, a part of Scott Reef, is a known nesting site for green turtles, with a number of long-term studies, funded by Woodside, undertaken to establish a baseline of turtle nesting activity (including breeding, interesting and nesting behaviours) at Scott Reef. A total of 435 nesting green turtles were tagged at Sandy Islet over seven surveys undertaken during 2006, 2008 and 2009 (Guinea, 2009), with the peak breeding season observed to be from late November to February. Nesting turtles have been observed to utilise the entire available area of Sandy Islet for nesting, with seasonal variation recorded in the areas used. In terms of interesting habitat, the studies demonstrated that two areas of sandy substrate located to the south of Sandy Islet were identified as a preferred interesting area for the green turtles at Sandy Islet. Tracking of 12 green turtles was undertaken at Sandy Islet in 2010 (Guinea, 2011). These turtles were found to re-nest at Sandy Islet up to five times with an average interesting interval of 10 days. Interesting habitat for these individuals ranged up to 14 km out from the Sandy Islet (Guinea, 2011). Following nesting, these individuals were found to disperse from Sandy Islet toward the WA mainland via two distinct post-nesting migration pathways: travelling east and north toward the Bonaparte Archipelago and then north along the coast to the NT or travelling south to Cape Leveque and then south along the coast to the De Grey River in the Pilbara (Guinea, 2011). It should be noted that while the green turtles at Scott Reef and Browse Island represent a distinct genetic stock, the relatively small available nesting area on Sandy Islet ensures that this location is likely to represent a marginal nesting habitat for the broader population of green turtles within the region, with more significant rookeries located at the Lacepede Islands and Ashmore Reef (both noted as nesting and interesting BIAS for green turtles). The turtle studies undertaken at Scott Reef have provided Woodside with a comprehensive understanding of the nesting carrying capacity of Scott Reef, as well as the population dynamics, preferential nesting and interesting behaviours of marine turtles within the proposed Browse Development Area. The inter-annual nesting population of green turtles at Sandy Islet varies greatly (by at least an order of magnitude) and it is known that a significant proportion of the Scott Reef/ Browse Island green turtle meta-population nest at Sandy Islet. Given the large variability in inter-annual turtle numbers, additional data collection is unlikely to add to this knowledge base. Udyawer et al. (2016) has recently analysed data collected from 2230 Baited Remote Underwater Video Stations (BRUVS) between 1999 and 2016 to better define the range and distribution of sea snake families in the NVMR and to produce predictive models to assess the likelihood of occurrence for major families of sea snakes. From this data, 582 sea snakes were recorded with the highest rates of sea snake sightings observed in the Northern Oceanic Shoals. The majority of sea snakes were of genus <i>Aipysurus</i> (63%) followed by <i>Hydrophis</i> (12%) and <i>Emydcephalus</i> (11%) (Udyawer et al., 2016). Probability of occurrence maps based on available habitats and other environmental parameters indicate that Scott Reef and other remote reef systems within the Northern Oceanic Shoals, as well as mid-shelf shoal habitat along the Kimberley and Pilbara coasts were likely ideal habitat for two IUCN and DoEE listed critically endangered sea snake species, the short-nosed sea snake and the leaf-scaled sea snake (Udyawer et al., 2016, and available at: https://vinyayudawer.github.io/SeaSnake-NicheModels/ModelMap.html). Historically these two species were only recognised as occurring at Ashmore and Hibernia reefs (Cogger, 2014; Guinea, and Whiting, 2005; Storr et al., 2002), although they have not been observed in these locations since 2001 despite considerable effort between 2005 and 2013 (Guinea, 2013). These species have also not been recorded at Scott Reef. Preliminary Protected Matters Searches have identified the short-nosed sea snake as potentially occurring within the Project Area, however, did not identify occurrence of the leaf-scaled sea snake. Recent genetic analysis and field surveys have provided further evidence that these threatened species are more widely distributed than previously thought (D'Anastasi et al., 2016; Sanders et al., 2015). Sanders et al. (2015) found significant molecular and morphological variation between specimens of short-nosed and leaf-scaled sea snakes collected at offshore locations and those collected in coastal areas which were previously considered vagrant. The study indicates specimens of short-nosed seasnakes collected on Barrow Island in 2010 and leaf-scaled seasnakes collected in Exmouth Gulf in 2004 and Broome in 2012 were from distinct coastal breeding populations of sea snakes (Sanders et al., 2015). D'Anastasi et al. (2016) confirmed a wider distribution for these species, providing live records of the short-nosed and leaf-scaled sea snakes outside of Ashmore and Hibernia. The study, which conducted intensive field surveys, assessed previous survey and	Literature review of Woodside information and publicly available information including a review of applicable State and Commonwealth guidance and conservation plans. Protected Matters Search and SPRAT profile review of relevant species. No further marine reptile specific surveys are considered necessary to inform the impact assessment. However, the implementation of a marine environmental survey of the BTL corridor will include the opportunist recording of marine mega fauna and sea snakes.

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Receptor Group	Receptor	Key Areas of Consideration	Assessment of Current Level of Understanding and information gaps	Environmental Studies Workplan
Ecological	Key Ecological Features (KEFs)	- Continental shelf demersal fish communities - Seringapatam Reef and Commonweal th waters in the Scott Reef complex - Ancient coastline at 125 m depth contour - Mermaid Reef and Commonweal th waters surrounding Rowley Shoals.	habitat data and molecular genetics data to resolve gaps regarding these two species' distributions, abundances, habitat requirements and conservation statuses in coastal WA, observed sixteen leaf-scaled sea snakes within Shark Bay and seven short-nosed sea snakes within Exmouth Gulf (D Anastasi et al., 2016). These studies significantly increase the known geographic range of these threatened species, as well as expands their preferred habitat to include seagrass meadows, and are significant given the critically endangered conservation statuses of these species are based off the understanding that their range is restricted to Ashmore and Hibernia (i.e. < 10 km²). Comprehensive surveys of sea snakes at Scott Reef were undertaken in February, September and November in 2006 (URS, 2007; URS Australia Pty Ltd, 2006) did not observe these two threatened species, however, recorded similar abundances of sea snakes as observed on Hibernia and Carlier Island during the same year. The abundance of sea snakes was found to be dependent on habitat type and ranged between 0 to 2 individuals per hectare. The majority of sea snakes recorded were olive sea snakes and turtle-headed seashakes, with other species including the dusky sea snake, Dubois's sea snake, horned sea snake, and slender-neck sea snake (Guinea 2013). Sea snakes that were recorded were most common in the more complex reef habitats, although no key sites for juveniles or adults were identified at Scott Reef. No seasonal peaks were detected indicating the majority of individuals were likely residential. Based on the available studies and literature, Woodside has sufficient information on sea snakes that may occur within the Development Area, and specifically within the area of Scott Reef to support the impact assessment process for the project. Sufficient information exists on the relevant KEFs for the purpose of impact assessment within the North West Marine Bioregional Plan (Commonwealth of Australia 2012). However additional information will be gained from the pipeline environmental survey.	Literature review of Woodside information and publicly available information. Implementation of a marine environmental survey of the BTL corridor including the benthic habitat survey, sediment sampling and water quality sampling within each intersected KEF.
Ecological	Australian marine parks	Relevant Australian marine parks. - Kimberley Marine Park - Argo-Rowley Terrace Marine Park - Mermaid Reef Marine Park (not intersected)	Sufficient information exists on the relevant Australian marine parks for the purpose of impact assessment within the North-west Marine Parks Network Management Plan 2018 (Director of National Parks 2018). However additional information will be gained from the pipeline environmental survey.	Literature review of Woodside information and publicly available information. Implementation of a marine environmental survey of the BTL corridor including the benthic habitat survey, sediment sampling and water quality sampling within each intersected Australian marine park.
Ecological	State marine parks and reserves	Relevant state marine parks and reserves: Rowley Shoals	Sufficient information exists on the relevant state marine parks and reserves for the purpose of impact assessment (e.g. DEC 2007).	Literature review of Woodside information and publicly available information.

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Receptor Group	Receptor	Key Areas of Consideration	Assessment of Current Level of Understanding and Information gaps	Environmental Studies Workplan
Socio-Economic		- Marine Park (not intersected) - Scott Reef Nature Reserve		
	Commonwealth managed fisheries	- Relevant Commonwealth managed fisheries including: - North West Slope Trawl Fishery (NWSTF) - Western Tuna and Billfish Fishery - Southern Bluefin Tuna Fishery - Western Skipjack Tuna Fishery	Woodside has sufficient information on the relevant Commonwealth managed fisheries (Patterson et al. 2018) for the purpose of impact assessment via work undertaken on the previously proposed Browse development concepts and ongoing stakeholder consultation.	Literature review of Woodside information and publicly available information. Ongoing stakeholder consultation.
	State managed fisheries	- Relevant State managed fisheries including: - Northern Demersal Scalefish Managed Fishery (NDSF) - Mackerel Managed Fishery - Western Australia North Coast Shark Fishery (WANCSE) - Onslow Prawn Managed Fishery - Abalone Fishery - South west Coast Salmon - Pilbara Fish Trawl and Trap Fishery - Specimen	Woodside has sufficient information on the relevant State managed fisheries (Gaughan et al. 2018) for the purpose of impact assessment via work undertaken on the previously proposed Browse development concepts and ongoing stakeholder consultation.	Literature review of Woodside information and publicly available information. Ongoing stakeholder consultation.

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Receptor Group	Receptor	Key Areas of Consideration	Assessment of Current Level of Understanding and Information gaps	Environmental Studies Workplan
		- Shell - Marine Aquarium Fish - West Coast Deep Sea Crustacean - Pearl Oyster Managed Fishery.		
Socio-Economic	Tourism and recreation	Scott Reef, Rowley Shoals	Sufficient information exists on the use of Scott Reef and Rowley Shoals for tourism and recreation purposes for the purpose of impact assessment.	Literature review of Woodside information and publicly available information. Ongoing stakeholder consultation.
Socio-Economic	Shipping	Browse Development Area, BTL Corridor	Sufficient information exists on the use of the Project area and surrounds for shipping for the purpose of impact assessment.	Literature review of Woodside information and publicly available information. Ongoing stakeholder consultation.
Socio-Economic	Industry	Regional	Sufficient information exists on industry in the region including petroleum exploration and production for the purpose of impact assessment.	Literature review of Woodside information and publicly available information. Ongoing stakeholder consultation.
Socio-Economic	Indigenous heritage	Scott Reef, Dampier Archipelago (including Burrup Peninsula) National Heritage place	Sufficient information exists on indigenous heritage (Traditional Indonesian fishers) in the water surrounding Scott Reef for the purpose of impact assessment. Woodside will point to and provide context for the assessment of the potential impacts of the North West Shelf Project Extension Proposal (EPBC 2018/6335) on values specifically related to the National Heritage listing on the Burrup Peninsula.	Literature review of Woodside information and publicly available information. The assessment documentation must provide details of any potential indirect impacts of the proposed action on the (Indigenous rock art) values of the Dampier Archipelago (including the Burrup Peninsula) National Heritage Place, and the extent to which these values may be impacted by the proposed action following any planned mitigations.
Socio-Economic	Maritime archaeology	Browse Development Area, BTL Corridor	Sufficient information exists on maritime archaeology including known ship wrecks in the Project area for the purpose of impact assessment.	Literature review of Woodside information and publicly available information.

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3.7.6 Scope of Technical Studies informing Existing Environment

The following technical studies will be undertaken to inform the existing environment description. It should also be noted that Woodside is committed to the continuation of the long-term monitoring at Scott Reef and the Rowley Shoals undertaken in conjunction with the Commonwealth research agency, the Australian Institute of Marine Science (AIMS).

Environmental Survey of BTL Corridor

The objectives of this study are to:

- confirm the environmental characteristics (physical and biological attributes) of the seabed along the BTL route which will include identification and semi qualitative descriptions of seabed habitat types, infauna and epifauna and their general distribution
- determine the baseline condition and physico-chemical composition of seabed sediments and water quality at selected locations along the BTL corridor
- document presence of marine mega fauna sighted opportunistically along the BTL corridor.

The data and information (including habitat mapping) from the environmental survey will be utilised to describe the existing environment and baseline conditions along the BTL route and to inform a regional understanding of marine environmental values through which the BTL traverses. The determination of the baseline environmental values at selected locations of the BTL route will be used as part of the environmental impact and risk assessment process of the EIS/ERD to determine the impacts (if any) to the receiving environment from the installation and physical presence of the BTL.

A reconnaissance survey of the BTL corridor (geophysical) has been undertaken and has been used to identify sampling locations along the BTL corridor. The sampling locations have been selected to characterise the marine environment in proximity to the proposed BTL, with consideration given to regional environmental sensitivities and key ecological features.

At each of the sampling locations the following environmental parameters will be collected:

- water, seabed sediment, infauna and epifauna
- benthic habitat imagery for habitat classification and description (semi-quantitative analysis of seabed imagery (High Resolution video and stills))
- opportunist sightings of marine mega fauna.

3.8 Impacts and Risk

3.8.1 Overview

The purpose of this chapter is to present the environmental impact and risk assessment undertaken including the source activities, the magnitude and extent of potential impacts, proposed mitigation strategies, environmental objectives and performance criteria.

3.8.2 Format of Chapter

The impact and risk chapter will provide a high-level overview of the sources of each risk and impact aspect as well as the potential receptors groups that may be affected. This will be followed by a detailed description of each relevant impact and risk, proposed mitigation measures and an overall conclusion on the predicted environmental outcome, in relation to the aspect, and with reference to the relevant MNES significance criteria and/or WA EPA Environmental Objective.

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The description of each aspect will be set out in a format broadly similar to the following outline:

1. Aspect (e.g. Noise Emissions)
 - 1.1. Environmental Objective
 - 1.2. Policy and Guidance
 - 1.3. Source Activities
 - 1.4. Receptor and Receptor Sensitivity
 - 1.5. Environmental Impact
 - 1.6. Environmental Risk
 - 1.7. Cumulative Impacts
 - 1.8. Mitigation and Management
 - 1.9. Other Considerations
 - 1.10. Performance Criteria
 - 1.11. Impact and Risk Assessment Summary and Acceptability Assessment

3.8.3 Impact and Risk Assessment Requirements

This section will include:

- description of all relevant potential impacts and risks of the action
- a detailed assessment of the nature and extent of the potential short term and long term relevant impacts, including on MNES and WA EPA Environmental Factors including the natural Heritage values of 'Scott Reef and surrounds'
- a statement whether any relevant potential impacts are likely to be unknown, unpredictable or irreversible
- analysis of the significance of the relevant potential impacts and risks
- any technical data, any sources of authority, and other information used or needed to make a detailed assessment of the relevant potential impacts. Reliability of forecasts and predictions, confidence limits and margins of error will be indicated as appropriate.

In discussing potential impacts, particular emphasis is to be given to providing details on the potential impacts to the receiving environment's unique flora and fauna, as identified and to any protected areas in the vicinity.

In particular the EIS/ERD will address the following.

General impacts

The following encompasses a list of general impact considerations:

- discuss the effects of the overall action on the functioning of the marine environment, including effects to the marine environment surrounding the proposed development
- identify the source of potential impacts, e.g. ship-movements, artificial lighting, noise
- discuss potential impacts which may arise through the transportation, storage and use of dangerous goods (if any), fuels and chemicals, such as accidental spills
- consider the application of a waste management hierarchy (e.g. reduce, reuse, recycle, treat, dispose) and potential impacts caused by the need for waste disposal and management of emissions, refuse, effluent and hazardous waste (if any)

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- in discussing potential impacts, consider how the interaction of extreme environmental events and any related safety response may impact on the environment
- consider potential impacts throughout the life of the proposed Browse to NWS Project – from construction, commissioning, IMR activities and operations through to decommissioning.

Physical and biodiversity impacts

The following encompasses a list of physical and biodiversity impact considerations:

- consider potential impacts to the sea floor through anchoring and direct placement, sediment disturbance, as well as any impacts of removal. The zone of likely seabed disturbance will be identified.
- consider potential impacts to fauna and flora species, including rare, threatened, or otherwise valuable flora and fauna, communities (particularly listed threatened species and communities, listed marine species including whales and other cetaceans and listed migratory species). In assessing impacts, consideration will be given to factors such as population composition and density including changes to communities, breeding success, habitat, or disturbances to migration or migratory patterns and other wildlife movements.
- consider potential impacts to the recovery of species where a species recovery plan is in place including factors called up in the requirements of the relevant recovery plans.
- consider potential impacts, if any, on and habitat, conservation areas, biological important areas, key ecological features and protected areas (including Australian Marine Parks), and in particular Scott Reef and surrounds.
- consider potential impacts arising from the introduction and/or spread of exotic pest species.

Impacts of emissions to air and water

The following encompasses a list of emissions to air and water impact considerations:

- discuss the potential impact of solid, liquid and gaseous emissions and waste produced by the operation, including greenhouse gas emissions.
- refer to the NWS Extension assessment being progressed by the NWS JV under the EP Act (Assessment number 2186) and EPBC Act (EPBC 2018/8335) in relation to potential impacts resulting from the processing of Browse gas by a third party on the Burrup Peninsula.
- include a discussion on the eventual fate of the waste.
- provide a full evaluation of PW, CW and hydrotest discharges including anticipated composition of discharge, modelling of the mixing zones and discussion on the potential impacts of discharge, including the spatial and temporal impacts of discharged PW and hydrotest fluid on marine fauna and key benthic ecological receptors (e.g. corals, seagrass, macroalgae), which may provide habitat and food resources for listed threatened species (e.g. marine turtles).
- consider the potential impacts of water clarity, salinity and temperature changes with specific reference to stratification of the water column.
- discuss potential impacts related to the discharge of sewage, sullage and other production related discharges.
- discuss impacts of potential spillage of hydrocarbons related to construction, production, storage and shipping. Modelling of spills will take into account seasonal variations throughout the year. Modelling will also take into account proximity to sensitive marine areas, in particular Scott Reef and surrounds. The evaluation of the potential impacts of oil spills is to be carried out using a thorough risk-assessment methodology.

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Socio-economic and cultural impacts

Discussion of the potential socio-economic and cultural impacts of the proposed Browse to NWS Project as required. This will include a description and discussion of potential impacts (both positive and negative):

- caused by any short, medium and long-term changes, interruption, alteration or curtailment of activities and uses of the area due to the Proposed Action, including changes affecting traditional uses, recreational uses, conservation and tourism
- on sites of historical or cultural significance
- on existing industry and commerce
- to employees in terms of workplace health and safety
- on shipping and any potential traffic hazards
- on visual and aesthetic values, impacts to tourism and access for conservation purposes
- to historic shipwrecks in the area, including potential impacts on, as yet, unknown shipwrecks or those in unsurveyed areas.

Cumulative Impacts

Cumulative impacts will also be identified and addressed. Cumulative impacts from the proposed Browse to NWS Project may occur in two ways:

- Aspect-based – Cumulative or combination effects from concurrent and/or sequential activities associated with the proposed Browse to NWS project, and other activities/projects resulting in the same aspects as those identified for the proposed Browse to NWS Project
- Receptor-based – Cumulative or combination effects on a receptor, both from multiple aspects of the proposed Browse to NWS Project and similar/multiple aspects resulting from other activities/projects.

The aspect based cumulative impacts will be presented within each aspects chapter (e.g. noise emissions).

Aspect-based cumulative impacts resulting from concurrent activities with the same aspect (e.g. concurrent underwater noise emissions from different project activities) will be assessed as part of the impact and risk assessment for each aspect. Where appropriate, modelling studies will take into account the multiple sources to inform a robust impact and risk assessment of each aspect on each relevant receptor.

The assessment of aspect-based cumulative impacts resulting from activities/projects not associated with the proposed Browse to NWS project will include assessment of reasonably foreseeable activities and projects. These activities may include:

- Woodside and other operator exploration activities
- Other oil and gas developments (including those known potential future expansions or developments in the vicinity)
- Commonwealth and State Managed Fisheries
- Other users such as tourism and recreation, traditional fishing and commercial fishing.

Other activities/project considered in the cumulative impact assessment will be selected based on the type of activity, spatial scale and time scale. Activities will only be taken into account if they:

- Have not already been taken into consideration previously in the impact assessment (i.e. as part of baseline conditions)

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- Have aspects that may cause impacts on the same receptors as the proposed Browse to NWS Project
- Activities that exist or have a high degree of certainty of proceeding in the future, such as those with construction activities underway or for which approvals and budget have been obtained
- Activities for which sufficient information is available to conduct a qualitative assessment to a reasonable standard.

Once each potential cumulative impact from other activities/projects is identified an assessment of the significance of the cumulative impact will be undertaken and documented. Note that due to the inherent difficulties associated with accessing data associated with other proposed developments, the evaluation will be based on a qualitative assessment.

Receptor-based cumulative impacts resulting from concurrent activities generating common pressures (e.g. sequential drilling over the project and its light emissions) will be addressed in the overall conclusions section which will include a qualitative assessment of the cumulative impacts on each key receptor and assess impacts on a more holistic, whole-ecosystem level, considering the potential cumulative impacts of the proposed project, and any existing and future concurrent activities, on the existing environment.

3.8.4 Impact and Risk Assessment Process

An environmental risk and impact assessment will be undertaken in accordance with Woodside's Environment Impact Assessment Guideline. This guideline and associated Environment Impact Assessment Guidance Tool and Environment Risk Assessment Guidance Tool support the implementation of impact assessments and set out the broad principles and high-level steps for assessing environmental impacts across the lifecycle of Woodside's activities.

Within this process, a distinction is made between an 'impact' and a 'risk' as follows:

Environmental Impact: An expected change to the environment, whether adverse or beneficial, wholly or partially resulting from the planned and routine project activities including mitigation measures (e.g. routine liquid discharges).

Environmental Risk: A change to the environment resulting from an unplanned event or incident (e.g. oil spill resulting from vessel collision).

The environmental impact assessment approach undertaken will include the following steps:

1. Identification of project **aspects** (i.e. results of planned or unplanned project activities that have the potential to impact on the environment).
2. Identification of the **receptors** (i.e. physical, biological, cultural or human elements of the environment that may be impacted by project aspects).
3. Assessment of the **receptor sensitivity** (i.e. the sensitivity/vulnerability/importance of the /receptor) as either high, medium or low value.
4. Assessment of the **magnitude** (i.e. no lasting effect, slight, minor, moderate, major or catastrophic) of the credible environmental impacts from each aspect based on the extent, duration, frequency and scale.
5. Assigning an **impact significance level** to each environmental impact based on the receptor sensitivity and the magnitude of the impact.
6. Assigning an **environment risk consequence** to each environmental risk based on the receptor sensitivity and magnitude of the impact; and the likelihood of occurrence.
7. Utilising the impact significant level and environmental risk consequence to undertake an assessment of the Proposed Action against the EPBC Act Significant Impacts Criteria, Western

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Australian EPA Objectives and other policy instruments including Australian Marine Park management plans and species recovery plans.

The following impact significant levels may be assigned for the environmental impacts:

- Catastrophic (A) - Applicable limits or standards are substantially exceeded and/ or catastrophic or major magnitude impacts are expected to receptors of medium/ high or high sensitivity respectively.
- Major (B) - Applicable limits or standards are exceeded and/ or moderate, major or catastrophic magnitude impacts are expected to occur to receptors of high, medium or low sensitivity respectively.
- Moderate (C) - Impacts are close to applicable limits or standards, or within standards but with potential for occasional exceedance. Minor, moderate or major magnitude impacts are predicted to occur to receptors of high, medium or low sensitivity respectively.
- Minor (D) - Impact magnitude is within applicable standards but is considered to have significance. Slight, minor or moderate impacts are predicted to occur to receptors of high, medium or low sensitivity respectively.
- Slight (E) - The receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and well within applicable standards, and/or the receptor is of low value.
- Negligible (F) - The receptor will essentially not be affected.

Environment risk consequences are determined slightly differently than impact significant levels due to the requirement to consider the likelihood that the unplanned event or incident occurs.

The likelihood of a risk event occurring can be considered:

- Remote (0) – unheard of in the industry
- Highly unlikely (1) – has occurred once or twice in the industry
- Unlikely (2) – has occurred many times in the industry by not at Woodside
- Possible (3) – may possible occur
- Likely (4) – is likely to occur
- Highly likely (5) – is expected to occur

The following risk levels may be assigned for the environmental risks:

- Severe
- Very High
- High
- Moderate
- Low.

The outcomes of the preliminary environment impact assessment of planned activities are shown in **Table 7**. The outcomes of the preliminary assessment in relation to environmental risks from unplanned incidents or risk events are shown in **Table 8**. The preliminary impact and risk assessments were undertaken as part of the EPBC Act and EP Act referral process and have been provided to provide context to the workplan detailed in this EISG/ESD. It should be noted that the impact and risk assessment outcomes may change as further information comes available and more detailed analysis and evaluation is undertaken in preparing the EIS/ERD. Further change may also occur as a result of considering any feedback received from Stakeholders on the draft EIS/ERD.

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3.8.5 Source, Aspect and Receptor Scoping

Preliminary scoping of the relationship between the proposed activities and the aspects has been undertaken and is presented in **Table 9**.

Each of these relationships will be considered when assessing the impact (from planned routine and non-routine events) and risk (from unplanned events) of the aspect. Scoping of the receptors that could be conceivably (in consideration of the location of the receptors) be affected by the potential impacts and risks has been undertaken and is presented in **Table 10**.

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Table 7 Preliminary Environmental Impact Assessment (Woodside 2018)

Ref.	Aspect	Source/Activity	Receptor Sensitivity Level	Predicted Impact	Impact Significance Level
IMP-1	Underwater noise emissions	- Drilling and completion of wells including vertical seismic profiling (VSP) - Installation of SURF, BTL and inter-field spur line - Suction piling for mooring installation (FPSO and MODU) - Pile Driving as a contingent planned activity - MODU dynamic positioning - Wellhead operations - Routine FPSO operations (thrusters, compressors, pumps) - Condensate tanker operations - Construction and support vessel operations - Inspection, maintenance and repair activities including ROVs - Routine helicopter operations - Decommissioning activities.	High value species (e.g. cetaceans)	Slight impact (behavioural avoidance) on high value species on a near-field scale for duration of activities.	D – Minor
IMP-2a	Light emissions – MODU and FPSO	- Routine FPSO operations - Intermittent FPSO flaring - MODU operations.	High value species (e.g. marine turtles)	Slight impact (attraction/repulsion, disorientation) on high value species on a near-field scale for duration of the activities.	D – Minor
IMP-2b	Light emissions - Vessels	Construction and support vessel operations.	High value species (e.g. seabirds and migratory birds)	Slight impact (attraction/repulsion, disorientation) on high value species on a near-field scale for duration of the activities.	D – Minor
IMP-3a	Physical presence of infrastructure during construction	Seabed disturbance from seabed preparation, MODU anchors and FPSO anchoring and mooring lines.	Medium value habitat (not impacting Scott Reef or Rowley Shoals)	Slight impact (due to short duration) to medium value habitat on a localised scale during construction activities.	E – Slight
IMP-3b	Physical presence of infrastructure during operations	- Seabed disturbance from the installation of infrastructure (wells, SURF, BTL and inter-field spur line) - Construction and support vessel operations.	Medium value habitat (not impacting Scott Reef or Rowley Shoals)	Slight impact (due to low magnitude) to medium value habitat on a localised scale for the duration of the activities.	E - Slight
IMP-4a	Gaseous emissions - direct air emissions	- Power generation on construction vessels, support vessels, FPSO facilities - Condensate tankers - Flaring	Low value (remote location with limited sensitive receptors)	Slight reduction in air quality on a local scale for the duration of the activities.	F - Negligible

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Ref.	Aspect	Source/Activity	Receptor Sensitivity Level	Predicted Impact	Impact Significance Level
		- Venting - PW degassing - Gas export compression units - AGRU - venting of hydrocarbons in waste Acid gas stream			
IMP-4b	Gaseous emissions – indirect air emissions	Woodside will point to and provide context for the assessment of the potential impacts of the North West Shelf Project Extension Proposal (EPBC 2018/8335) on values specifically related to the National Heritage listing on the Burrup Peninsula.			
IMP-4b	Gaseous emissions -GHG	Refer to Section 3.9.			
IMP-5	Treated sewage	Discharge of sewage and sillage (within regulatory discharge limits) from FPSO, condensate tanker and construction and support vessels.	Medium value (open offshore waters)	Slight impact as a result of near-field nutrient enrichment of surrounding waters in offshore open ocean waters.	E - Slight
IMP-6	Treated PW and NORMs.	- Discharge of PW from the FPSOs to the marine environment (within accepted industry standards limits) - Discharge of formation water from MODU during well clean-up activities - Release of NORMs contained in produced sand and scale (if produced) to marine environment - Discharge of MEG as part of PW (MEG injection on start-up and shutdown) - Discharge of mercury within PW to the marine environment (within accepted industry standards limits)	Medium value (open offshore waters)	Minor impact as a result of near-field contamination to surrounding waters above relevant guidance/ background levels for the duration of the activity.	D – Minor
IMP-7a	Treated utility water	- Oil/water drainage from machinery and storage areas discharged to sea (within regulatory discharge limits) from the FPSO facilities, MODU, construction vessels and support vessels - Discharge (within regulatory discharge limits) of water used in power generation (blade washing) on FPSO - Discharge of bilge water (within regulatory discharge limits) from FPSO, MODU construction vessels and support vessels - Discharge of ballast water including biofouls from the FPSO.	Medium value (open offshore waters)	Negligible impact as a result of temporary localised contamination to surrounding waters.	F - Negligible
IMP-7b	Treated utility water – desalination brine	Discharge of brine from potable water maker on FPSO, MODU, construction vessels and support vessels	Medium value (open offshore waters)	Negligible impact as a result of temporary localised contamination to surrounding waters.	F - Negligible
IMP-8	Cooling water	Discharge of cooling water from the FPSO facilities.	Medium value (open offshore waters)	Minor, near-field contamination to surrounding waters above relevant guidance/ background levels for the duration of the activity.	D – Minor
IMP-9	Putrescible organic waste	Disposal of food scraps and other	Medium value (open offshore waters)	Negligible, localised impact to surrounding waters as a result of nutrient enrichment for	F - Negligible
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Ref.	Aspect	Source/Activity	Receptor Sensitivity Level	Predicted Impact	Impact Significance Level
IMP-10	Inorganic waste	- putrescible wastes from offshore facilities. - Generation and disposal (at a licensed onshore facility) of general inorganic non-hazardous wastes from offshore activities - Generation and disposal at a licensed onshore facility) of hazardous wastes from offshore activities (e.g. tank cleaning waste, contaminated amine, waste, produced sand, mercury waste)	Low (licensed disposal facility)	the duration of the activity. Negligible localised impacts to a low value environment (licensed disposal facility) for the duration of the activities.	F- Negligible
IMP-12	Drilling cuttings and fluids	- Generation of drill cuttings during drilling and completion activities. - Discharge of cement slurry	Medium value (sparse deep water benthic habitats)	1. Slight, short term decrease in water quality on near field scale. 2. Slight, localised impact on benthic habitat that is permanent.	E- Slight
IMP-13	Subsea control fluid	Discharge of subsea control fluid during operations of the SURF	Medium value (open offshore waters)	Negligible impact as a result of contamination to surrounding waters that is temporary and localised which may occur sporadically for the duration of the activities.	F- Negligible
IMP-14	Hydrotest and preservation fluid	- Discharge of hydrotest and preservation fluid from the BTL and inter-field spur line. - Discharge of hydrotest and preservation fluid from the SURF	Medium value (open offshore waters)	Negligible impact as a result of contamination to surrounding waters that is temporary and localised and will occur only once during commissioning.	F- Negligible
IMP-15	Atmospheric Noise	Helicopter movements between mainland and project area.	High value species (e.g. cetaceans)	Slight impact (behavioural avoidance) on high value species on a near-field scale for duration of activities.	D- Minor

* IMP-11 Hazardous Waste combined with IMP-10 – inorganic waste

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Table 8 Preliminary Environmental Risk Assessment (Woodside 2018)

Ref.	Aspect	Risk Event	Receptor Sensitivity Level	Risk Consequences	Risk Consequence Level	Likelihood	Risk Rating
Risk-1	IMS	Vessel (including FPSO) and MODU movements or ballast water exchange leads to the introduction and establishment of IMS	High value habitat (Scott Reef, Rowley Shoals etc)/native species	Moderate, medium term impact to high value habitat/native species on a regional scale.	B – Major	1 – Highly unlikely	Moderate
Risk-2	Treated PW	Discharge of PW to the marine environment at levels significantly higher than expected levels	High value habitat (Scott Reef)/native species	Minor, short term impact (contamination) to high value habitat (Scott Reef)/native species.	C - Moderate	0 - Remote	Moderate
Risk-3	Utility Water – drain discharges	Unplanned discharge of drain waters potentially containing oil and grease	High value habitat (Scott Reef)/native species	Negligible short term impact (contamination) to high value habitat (Scott Reef)/native species.	E - Slight	1 – Highly unlikely	Low
Risk-4	Cooling water	Cooling water mixing zone significantly larger than predicted resulting in impacts to Scott Reef or high value species	High value habitat (Scott Reef)/native species	Slight short term impact (contamination) to high value habitat (Scott Reef)/native species.	D - Minor	0 - Remote	Low
Risk-5	Non-hazardous inorganic waste	Unplanned discharge of non-hazardous inorganic waste to the marine environment	High value habitat (Scott Reef)/native species	Negligible short term impact (contamination) to high value habitat (Scott Reef)/native species.	E - Slight	1 – Highly unlikely	Low
Risk-6	Hazardous Waste	Unplanned discharge of hazardous waste to the marine environment	High value habitat (Scott Reef)/native species	Slight short term impact (contamination) to high value habitat (Scott Reef)/native species.	D - Minor	2 – Unlikely	Moderate
Risk-7	Drilling cutting and fluids	Distribution and impact of drill cuttings significantly wider than predicted resulting in impacts to Scott Reef	High value habitat (Scott Reef)/native species	Slight short term impact (contamination) to high value habitat/native species.	D - Minor	2 – Unlikely	Moderate
Risk-8	Seabed subsidence	Removal of hydrocarbons from Torosa results in seabed subsidence impacting on the ecological function of Scott Reef	High value habitat (Scott Reef)/native species	Permanent event with negligible impact to high value habitat (Scott Reef)/native species.	E - Slight	1 – Highly unlikely	Low
Risk-9	Hydrocarbon spill	1. Loss of well controls 2. Subsea loss of control 3. Loss of hydrocarbons from topsides 4. Loss of control from substructure (storage of condensate or diesel) 5. Loss of containment from export BTL (gas only) 6. Loss of containment from vessel collision	Multiple high value habitats and high values species	Long term contamination to multiple high value habitats and native species at levels above standards and on a regional scale.	A - Catastrophic	1 – Highly unlikely	High
Risk-10	Vessel interaction with fauna	Vessel collision (including fast crew transfer vessel) with fauna resulting in injury or death to individual	High Value Species	Slight impact (injury or mortality to single individual) of high value species	C - Moderate	2 – Unlikely	Moderate

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Table 9 Activity-Aspect Relationships

Aspect Name	Development Drilling	Installation of Subsea Umbilicals, Risers and Flowlines (SURF)	Installation of FPSO facilities	Installation of BTL and Inter-Field Spur Line	Extraction	Processing (FPSO facilities)	Condensate Offload (FPSO facilities)	Gas Export (to NWS Infrastructure)	IMR Activities	Decommissioning	Support Activities and Helicopters
Underwater noise emissions	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Atmospheric noise emissions											✓
Light emissions	✓	✓	✓	✓		✓			✓	✓	✓
Physical presence of infrastructure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gaseous emissions	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Marine Discharges	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Drill cuttings and fluids	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IMS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Seabed subsidence	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hydrocarbon spill	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 10 Impact-Receptor Relationships

Aspect	Physical					Ecological													Socio-Economic										
	Marine Sediments	Water quality	Air Quality	Ambient Light	Ambient Noise	Planktonic Communities	Epifauna and Infauna	Coral	Seagrass	Macroalgae	Saltmarsh	Mangroves	Shoreline Habitats	Seabirds and Migratory Shorebirds	Fish	Marine Mammals	Marine Reptiles	Key Ecological Features	Australian Marine Parks	State Marine Parks and Reserves	Commonwealth Managed Fisheries	State Managed Fisheries	Tourism and Recreation	Shipping	Industry	Settlements	Other Protected Places	Indigenous heritage	Marine Archaeology
Underwater noise emissions					✓									✓	✓	✓	✓	✓				✓							
Atmospheric noise emissions					✓									✓		✓	✓						✓						
Light emissions				✓										✓	✓		✓	✓					✓						
Physical presence of infrastructure	✓						✓	✓	✓				✓	✓	✓	✓	✓	✓				✓	✓	✓	✓			✓	✓
Gaseous emissions			✓																										
Marine Discharges	✓	✓				✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓
Drill cuttings and fluids	✓	✓													✓	✓	✓	✓											
IMS							✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓					✓	✓
Seabed																													

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Aspect	Physical					Ecological															Socio-Economic									
	Marine Sediments	Water quality	Air Quality	Ambient Light	Ambient Noise	Pelagic Communities	Epifauna and Infauna	Coral	Seagrass	Macroalgae	Saltmarsh	Mangroves	Shoreline Habitats	Seabirds and Migratory Shorebirds	Fish	Marine Mammals	Marine Reptiles	Key Ecological Features	Australian Marine Parks	State Marine Parks and Reserves	Commonwealth Managed Fisheries	State Managed Fisheries	Fisheries	Tourism and Recreation	Shipping	Industry	Settlements	Other Protected Places	Indigenous heritage	Marine Archaeology
subsidence	✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	
Hydrocarbon spill		✓																												

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3.8.6 Previous studies to assess impacts and risks

Throughout the approvals process of the previous Browse development concepts (JPP and FLNG) various technical studies were undertaken to inform the assessment of the impacts and risks associated with the development concept. These technical studies are detailed in **Table 11**. Many of the potential environmental impacts associated with offshore drilling and completion, installation and operational activities of the previous Development concepts remain unchanged and relevant to the proposed Browse to NWS Project. Similarities between the concepts include the number and locations of wells and subsea tiebacks which have either reduced or remain broadly unchanged. The notable differences are the addition of the inter-field spur line and the BTL.

Due to these similarities, significant work has previously been undertaken with respect to understanding, assessing and mitigating potential environmental impacts and risk. With respect to the environmental aspects, the proposed Browse to NWS Project is expected to lead to the following when compared to the approved FLNG development concept:

- A reduction in the number of offshore facilities (2 x FPSO vs 3 x FLNG). Only one FPSO will be located at Torosa (compared to 2 x FLNG)
- A reduction in the number of development wells from 64 over Development life to a maximum of 49
- A reduction in shipping near Scott Reef as there is no LNG offtake
- A reduction in cooling water discharge
- Approximately the same amount of condensate storage per FPSO and offtake (reduction overall due to 2 x FPSO vs 3 x FLNG)
- Increased produced water (PW) during later field life
- Approximately the same distance between the facilities and Scott Reef
- A reduction in noise sources (fewer offshore facilities and less well drilling, completion and well unload (drilling and completion) activities)
- A reduction in mono ethylene glycol (MEG) injection requirements relating to a change from continuous MEG injection to active heating (noting that MEG injection will still be required for start-up and shutdown)
- A change to MEG discharge within the FPSO PW stream as opposed to recovery on a FLNG facility. This will result in higher MEG concentrations discharged but only at flowline or well restarts as opposed to continuous trace MEG concentrations in the PW stream
- Decreased energy consumption (CO₂) for offshore processing as compared to FLNG based on removal of liquefaction requirements from the proposed offshore development concept. This decrease is partially offset by additional requirement for export compression
- Increased seabed disturbance due to installation of the BTL and the inter-field spur line.

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Table 11 Previous studies undertaken to understand the impacts and risks in relation to development of the Browse resource

A full index of previous Browse technical studies is available at <https://www.woodsides.com.au/our-business/burnup-hub/index-of-previous-browse-studies>.

Organisation	Study Name	Link to Report	Aspect / Impact / Risk
Asia Pacific Applied Science Associates (APASA)	Browse FLNG Development - Quantitative Spill Risk Assessment	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f01---apasa-2014---browse-flng-development-quantitative-spill-risk-assessment_.pdf?stfrsn=722b339_2	Hydrocarbon spills
CGSS	Review of Reports on possible Subsidence at Scott Reef: Torosa Field – 2012	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f08---cgss-2012---review-of-possible-subsidence-scott-reef-torosa-field_.pdf?stfrsn=f08e45af_2	Seabed subsidence
	Follow-up Review of Reports on Possible Subsidence at Scott Reef: Torosa Field – 2013	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f09---cgss-2013---follow-up-review-of-reports-on-possible-subsidence-at-scott-reef-torosa-field_.pdf?stfrsn=714284fc_2	Seabed subsidence
GMI Geomechanics Services	A Review of Analytical Compaction and Subsidence Modelling - First Order Analytical Estimates of Scott Reef Subsidence as a result of Reservoir Compaction in the Torosa Field, Browse Basin - 2012	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f04---baker-hughes-2012---a-review-of-analytical-compaction-and-subsidence-modelling_.pdf?stfrsn=9c7bba7c_2	Seabed subsidence
Woodside	First Order Analytical Estimates of Scott Reef Subsidence as a result of Reservoir Compaction in the Torosa Field, Browse Basin – 2014	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f39---woodside-2014---first-order-analytical-estimates-of-scott-reef-subsidence-as-a-result-of-reservoir-compaction-in-the-torosa-field_.pdf?stfrsn=c309fb66_2	Seabed subsidence
DHI Water & Environment	Browse Environmental Modelling – Upstream EIS Wastewater Modelling - 2011	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f11---dhi-2011a---browse-environmental-modelling-upstream-eis-wastewater-modelling_.pdf?stfrsn=6311c988_2	Produced water discharge Cooling water discharge
	Browse Environmental Modelling – Upstream EIS Sediment Transport Modelling of Drill Cuttings - 2010	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f12---dhi-2011b---browse-environmental-modelling-upstream-eis-sediment-transport-modelling-of-drill-cuttings_.pdf?stfrsn=fb399c4_2	Drill cuttings discharge
	Browse FLNG Development - Wastewater Dispersion Modelling - 2014	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f26---guinea-2010---long-term-monitoring-of-the-marine-turtles-of-scott-reef-february-2010_.pdf?stfrsn=2339899b_2	Produced water discharge Cooling water discharge
ERM	Browse Upstream LNG Development: Light Impact Assessment – 2010	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f16---erm-2010---browse-upstream-lng-development-light-impact-assessment_.pdf?stfrsn=c2e5f4d_2	Light emissions
Centre for Marine Science and Technology (CMST) (Curtin University of Technology)	Prediction of Underwater Noise Levels Associated with the Operation of FLNG Facilities in the Browse Basin - 2014	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f30---meekan-amp-radford-2010---migration-patterns-of-whales-sharks-a-summary-of-15-satellite-tag-tracks-from-2005-to-2008_.pdf?stfrsn=f996a7e4_2	Underwater noise Emissions
	Prediction of Received Underwater Sound Levels from Torosa D and Torosa E Subsea Manifolds (Revised)	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f14---duncan-2010---prediction-of-received-underwater-sound-levels-from-torosa-d-and-torosa-e-subsea-manifolds_.pdf?stfrsn=eb4c19e9_2	Underwater noise Emissions
JacobsSKM	Light Modelling Study - 2014	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f28---jacobs-skm-2014---light-modelling-study_.pdf?stfrsn=7a5395f6_2	Light emissions
SKM / ERM	Torosa South-1 (TS-1) Pilot Appraisal Well, Environmental Monitoring Programme – Development of Methodologies (Part 1)	https://files.woodsides.com.au/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f17---erm-amp-skm-2008---torosa-south-1-pilot-appraisal-well---environmental-monitoring-programme-development-of-methodologies-(part-1)_.pdf?stfrsn=58a2a1a_2	Seabed disturbance Drill cuttings Wastewater discharge Underwater noise

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Organisation	Study Name	Link to Report	Aspect / Impact / Risk
AIMS	AIMS Expert Opinion on Recovery Trajectories of Coral Communities at Scott Reef - 2014	https://files.woodsie/docs/default-source/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f02---aims-2014-expert-opinion-on-recovery-of-scott-reef-from-a-hydrocarbon-spill_.pdf?svsn=fb882111_2	Light emissions Hydrocarbon Spill
	AIMS Expert Opinion: Subsidence of Scott Reef - 2012	https://files.woodsie/docs/default-source/our-business---documents-and-files/burnup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f03---aims-2012b---expert-opinion-on-subsidence-of-scott-reef_.pdf?svsn=7a0d2a36_2	Seabed subsidence

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3.8.7 Summary of Workplan

Woodside has reviewed the previous technical studies in terms of relevance to the proposed Browse to NWS Project. Where emissions (in terms of location, magnitude, frequency and toxicity) are expected to be comparable to previous Development concepts, it is considered that sufficient understanding of the impacts and risks exists. Where significant differences exist to previous studies, new studies will be undertaken to inform the EIS/ERD. An overview of the current level of understanding of the potential impacts and risks as well as the workplan for each aspect is provided in **Table 12**.

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Table 12 Impact and Risk Assessment Workplan

ID	Aspect	Key Aim	Assessment of Current Level of Understanding	Workplan
IMP-1	Underwater noise emissions	Understand and assess potential impacts to sensitive receptors (marine fauna) resulting from the generation of underwater noise.	Woodside has a good understanding with respect to the underwater noise generated from the proposed activities via studies undertaken for the previous Browse Development concepts. Understanding of underwater noise from construction activities (e.g. VSP, drilling, seabed preparation, vessel movements) is considered sufficiently understood to inform the impact assessment for the EIS/ERD. Underwater noise associated with the physical presence of dynamically positioned MODU/vessel is also considered well understood, however to support the environmental impact assessment of this activity in the EIS/ERD, an acoustic modelling study for MODU DP activities is planned. Noise Modelling was conducted to support the FLNG EIS/ERD (Duncan 2014) where the acoustic source spectra for the FLNG facility during normal operations were based on a generic FPSO facility. It is considered that the noise assumed to be produced by the FLNG facility in the Duncan (2014) study is sufficiently representative of the Torosa FPSO facility which represents the worst-case scenario with respect to FPSO noise generation for the Proposed Action. As such, it is considered that the Duncan (2014) study is appropriate to describe the impact of noise on sensitive receptors originating on the Torosa FPSO and no further modelling of FPSO generated noise is required. Woodside modelled underwater noise generated by subsea choke valves (Duncan, 2010) within wellheads to support the FLNG EIS/ERD. This modelling was undertaken for the Torosa D (TRD) and Torosa E (TRE) subsea manifolds (i.e. located in channel between North and South Scott Reef) which is considered worst case with respect to underwater noise impacts. It is considered that this modelling is representative for the proposed Browse to NWS Project and no further modelling is considered required. It is also noted that relative to the FLNG EPBC approval (2013/7079), in addition to TRE, the TRD drill centre is now planned to be installed post Ready for Start Up (RFSU). This will allow Woodside to monitor both choke noise emissions from wells outside the channel, plus pygmy blue whale presence/absence in the area prior to the installation of wells at TRD and TRE. As outlined during assessment of 2013/7079 there is potential to further mitigate choke noise for post RFSU wells if warranted. While considered unlikely to be required, driving piling is considered a planned contingent activity that will be used in the event suction piling is not feasible in any area due to geotechnical conditions. Available noise modelling of pile driving activities is not considered sufficient to support the environmental impact assessment of this activity in the EIS/ERD, and as such Browse to NWS Project specific modelling is required.	Literature review of Woodside owned and publicly available information including a review of applicable State and Commonwealth guidance and conservation plans. Implementation of a subsea piling acoustic modelling study to generate predictions of the ensounded area and ranges to acoustic thresholds and estimate acoustic exposure to pygmy blue whales and green turtles. Implementation of acoustic modelling study for MODU DP activities to generate predictions of the ensounded area and ranges to acoustic thresholds and estimate acoustic exposure to pygmy blue whales and green turtles.
IMP-2	Light emissions – MODU and FPSO including flaring	Understand and assess potential impacts to sensitive receptors (marine fauna) resulting from the generation of light emissions.	Woodside has a good understanding with respect to the light emissions generated from the proposed activities via studies undertaken for the previous Browse Development concepts.	Literature review of Woodside owned and publicly available information including a review of applicable State and Commonwealth guidance and conservation plans.
IMP-2b	Light emissions – vessels		Light emissions from construction and operation activities were modelled (ERM 2010 and Jacobs 2014) as part of the two previous Browse Development concepts (JPP and FLNG). It is considered that the source light levels for the proposed FPSO facilities are similar to those previously modelled as part of the previous studies, with the overall artificial light footprint likely to be smaller due to the significantly reduced size of the facilities. Given the similarities between the previous concepts and the proposed Browse to NWS Project (with potential reduction in light emissions) it is considered that these studies adequately define the potential impacts from artificial light emissions associated with the development.	Use of previous modelling to inform impact assessment.
IMP-3a, Risk 10	Physical presence of infrastructure during construction	Understand and assess potential impacts to sensitive receptors (marine fauna, benthic habitat) resulting from the physical presence of infrastructure during construction and operations.	Woodside has a detailed understanding of the extent of temporary and permanent seabed disturbance as well as the number, frequency and location of surface facilities and support vessels. As detailed in Table 6 Woodside has a good understanding of the seabed that is expected to be disturbed and is undertaking an environmental survey, including benthic habitat study of the BTL corridor (refer to Section 3.7.6).	Literature review of Woodside owned and publicly available information to inform impact assessment including the calculation of predicted seabed disturbance.
IMP-3b, Risk 10	Physical presence of infrastructure during operations		This information is considered sufficient to define the impacts associated with the physical presence of the infrastructure.	
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ID	Aspect	Key Aim	Assessment of Current Level of Understanding	Workplan
IMP-4a	Gaseous emissions - air emissions	Predict impact to local air quality as a result of gaseous emissions	Woodside has sufficient understanding of the characteristics of the Browse resource and the combustion requirements to extract, process and export the gas to accurately quantify gaseous emissions. As such no further studies are considered required.	Literature review of Woodside owned and publicly available information to inform impact assessment
IMP-4b	Gaseous emissions - GHG	In relation to GHG assessment refer to Section 3.9.	In relation to GHG assessment refer to Section 3.9.	In relation to GHG assessment refer to Section 3.9.
IMP-5	Treated sewage	Understand and assess impact of the discharged of treated sewage.	Woodside will point to and provide context for the assessment of the potential impacts of the North West Shelf Project Extension Proposal (EPBC 2018/8335) on values specifically related to the National Heritage listing on the Burrup Peninsula.	The assessment documentation must provide details of any potential indirect impacts of the proposed action on the (Indigenous rock art) values of the Dampier Archipelago (including the Burrup Peninsula) National Heritage Place, and the extent to which these values may be impacted by the proposed action following any planned mitigations. .
IMP-6, Risk 2	Treated PW and NORMs.	Understand and assess potential impacts resulting from the discharge of PW and NORMS from the FPSO, including the extent of impact based on the determination of Predicted No Effect Concentrations (PNEC) and the mixing zone.	Sewage generated during the Proposed Action will be treated and disposed of in accordance with MARPOL 73/78 Annex IV, Sewage – (as applied in Australia under Commonwealth Protection of the Sea (Prevention of Pollution from Ships) Act 1983); AMSA Marine Orders - Part 96: Marine Pollution Prevention – Sewage, as applicable to vessel class. As such, no further studies are considered to be required. Woodside has a good understanding of the predicted PW discharge rates and composition. However, confirmation of the dilution rate that will be achieved from the FPSO facilities and the extent of the mixing zone is required. PW discharges were modelled during the assessment of the previous Browse development concepts (DHI 2011, DHI 2014). The modelling undertaken for the FLNG EIS (DHI 2014) predicted that the PW plume would disperse to below toxicity threshold concentrations within less than 3 km from the facility. PW emissions from the FPSO facilities are expected to be broadly similar (other than MEG concentrations are likely to be pulsed at high concentrations as opposed to continuous trace concentrations). There is potential for PW volumes and discharge rates to increase during later field life to levels above predicted in the Browse FLNG EIS. Due to the increase in PW volume and discharge rates late in field life, the existing modelling can only inform the scope of the new modelling and cannot be used to inform the impact assessment. Ecotoxicology studies to determine the safe concentration of Browse PW for 99% of species protection have previously been undertaken and will be used to inform the interpretation of the PW modelling study.	Literature review of Woodside owned and publicly available information to inform impact assessment. Implementation of a PW Dispersion Modelling study to predict the fate and transport of PW discharges from the FPSO in order to determine the number of dilutions achieved from the FPSO facilities, which is required to determine an appropriate mixing zone, outside which no impacts to the receiving environment are predicted. The PW Dispersion Modelling will also be used to inform predictions of the extent, severity and persistence of environmental impacts within the defined mixing zones.
IMP-7a, Risk 3	Treated utility water – drain discharges	Understand and assess impact of the discharge of treated utility water.	Drain discharges generated during the Proposed Action will be treated and disposed of in accordance with MARPOL 73/78 Annex 1, as applied in Australia, under the Commonwealth Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Part II Prevention of pollution from oil); Marine Orders 91 (Marine pollution prevention – Oil) 2006 as applicable to vessel class; and the Pollution of Waters by Oil and Noxious Substances Act 1987 (WA).	Literature review of Woodside owned and publicly available information to inform impact assessment.
IMP-7b	Treated utility water – desalination brine	Understand and assess impact of the discharge of treated desalination brine.	Woodside has a good understanding of the expected desalination brine discharge rates and composition. Given the low likelihood of significant impacts occurring, no further studies are considered required.	Literature review of Woodside owned and publicly available information to inform impact assessment.
IMP-8, Risk-4	Cooling water	Understand and assess potential impacts resulting from the discharge of cooling water from the FPSO including the determination of the mixing zone.	Woodside has a good understanding of the predicted cooling water discharge rates and composition. However, confirmation of the extent of the mixing zone is required. Cooling water discharges were modelled during the assessment of the previous Browse Development concepts (DHI 2011a, DHI 2014). The modelling undertaken for the FLNG EIS (DHI, 2014) predicted that temperatures would return to with 3 degrees of ambient temperature within 190 m of the discharge point in winter and 110 m or less in summer. The modelling also predicted that residual chlorine concentrations in cooling water (0.20ppm) will reduce down-current of the discharge point to threshold concentration (0.002ppm) within 1.4 km or less in winter and within shorter distances in the transitional and summer seasons (1.3 km or less and 1.1 km or less respectively) for 95% of the time. Cooling water emissions from each of the FPSO facilities are expected to be significantly reduced compared to those assessed for Browse FLNG EIS and as such the existing modelling can only inform the scope of the new modelling and cannot be used to inform the impact assessment.	Literature review of Woodside owned and publicly available information to inform impact assessment. Implementation of a Cooling Water Dispersion Modelling study to predict the fate and transport of cooling water discharges from the FPSO in order to determine the mixing zone, outside which no impacts to the receiving environment are predicted. The Cooling Water Dispersion Modelling will also be used to inform predictions of the extent, severity and persistence of environmental impacts within the defined mixing zones
IMP-9	Putrescible organic waste	Understand and assess impact of the discharge of putrescible organic waste and the risks associated with the accidental discharge of hazardous and non-hazardous inorganic	Woodside has a good understanding of the expected organic and non-organic wastes expected to be generated during the proposed Browse to NWS Project. These wastes will be managed in accordance with legislative requirements. No further studies are	Literature review of Woodside owned and publicly available information to inform impact assessment.
IMP-10, Risk-5	Inorganic non-hazardous waste			

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ID	Aspect	Key Aim	Assessment of Current Level of Understanding	Workplan
IMP-10, Risk-6	Hazardous waste - chemicals, radioactive and medical	waste.	considered required.	
IMP-12, Risk-7	Drilling cuttings and fluids	Understand and assess impact of the discharge of drill cuttings on sensitive receptors.	Woodside has a good understanding of the quantity and nature of the drill cuttings that are predicted to be generated and the drill fluids to be used. There is also a good understanding on the predicted fate of the discharges via drilling cuttings discharge modelling undertaken as part of the previous Browse Development concepts (DHI 2011b). This modelling indicated predicted that the seabed discharge of drill cuttings from top hole sections of the wells results in no sedimentation on Scott Reef coral habitats. This modelling was based on drill centres in the channel between North and South Scott reef and is considered to be representative of the worst case scenario. Drilling and completion activities required for the proposed Browse to NWS Project area expected to be broadly similar to that of the previous development concepts. As such the previous modelling is considered representative and sufficient for assessing the potential impacts.	Literature review of Woodside owned and publicly available information to inform impact assessment. Use of previous modelling to inform impact assessment.
IMP-13	Subsea control fluid	Understand and assess impact of the discharge of subsea control fluid.	Woodside has a good understanding of the quantity and nature of the subsea control fluid to be discharged. These discharges are minor, similar to that predicted for previous Browse development concepts and with a negligible impact predicted. As such further studies are not considered necessary.	Literature review of Woodside owned and publicly available information to inform impact assessment.
IMP-14	Hydrotest fluid	Understand and assess potential impacts resulting from the discharge of hydrotest fluid including the determination of the mixing zone.	Hydrotest fluid discharge modelling was not undertaken as part of the previous Browse development concepts due to the relatively small amount of hydrotest fluid that was planned to be released. Significantly larger quantities may be discharged as part of the proposed Browse to NWS Project however, due to the potential requirement to hydrotest the BTL. As such, modelling is considered required to predict the fate and transport of hydrotest discharges to inform the impact assessment.	Literature review of Woodside owned and publicly available information to inform impact assessment. Implementation of a Hydrotest Dispersion Modelling Study to predict the fate and transport of hydrotest discharges from the BTL in order to determine the number of dilutions achieved, which is required to determine an appropriate mixing zone, outside which no impacts to the receiving environment are predicted. The Hydrotest Dispersion Modelling will also be used to inform predictions of the extent, severity and persistence of environmental impacts within the defined mixing zones.
IMP-15	Atmospheric Noise	Understand and assess potential impacts resulting from Atmospheric Noise Emissions resulting from helicopter movements	Woodside has a good understanding of the noise emissions from helicopter movements and no further studies are considered necessary.	Literature review of Woodside owned and publicly available information to inform impact assessment.
Risk-1	IMS	Understand and assess the potential risks associated with the introduction of IMS.	The risk of the introduction of IMS as a result of the project will be managed in accordance with legislative requirements. No further studies are considered necessary.	Literature review of Woodside owned and publicly available information to inform impact assessment.
Risk-8	Seabed subsidence	Understand and assess the potential risks associated with seabed subsidence as a result of the extract of the Browse resource.	Woodside has modelled the magnitude of subsidence and associated horizontal movements for the Browse reservoirs as part of the previous Browse Development concepts. This analysis has been peer reviewed by Baker Hughes GMI Geomechanics Services (Baker Hughes 2012) who concluded that the method and supplied data was appropriate. The DoEE sought further independent review by CO2 Geological Storage Solutions Pty Ltd (CGSS) (CGSS 2012) who found that the report conclusions were reasonable. As such Woodside has sufficient understanding of the risks associated with seabed subsidence and no further studies are considered necessary.	Literature review of Woodside owned and publicly available information to inform impact assessment.
Risk-9	Hydrocarbon spill	Understand and assess the potential risks associated with a hydrocarbon spill.	Woodside has modelled multiple hydrocarbon spill scenarios as part of the previous Browse development concepts. However, given ongoing improvements in modelling and understanding of conditions, and the addition of the BTL, a hydrocarbon Spill Modelling study will be undertaken.	Literature review of Woodside owned and publicly available information to inform impact assessment. Implementation of a Hydrocarbon Spill Modelling study to describe the dispersion and degradation characteristics of a range of hydrocarbon spill scenarios.

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3.8.8 Scope of Technical Studies informing Impact and Risk Assessment

The following technical studies will be undertaken to inform the impact and risk assessment. Where applicable the assessment will be done in consideration of the Revised Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (ANZG (2018)) which provide the recommended limits to acceptable change in water quality that will continue to protect the associated environmental values.

Subsea Piling and MODU DP Acoustic Modelling

Acoustic modelling of the subsea impact pile driving operations for the mooring of the Torosa FPSO facility and of the MODU DP will be undertaken. The objective of this study is two-fold:

- to generate predictions of the ensonified area and ranges to acoustic thresholds that may result in injury to or behavioural disruption of cetaceans, turtles and fish near the construction area; and
- estimate acoustic exposure to pygmy blue whales and green turtles.

For the subsea impact pile driving operations, modelling will be undertaken for the following scenarios for a single pile type:

1. One 'light' subsea hammer
2. One 'high energy' subsea hammer

Both scenarios will be modelled at the same location using conservative assumptions from the provided information. Footprints for impact pile driving will be computed at three penetrations, and a combined footprint for the entire driving of a single pile will be computed. The modelling will assume a single pile will be driven per day.

Exposures for pygmy blue whales and inter-nesting green turtles will be assessed using a simulated animal (animat) approach. This approach will use acoustic modelling to compute three-dimensional (3-D) sound fields that vary with time, and simulated realistic movements of animats within these fields to sample the sound levels in a manner representing how real animals would experience this sound. Using the time history of the received sound levels, the number of animats exposed to levels exceeding threshold criteria will be determined and then adjusted by the number of animals in the area to estimate the potential number of animals impacted.

Produced Water Dispersion Modelling

PW dispersion modelling will be undertaken to predict the fate and transport of PW discharges from the FPSO in order to determine the number of dilutions achieved from the Browse FPSO facilities, which is required to determine an appropriate mixing zone, outside which no impacts to the receiving environment are predicted. It will also be used to inform predictions of the extent, severity and persistence of environmental impacts within the defined mixing zones.

The proposed modelling will describe the dispersion geometry (i.e. width and thickness with distance) and dilution characteristics of the discharge plume, it has been determined that hydrocarbons are the most toxic constituent of the PW discharge, with other potential contaminants such as metals present in less toxic concentrations. In addition additional production chemicals will not be continuously injected. Hence, the toxicity values used to characterise impacts to marine organisms has been derived from ecotoxicological studies conducted on Torosa condensate samples.

The modelling will take into consideration all relevant metocean parameters of the receiving environment including seasonal fluctuations as well as parameters from possible discharge scenarios (e.g. discharge location, water depth, discharge pipe diameter and orientation, and discharge volume, density, temperature and salinity). In addition, validation of the hydrodynamic model against measured data will be undertaken.

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This information will be used as part of the environmental impact and risk assessment process of the EIS/ERD to determine the impacts (if any) to the receiving environment from the PW discharge and to determine the extent of the mixing zone around the Torosa FPSO discharge location (as the worst-case scenario due to the location in proximity to Scott Reef). The modelling will then also be applied to the Brecknock/Calliance FPSO facility to enable assessment of impacts from both facilities.

Cooling water dispersion modelling

Cooling water dispersion modelling will be undertaken to predict the fate and transport of cooling water discharges from the FPSO in order to determine the number of dilutions achieved from the Browse FPSO facilities, which is required to determine an appropriate mixing zone, outside which no impacts to the receiving environment are predicted. It will also be used to inform predictions of the extent, severity and persistence of environmental impacts within the defined mixing zones.

The proposed modelling will describe the dispersion geometry (i.e. width and thickness with distance) and dilution characteristics of discharge plume. This information will be used as part of the environmental risk assessment process of the EIS/ERD to determine the impacts (if any) to the receiving environment from the cooling water discharge and to determine the extent of the mixing zone around the Torosa FPSO discharge location outside which no detectable change from natural variation is predicted. The modelling will then also be applied to the Brecknock/Calliance FPSO facility to enable assessment of impacts from both facilities.

Modelling will take into consideration all relevant metocean parameters of the receiving environment including seasonal fluctuations as well as parameters from possible discharge scenarios (e.g. discharge location, water depth, discharge pipe diameter and orientation, and discharge volume, density, temperature and salinity).

Hydrotest Dispersion Modelling (BTL and Inter Field Spur Line)

Hydrotest modelling will be undertaken to predict the fate and transport of hydrotest discharges, in order to determine the number of dilutions achieved within the receiving environment. Modelling will be undertaken at all potential locations for planned discharge of hydrotest fluid from the BTL and Inter-Field Spur Line. Discharge of the hydrotest fluid from the flowlines will be discharged at the similar locations as the Inter-Field Spur line and will involve discharge of volumes many orders of magnitude less than the spur line. As such, the potential impacts associated with the flowline hydrotest have been adequately assessed within the larger hydrotest volume.

For the purpose of modelling the BTL and Inter-Field Spur Line and the associated risk assessment, it has been assumed that the hydrotest fluid will consist of a combination of filtered inhibited seawater and biocide. The 99% species protection for biocide chemical (nominally product name Hydrosure) will be used as the threshold.

The proposed modelling will describe the dispersion geometry (i.e. width and thickness with distance) and dilution characteristics of discharge plume. This information will be used as part of the environmental risk assessment process of the EIS/ERD to determine the impacts (if any) to the receiving environment from the hydrotest discharges based on the known toxicities of the chemical additives within the hydrotest waters.

Hydrocarbon Spill Modelling

Hydrocarbon spill modelling will be undertaken to describe the dispersion and degradation characteristics of a range of hydrocarbon spill scenarios. This information will be used as part of the environmental risk assessment process of the EIS/ERD to determine the impacts (if any) to the receiving environment from hydrocarbon spills.

The credible hydrocarbon spill scenarios to be modelled are as follows:

- Hydrocarbon release caused by loss of well containment

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- Hydrocarbon release due to cargo tank or condensate tanker loss of containment
- Hydrocarbon release during offtake operations
- Hydrocarbon release from fuel tanker in proximity to Rowley Shoals.

It is not proposed to model the release of dry gas from the BTL as the high temperature and low-pressure conditions would result in the released dry gas combining with water to form hydrates which would rise to the surface, decompose into methane and water. Dissolved methane would biodegrade whereas the gaseous methane will continue to rise to the sea surface and be transported away by surface winds. Water produced by the dissociation of hydrates would disperse within the water column. Due to this, the release of liquid hydrocarbons (as per the above four scenarios to be modelled) are considered the worst case credible scenarios. A detailed technical explanation and appropriately-supported evaluation of the fate and effect(s) on the environment of a release of dry gas will be included in the EIS/ERD.

It is also not proposed to model heavy fuel oil (HFO) and Marine Diesel Oil (MDO) spills from vessels. Based on the International Maritime Organisation's decision to implement a 0.50% sulphur cap on marine fuel from 2020, the assumption is being made that there will be no HFO, which have sulphur levels much higher than this cap, in use or stored onboard any of the project vessels. While MDO may be considered worse from a contaminant perspective than condensate, due to the significantly higher volumes of condensate involved in a condensate tanker loss of containment at a nearby location, this scenario is considered to be a worse case credible scenario in the vicinity of Scott Reef.

Modelling will take into consideration all relevant metocean parameters of the receiving environment including seasonal fluctuations as well as parameters from possible discharge scenarios (e.g. discharge location, water depth, discharge pipe diameter and orientation, and discharge volume, density, temperature and salinity).

Modelling will be undertaken with regard to NOPSEMA's Guidance Note on Oil pollution risk management (Rev 2, Feb 2018).

3.9 Greenhouse Gases

As requested by the Commonwealth DoEE, this chapter will summarise:

1. receptors in the environment in the Australian jurisdiction that are sensitive to an increase in greenhouse gas (GHG) content in the atmosphere - the focus should be on the most sensitive receptors, and receptors that may be sensitive to elevated GHG levels in the local airshed
2. trends in the condition of the receptors identified at point 1
3. the (direct and indirect, or Scope I–III) GHG emissions from the Proposed Action (sources and volumes, see also point 1 in [Appendix A](#))
4. how the (total of direct plus indirect) GHG emissions from the Proposed Action could impact the receptors identified at point 1
5. mitigation and any offset measures proposed to reduce: GHG emissions from the Proposed Action; and their impacts (see also point 2 in [Appendix A](#)) - this section will include a discussion of the steps taken at the: company, Burrup Hub vision and this individual project level, to reduce GHG emissions
6. how the Scope I GHG emissions from the Proposed Action will be estimated (see point 3 in [Appendix A](#))
7. how the Scope II and III GHG emissions from the Proposed Action will be estimated
8. the extent to which the direct and indirect GHG emissions from the Proposed Action will affect the trends in the condition of the receptors identified at point 1

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9. relevant Australian and international legislation and policy in relation to the management of climate change.

Note: Without limiting what is required, the EIS/ERD must (a) identify those components of the environment in the Australian jurisdiction that are most likely to be impacted by climate change/most vulnerable to the impacts of climate and assess in detail the likely flow-on consequences of such an increase in atmospheric, air and water temperatures to those components of the environment; and (b) for all other components of the environment in the Australian jurisdiction, assess the likely impacts of climate change at a higher level (for instance, a more general discussion and/or impacts on types of ecosystems, heritage places, terrestrial habitat, marine habitat, migratory species).

3.10 Environmental Mitigation, Management and Monitoring

3.10.1 Environmental Management Framework

An environmental management framework will be described within the EIS/ERD. This will include:

- Overview of Woodside's HSE Management System Standard
- Health, Safety, Environment and Quality (HSEQ) Policy
- Standards
- Environmental Objective
- Processes for implementing, checking and acting on relevant environmental management measures as the Project is developed.

3.10.2 Management and Mitigation

As part of the EIS/ERD process, management and mitigation measures will be identified to reduce the level of impact and risk to an acceptable level in consideration of the EPBC Act, EP Act and other relevant policy instruments. This includes any practices that will reduce the impacts and risks in order to meet the identified performance criteria, any relevant legal requirements (related specifically to the impact/risk), internal company requirements, and any requirements that are identified through the stakeholder consultation process. It should be noted that further review and potential adoption of additional controls will be undertaken in subsequent phases of the project, such as during the preparation of Environment Plans (EPs) for activities under the scope of the EIS/ERD. While the overarching environmental objectives will be carried through to the EPs, controls and corresponding performance criteria will be implemented to reduce risks to as low as reasonably practicable (ALARP).

In accordance with Woodside's risk management standards and for the purpose of the draft EIS/ERD, where a risk is assessed to be low, this risk will be deemed acceptable, and no further management is required. Where the risk level is higher than low, additional management and mitigation measures are required to be considered and implemented, if the cost is not grossly disproportionate to the environmental benefit gained, to prevent or mitigate the risk to an acceptable level.

The following framework tools will be applied, as appropriate, to assist with identifying appropriate management and mitigation measures:

- Good Industry Practice – identifies further engineering control standards and guidelines which may be applied by Woodside in addition to those required to meet the legislation, codes and standards.
- Professional Judgement – uses relevant personnel with the knowledge and experience to identify alternative controls.

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Using these tools, the following adaptive management framework will be used to identify appropriate management and mitigation measures for the proposed Browse to NWS Project:

- Eliminate the risk by removing the hazard.
- Substitute a hazard with a lesser one.
- Prevent a credible impact from occurring through the implementation of additional engineering control measures.
- Reduce the magnitude of a credible impact through the implementation of additional engineering control measures (e.g. solids control equipment onboard drilling rig to manage cuttings discharge).
- Mitigate the credible impact on the environment through the reduction in extent, scale, duration of impact (e.g. bunding, oil spill booms, relief well).
- Emergency response and contingency planning to facilitate recovery from the credible impact of an event.

Environmental objectives, proposed mitigation and management measures and performance criteria will be presented in the EIS/ERD.

3.10.3 Environmental Monitoring

Woodside will continue a long-term environmental monitoring program at Scott Reef, including water quality and coral health monitoring, that will be implemented prior to development at Torosa; with the results of this program used to demonstrate no long-term negative effects to Scott Reef resulting from the proposed Browse to NWS Project. The EIS/ERD will describe the objectives and scope of this long-term monitoring.

Where identified as required, additional planned monitoring will be described including the objective and scope of specific monitoring plans. These plans would subsequently be developed prior the commencement of the relevant activity and would take into consideration relevant guidance such as the Revised Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (ANZG(2018)).

3.10.4 Environmental Offsets

In the event that impacts cannot be avoided or mitigated, the EIS/ERD will provide detail of the approach to be applied to offsetting impacts. It should be noted that offsets for GHG emissions are addressed separately in Section 3.9. This approach will include a commitment to develop an offsets plan that would provide details of offsets proposed to compensate for residual impacts on EPBC listed species, including the following:

- The type of offsets proposed
- The extent to which the proposed offset actions correlate to, and adequately compensate for, the impacts to EPBC listed species
- For proposed land-based offsets, the suitability of the location of proposed offset sites, including the current land tenure and method of securing and managing the offset for the life of the impact
- For non-land-based offsets, details of the proposed offset and how it will compensate for the proposal's residual significant impacts
- The conservation gains to be achieved by the offset (for example, positive management strategies that improve the site, or how the future loss, degradation or damage of the protected matter will be averted or mitigated)

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- The time it will take to achieve the proposed conservation gains
- The level of certainty that the proposed offset will be successful.

The EIS/ERD will explain how the proposed approach to applying offsets (if any) meet the principles of the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (2012).

3.11 Overall Conclusion

An overall conclusion as to the environmental acceptability of the Proposed Action and State waters proposal will be provided, including discussion on compliance with the principles of Ecological Sustainable Development and the objects and requirements of the EPBC Act and EP Act. This will include a qualitative assessment of the cumulative impacts on each key receptor and assess impacts on a more holistic, whole-ecosystem level, considering the potential cumulative impacts of the proposed project, and any existing and future concurrent activities, on the existing environment.

Reasons justifying undertaking the Proposed Action and State waters proposal in a manner proposed will be outlined.

The conclusion will highlight measures proposed or required by way of mitigating or managing any unavoidable impacts on the environment.

Measures proposed by way of offset and the change in residual impacts following the offset will be restated here.

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3.12 Other Chapters

3.12.1 Environmental record of person(s) undertaking the Proposed Action

This chapter will outline the environmental record of the proponent including:

- details of any proceedings under Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against:
 - the person proposing to take the action; and
 - for an action for which a person has applied for a permit, the person making the application.
- details of the Woodside's HSEQ policy and planning framework.

3.12.2 Information Sources

For information given in a draft EIS/ERD, the draft must state:

- the source of the information
- how recent the information is
- how the reliability of the information was tested
- what uncertainties (if any) are in the information.

3.12.3 References

All reference cited within the draft EIS/ERD will be listed. This will be accurate and concise and include the addresses of an internet pages used as source data.

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4. PART C: STATE ESD

Proposal Name:	Proposed Browse to NWS Project
Proponent:	Woodside Energy Ltd., as Operator for and on behalf of the BJV
Assessment Number:	2191
Location:	- Approximately 425 km north of Broome, WA. - The Browse Joint Venture (BJV) holds seven petroleum retention leases. Five of the leases (WA-28-R, WA-29-R, WA-30-R, WA-31-R and WA-32-R) are located in Commonwealth waters and are governed under the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) (OPGGSA). The remaining two leases (TR/5 and R2) are governed under State legislation Petroleum (Submerged Lands) Act 1982 (WA) (PSLA) and the Petroleum and Geothermal Energy Resources Act 1967 (WA) (PGERA).
Local Government Area:	Lease R2 is linked to the Shire of Broome via the Local Govt Act 1995 (WA)
Public Review Period:	Environmental Review Document – 6 weeks
EPBC Reference Number:	2018/8319

4.1 Introduction

The Environmental Protection Authority (EPA) has determined that the Browse to NWS proposal is to be assessed under Part IV of the Western Australian (WA) Environmental Protection Act 1986 (EP Act). This EISG/ESD defines the form, content, timing, and procedure of the environmental review, as required by Section 40(3) of the EP Act. Woodside Energy Ltd. (Woodside) has prepared this EISG/ESD according to the EPA's Environmental Impact Assessment (Part IV Division 1 and 2) Procedures Manual (EPA 2018a).

4.1.1 Form

The EPA requires that the Environmental Review Document (ERD) required under Section 40 conforms with the EPA instructions on how to prepare an ERD (EPA 2018).

4.1.2 Content

The EPA requires that the ERD includes the content outlined in Sections 4.1 to 4.6 of this EISG/ESD.

4.1.3 Timing

Section 1.1.3.2 sets out the timeline for assessing the Browse to NWS proposal, as agreed between DoEE, EPA and Woodside which will be documented in a DoEE issued Client Service Charter.

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4.1.4 Procedure

The EPA requires Woodside to undertake the environmental review according to the procedures in the Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures (EPA 2016a) and the Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual (EPA 2018a).

4.1.5 Assessment

As described in Section 1.1.3.2, the assessment of the Proposed Action under the EPBC Act and State waters proposal under the EP Act is planned to be undertaken as a coordinated assessment between the DoEE and WA EPA. The National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) will be engaged to provide technical advice to the DoEE in relation to the assessment.

This approach includes the following:

- Simultaneous referrals under the EPBC Act and EP Act, which was completed in October 2018.
- The development of a single EISG/ESD (this document), which describes the proposed content of an Environment Impact Statement/Environmental Review Document (EIS/ERD). This ESD will be issued to DoEE and EPA for review and endorsement.
- The development of a single draft EIS/ERD document that is issued to DoEE and EPA for comment on adequacy and approval, prior to release for public comment.
- The preparation of a single final EIS/ERD document. The final EIS/ERD will be submitted to the DoEE and WA EPA for assessment and to be published.
- Decision on the acceptability of the Proposed Action and the State waters proposal.

Subsequent to a favourable decision on the acceptability of the proposed Browse to NWS Project, and prior to any development activity occurring in State waters, Environment Plans (EPs) including Oil Spill Contingency Plans (OSCP) will be developed for approval by the Department of Mines, Industry Regulation and Safety (DMIRS) in accordance with the Petroleum (Submerged Lands) (Environment) Regulations 2012.

4.2 The proposal

Refer to Section 2.2 for a description of the Proposed Action, while for the proposal relevant to State waters see Section 4.2.1.

4.2.1 Development in Western Australian State waters

The key characteristics of the proposal within State waters are described in **Table 13** and **Table 14** and shown in **Figure 1**.

Activities in State waters comprise a limited set of infrastructure and activities (**Table 13** and **Table 14**). The highest intensity of activities will likely occur during the drilling and completion activities, installation activities and future decommissioning phases; during which time, a MODU and vessel numbers of approximately ten or less may be present in the State waters. All the proposed infrastructure within State waters is subsea, with the operation of the wells to be controlled remotely from the FPSO facilities in Commonwealth waters. Outside of drilling, completion and installation periods, surface activities in State waters will comprise inspection, maintenance and repair (IMR) activities involving one or two vessels, later phase drilling and decommissioning (including well plugging and abandonment).

Proposal characteristics may change as a result of the findings of studies and investigations conducted and the application of the mitigation hierarchy by Woodside.

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Table 13 Summary of the Proposal

Proposal Summary	
Proposal Title	Proposed Browse to NWS Project (State waters components)
Proponent Name	Woodside Energy Ltd, on behalf of the BJV participants
Short Description	Drilling and completion, installation, commissioning, operation, well repair and workover and decommissioning of subsea wells and associated subsea infrastructure located in Western Australian State waters, to extract hydrocarbons from the Torosa reservoir, located approximately 425 km north of Broome and approximately 290 km off the Kimberley coast.

Table 14 Location and proposed extent of physical and operational elements

Element	Description	Proposed Authorised Extent
Physical Elements		
Drilling and completion activities of up to approximately 21 wells.	Installation and physical presence of infrastructure within indicative field layout as per Figure 1	Approximately 20 ha of seabed.
Associated subsea infrastructure (wellheads, manifolds, flowlines, and umbilicals).		
Mooring of vessels and MODU.		
Seabed preparation and flowline stabilisation.		
Operational Elements		
Water supply (installation vessels, MODU, support vessels and supply vessels).	Water requirements sourced either from seawater (reverse osmosis plant) or loaded at port.	Limited water requirements to support drilling and completion activities, vessel and MODU water needs and potentially also for hydrotesting and decommissioning activities.
Power supply (installation vessels, MODU, support vessels and supply vessels).	Power generated on board vessels and MODU.	As required for operations and safety.
Vessel discharges (installation vessels, MODU, support vessels and supply vessels).	Discharges from vessels and MODU include treated sewage, drain waters, cooling water, sillage, putrescible organic waste and desalination brine.	Limited volumes discharged in accordance with International Convention for the Prevention of Pollution from Ships MARPOL 73/78 Annex I, as applied in Australia under the Commonwealth <i>Protection of the Sea (Prevention of Pollution from Ships) Act 1983</i> (Part II Prevention of pollution from oil); Marine Orders 91 (Marine pollution prevention – Oil) 2006 as applicable to vessel class; <i>Pollution of Waters by Oil and Noxious Substance Act 1986</i> .
Drill cuttings and fluid discharges.	Disposal of drill cuttings and drilling fluids.	Approximately 800 - 900m ³ of cuttings are anticipated to be

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Element	Description	Proposed Authorised Extent
		generated per well.
Produced water.	Small volumes of formation water may result during well clean-up activities by the MODU. These will be discharged directly from the MODU.	Low volumes of water that occurs naturally within the hydrocarbon-bearing geological formations.
Subsea control fluid discharge.	Discharge of control fluid at the wellheads to maintain valve functionality.	Intermittent discharge of hydraulic fluid based control fluids when valves actuated (~0.1 L).
Underwater noise emissions.	Underwater noise generated during drilling, completion and installation activities (including vessel movements on DP and vertical seismic profiling). Underwater noise generated from subsea infrastructure during operations. Underwater noise from piling activities for mooring installation for the MODU (note that this is unlikely to be required). Underwater noise from support vessel and supply vessel operations.	Noise frequencies associated with these activities are described in the Proposed Browse to NWS Development, <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cwlth) (EPBC Act) and EP Act Environmental Referrals Supporting Document (Woodside, 2018).
Light emissions – operational lighting	Artificial light emitted by MODUs, installation vessels, and support vessels and supply vessels.	Limited to functional lighting at levels that provide a safe working environment for personnel.
Light emissions – flaring	Intermittent flaring from the FPSO facilities (located in Commonwealth waters) and MODU.	As required for operations and safety.

4.3 Preliminary key environmental factors and required work

The preliminary key environmental factors for the environmental review are:

- Benthic Communities and Habitat
- Marine Environmental Quality
- Marine Fauna
- Air Quality.

Table 15 to **Table 18** outline the objective, activities, potential impacts and risk and work required for each preliminary key environmental factor identified.

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Table 15: Preliminary Key Environmental Factor and Required Work – Benthic Communities and Habitats

Benthic Habitats and Communities	
EPA Objective	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained (EPA 2016c).
Relevant Activities	• Development drilling and completions • Installation of subsea umbilicals, risers and flowlines • Operation of wells and subsea infrastructure • Decommissioning.
Potential Impacts and Risks	Refer to Table 7 and Table 8 for the preliminary impact and risk assessments for the proposed Browse to NWS Project. In relation to the proposal within State waters, the following impacts and potential risks are considered relevant to the Environmental Factor - Benthic Habitats and Communities: • IMP-3a Physical presence of infrastructure during construction: Seabed disturbance from seabed preparation and MODU anchors. No impact to Scott Reef is expected. • IMP-3b Physical presence of infrastructure during operations: Permanent seabed disturbance from subsea infrastructure • IMP-12 Drilling cuttings and fluids: Localised impact to deep water benthic habitats as a result of the discharge of drill cuttings. • Risk-9 Hydrocarbon spill: Long term contamination to multiple high value benthic habitats at levels above standards and on a regional scale. Considered highly unlikely to occur.
Required Work	Refer to Table 12 for the full impact and risk assessment workplan. Refer to Section 3.8.8 for the scope of the proposed technical studies. In reference to the Environmental Factor – Benthic Habitats and Communities: • Determination of predicted temporary and permanent seabed disturbance within State waters. • Characterise the benthic habitats in the area potentially impacted using existing survey data and literature, including the preparation of habitat maps with demonstrated ground truthing for areas where proposed infrastructure will be installed on the seabed within State waters. Woodside has a good understanding of the benthic habitats expected to be disturbed within State waters and as such no further studies to characterise these benthic habitats is considered required. • Where significant benthic communities are identified in areas where infrastructure will be installed on the seabed, identify an appropriate Local Assessment Unit and assess cumulative loss of benthic communities and habitats in accordance with EPA's technical guidance (EPA 2016). • Predict the likely fate of discharged drill cuttings using existing data and modelling and assess impact on benthic habitats. Woodside has a good
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Benthic Habitats and Communities	
	understanding of the quantity and nature of the drill cuttings that are predicted to be generated and the drill fluids to be used. There is also a good understanding on the predicted fate of the discharges via drilling cuttings discharge modelling undertaken as part of the previously proposed Browse Development concepts. Drilling and completion activities required for the Proposal are expected to be broadly similar to that of the previously proposed development concepts. As such the previous modelling is considered representative of the Proposal and sufficient for assessing the potential impacts. Undertaken hydrocarbon spill modelling to describe the dispersion and degradation characteristics of a range of hydrocarbon spill scenarios to inform the risk assessment and the development of mitigation measures.
Relevant Policy and Guidance	EPA Policy and Guidance - Statement of Environmental Principles, Factors and Objectives (EPA 2016b) - Environmental Factor Guideline - Benthic Communities and Habitats (EPA 2016c) - Technical Guidance - Protection of Benthic Communities and Habitats (EPA, 2016d)

Table 16: Preliminary Key Environmental Factor and Required Work – Marine Environmental Quality

Marine Environmental Quality	
EPA Objective	To maintain the quality of water, sediment, and biota so that environmental values are protected (EPA, 2016f).
Relevant Activities	- Development drilling and completions - Installation of subsea umbilicals, risers and flowlines - Operation of wells and subsea infrastructure - Decommissioning - Support activities
Potential Impacts and Risks	Refer to Table 7 and Table 8 for the preliminary impact and risk assessments for the proposed Browse to NWS Project. In relation to the Proposal within State waters, the following impacts and potential risks are considered relevant to the Environmental Factor – Marine Environmental Quality: - IMP-5, IMP7a&b: Vessel discharges including treated sewage, drain discharges, cooling water and desalination brine: Discharges within regulatory limits from support vessels and the MODU leading to short term, localised reduction in water quality. - IMP-12 Drilling cuttings and fluids: Localised reduction in water quality and sediment quality as a result of the discharge of drill cuttings.

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Marine Environmental Quality	
	- IMP-13 Subsea control fluid: Localised reduction in water quality and sediment quality as a result of the discharge of subsea control fluids. - Risk-9 Hydrocarbon spill: Long term contamination to marine water and sediments at levels above standards and on a regional scale. Considered highly unlikely to occur.
Required Work	Refer to Table 12 for the full impact and risk assessment workplan. Refer to Section 3.8.8 for the scope of the proposed technical studies. In reference to the Environmental Factor – Marine Environmental Quality - Characterise the marine environmental quality in the area potentially impacted using existing survey data and literature. Woodside has a good understanding of the marine environment in the State waters within the Browse Development Area via numerous available studies and as such no further studies to characterise this marine environment is considered required. - Characterise discharge type that has the potential to impact on State coastal waters (e.g. vessel and MODU discharges, drill cuttings and fluids, produced water, cooling water, hydrotest fluid, subsea control fluids) in terms of volume, frequency, composition and ecotoxicity. - Present previously undertaken modelling or revised modelling where required as described in the workplan (Section 3.8.8) and describe the dilution and fate of the discharges to determine the spatial extent of potential impacts and appropriate mixing zones. - Based on characterisation of the existing marine environment and expected discharges and modelling, develop and present spatially proposed Environmental Quality Criteria (Environmental Quality Objectives and levels of ecological protection) for State waters within the Browse Development Area. - Outline a commitment to develop and implement a Marine Environmental Quality Plan (EQP) for the State coastal waters which identifies the Environmental Values to be protected and spatially defines the Environmental Quality Objectives and levels of ecological protection that Woodside aims to achieve in State waters. - Undertaken hydrocarbon spill modelling to describe the dispersion and degradation characteristics of a range of hydrocarbon spill scenarios to inform the risk assessment and the development of mitigation measures.
Relevant Policy and Guidance	EPA Policy and Guidance - Statement of Environmental Principles, Factors and Objectives (EPA 2016c) - Environmental Factor Guideline – Marine Environmental Quality (EPA 2016e) - Technical Guidance – Protecting the Quality of Western Australia's Marine Environment (EPA 2016f)

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Marine Environmental Quality	
	Other Policy and Guidance Revised Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (ANZG (2018))

Table 17: Preliminary Key Environmental Factor and Required Work – Marine Fauna

Marine Fauna	
EPA Objective	To protect marine fauna so that biological diversity and ecological integrity are maintained (EPA, 2016f)
Relevant Activities	- Development drilling and completions - Installation of subsea umbilicals, risers and flowlines - Operation of wells and subsea infrastructure - Decommissioning - Support activities and helicopters
Potential Impacts and Risks	Refer to Table 7 and Table 8 for the preliminary impact and risk assessments for the proposed Browse to NWS Project. In relation to the proposal within State waters, the following impacts and potential risks are considered relevant to the Environmental Factor – Marine Fauna: - IMP-1 Underwater noise emissions: Impacts to sensitive marine fauna from noise emissions during drilling and completion of the wells, wellhead operations, piling and routine vessel and aviation operations - IMP-2 Light emissions: Impacts (attraction/repulsion, disorientation) on sensitive marine fauna as a result of light emissions from the MODU and support vessels - IMP-3a Physical presence of infrastructure during construction: Impacts to marine fauna as a result of unintentional interaction with support vessels. - IMP-3b Physical presence of infrastructure during operations: Impacts to marine fauna as a result of unintentional interaction with support vessels - IMP-12 Drilling cuttings and fluids: Localised reduction in water quality and sediment quality as a result of the discharge of drill cuttings and fluids with subsequent impacts to marine fauna. - IMP-15 Atmospheric Noise: Atmospheric noise generated by helicopter movements between the mainland and project area. - Risk-9 Hydrocarbon spill: Large scale mortality and injury to marine fauna on a regional scale. Considered highly unlikely to occur.
Required Work	Refer to Table 12 for the full impact and risk assessment workplan. Refer to Section 3.8.8 for the scope of the proposed technical studies. In reference to the Environmental Factor – Marine Fauna: Characterise the marine fauna in the area potentially impacted using

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Marine Fauna	
	existing survey data and literature. Woodside generally has a good understanding of marine mammals that may occur in the Browse Development Area via a large number of surveys undertaken in relation to the previously proposed Browse Development concepts which have included habitat association surveys, long term sea noise logger deployment, aerial and vessel surveys and satellite tagging. • Characterise the predicted underwater noise emissions and potential impacts using existing and new modelling studies. • Characterise the predicted light emissions and potential impacts using existing modelling studies. Light modelling undertaken to support the FLNG EIS is considered representative of the Proposal facilities and as such no further modelling is considered necessary. • Predict the likely fate of discharged drill cuttings using existing data and modelling and assess impact on marine fauna. • Undertake a literature review on the impacts of electromagnetic emissions on marine fauna and utilise estimated direct electrical heating power demand to assess impacts. • Undertaken hydrocarbon spill modelling to describe the dispersion and degradation characteristics of a range of hydrocarbon spill scenarios to inform the risk assessment and the development of mitigation measures. This includes the modelling of a condensate spill which will be used to assess the risk to Scott Reef that such a spill would present (refer to Section 3.8.8).
Relevant Policy and Guidance	EPA Policy and Guidance
	• Statement of Environmental Principles, Factors and Objectives (EPA 2016b) • Environmental Factor Guideline – Marine Environmental Quality (EPA 2016e) • Technical Guidance – Protecting the Quality of Western Australia's Marine Environment (EPA 2016f). Other Policy and Guidance • EPBC Act Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales (DEWHA 2008) • Conservation Management Plan for the Blue Whale - A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 (DoE 2015) • Conservation advice <i>Anous tenuirostris melanops</i> Australian lesser noddy (Threatened Species Scientific Committee 2015a) • Approved Conservation Advice for <i>Megaptera novaeangliae</i> (humpback whale) (Threatened Species Scientific Committee 2015b) • Recovery plan for marine turtles in Australia (Commonwealth of Australia

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Marine Fauna	
	2017) - Conservation advice Rhincodon typus whale shark (Threatened Species Scientific Committee, 2015c) - Whale shark (<i>Rhincodon typus</i>) recovery plan 2005- 2010 (DEH, 2005)

Table 18: Preliminary Key Environmental Factor and Required Work – Air Quality

Air Quality	
EPA Objective	To maintain air quality and minimise emissions so that environmental values are protected (EPA 2016i).
Relevant Activities	- Development drilling and completions - Installation of subsea umbilicals, risers and flowlines - Decommissioning - Support activities and helicopters.
Potential Impacts and Risks	Refer to Table 7 and Table 8 for the preliminary impact and risk assessments for the proposed Browse to NWS Project. In relation to the proposal within State waters, the following impacts and potential risks are considered relevant to the Environmental Factor – Air Quality including GHG emissions in State waters: IMP-4a Gaseous emissions - Air Emissions: Impacts to local air quality
Required Work	Refer to Table 12 for the full impact and risk assessment workplan. Refer to Section 3.8.8 for the scope of the proposed technical studies. In reference to the Environmental Factor – Air Quality: Woodside has sufficient understanding of the characteristic of the Browse resource and the combustion requirements to extract, process and export the gas to accurately quantify gaseous. As such no further studies are considered required.
Relevant Policy and Guidance	EPA Policy and Guidance - Statement of Environmental Principles, Factors and Objectives (EPA 2016c) - Environmental Factor Guideline: Air Quality (EPA 2016b) Other Policy and Guidance - Air Quality Modelling Guidance Notes 2006 (DoE 2006)

4.4 Other environmental factors or matters

No other environmental factors or matters were identified as being relevant to the Browse to State waters proposal.

Note: Woodside is aware that other factors or matters may be identified during the course of the environmental review that were not apparent when this EISG/ESD was prepared. If this situation

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arises, Woodside will consult with the EPA to determine whether these factors and/or matters are to be addressed in the EIS/ERD and if so, to what extent.

4.5 Stakeholder consultation

Woodside will consult with stakeholders who are affected by, or are interested in, the proposed Browse to NWS Project. These stakeholders include decision-making authorities, other relevant government agencies and authorities (local, state, and Commonwealth), the local community, local indigenous groups, academics, research authorities and environmental non-government organisations. The EIS/ERD will describe the consultation method adopted, existing stakeholder forums and skills and techniques used to ensure effective communication of the nature and detail of the State waters proposal. This will include the means used to identify concerns and to gauge and progress mitigation strategies.

Stakeholder consultation will include consultation with Department of Primary Industries and Regional Development in respect to the introduction of marine pests (IMPs) to ensure that the potential risk of IMPs to State waters is adequately assessed and managed.

The assessment documentation must provide details of the potential indirect impacts of the proposed action on the (Indigenous rock art) values of the Dampier Archipelago (including the Burrup Peninsula) National Heritage Place, and the extent to which these values may potentially be impacted by the proposed action following any planned mitigations.

Woodside will document all relevant stakeholder consultation information in the EIS/ERD.

4.6 Decision-making authorities

The EPA has identified the decision-making authorities (listed in **Table 19**) for the proposal. Additional decision-making authorities may be identified during the assessment.

Table 19: Decision-making Authorities

Decision-making Authority	Relevant Western Australian Legislation
Minister for Mines and Petroleum	<i>Petroleum (Submerged Lands) Act 1982</i>
Chief Executive Officer, Department of Water and Environmental Regulation	<i>Environmental Protection Act 1986</i>
Chief Dangerous Goods Officer, Department of Mines, Industry Regulation and Safety	<i>Dangerous Goods Safety Act 2004</i>

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6. FIGURES

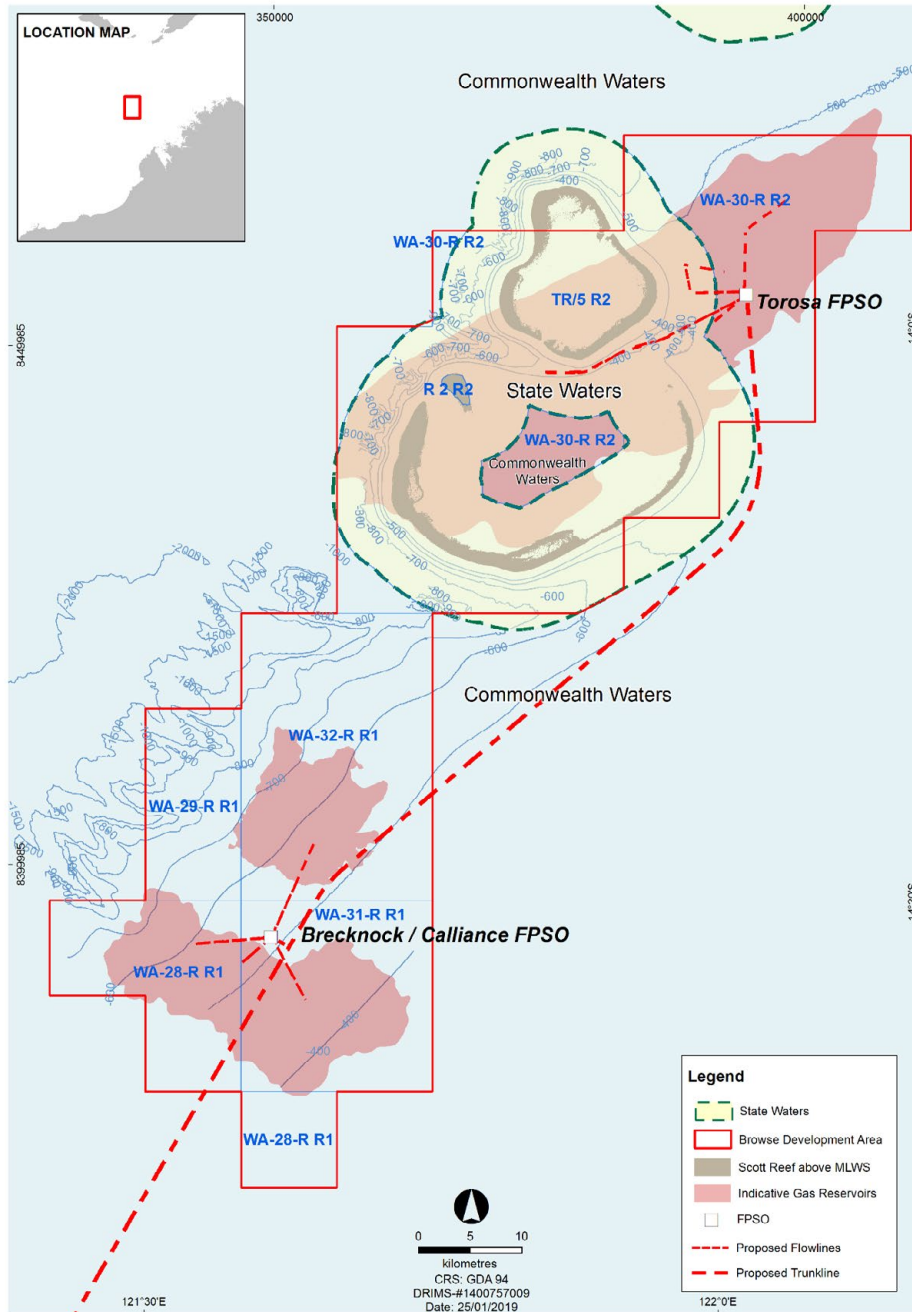


Figure 1 Proposed Browse Development Area

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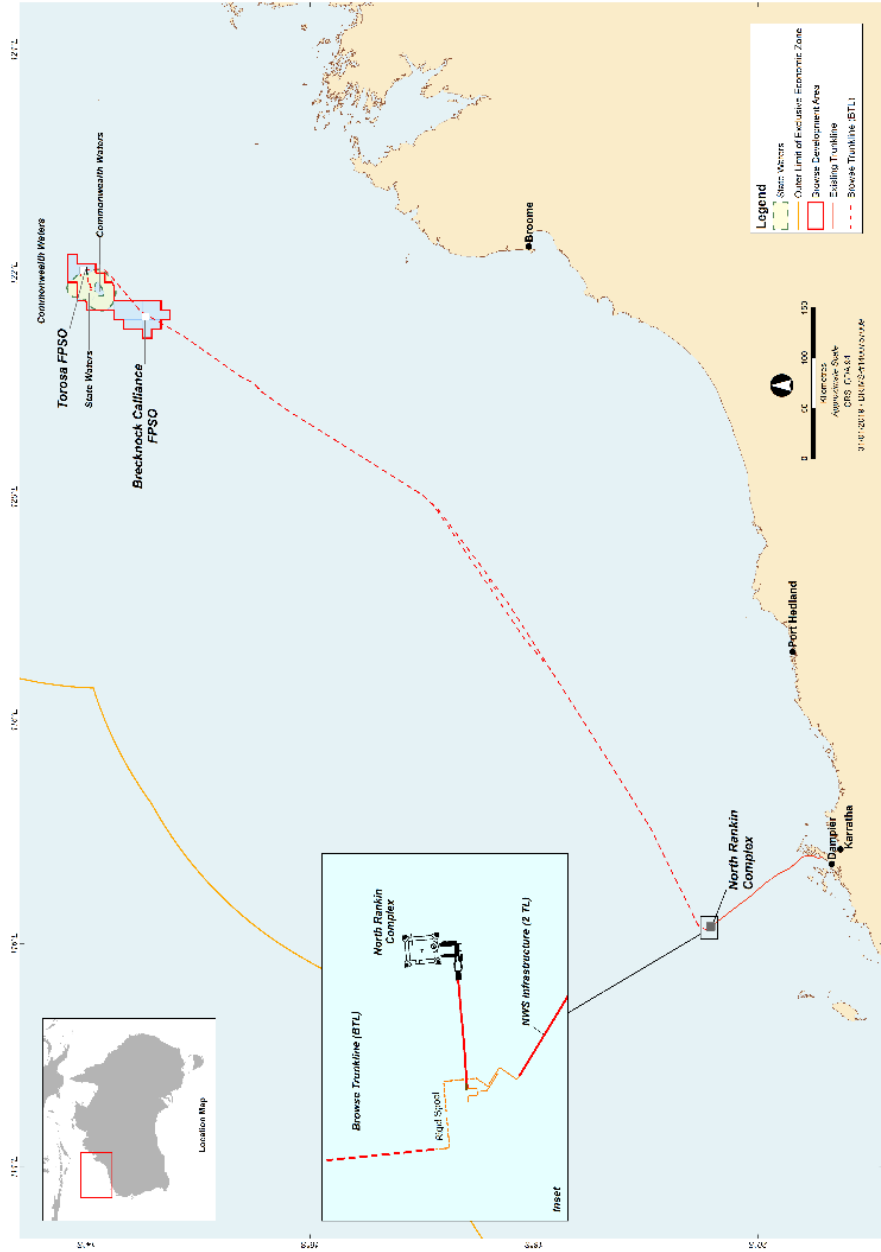


Figure 2 Indicative Browse Trunkline (BTL) route. Note alternative routes mid BTL are being assessed.

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7. APPENDIX A – COMMONWEALTH GUIDANCE FOR GREENHOUSE GAS EMISSIONS

The proponent is required to provide transparent and accurate information to support decision making. This document is intended to assist the proponent to structure the discussion of the greenhouse implications of their development proposal.

To aid assessment of greenhouse gas (GHG) emissions resulting from the Browse to NWS Project, the following information is required:

1. Inventory of annual emissions

Provide data on estimated maximum annual emissions of the greenhouse gases defined in the *National Greenhouse and Energy Reporting Act 2007* (Cth): from within the development area; and, to the extent it can be predicted, from elsewhere as it is transported, processed (liquefied) and combusted, in Australia or overseas.

The inventory should include: an estimate of emissions on a gas by gas basis; a summary table of emissions on a gas by gas basis; a summary table listing emissions on a carbon dioxide equivalent basis; and a table which includes gross emissions, emission reduction due to both offsets and mitigation, and net emissions.

As far as is practicable an inventory of cumulative emissions should be included with regards to known potential future expansions or developments by Woodside and other proponents in the vicinity of the development.

In addition, estimates of emissions per year over the life of the project (in addition to the existing requirement around maximum emissions) and estimate of emissions intensity of production (ie emissions divided by production) over the life of the project should be provided.

2. Mitigation

The proponent must include a full description of mitigation measures, including analysis of a full range of alternatives to the proposed project. This should include methods by which GHG emissions could be mitigated, including:

- a) analysis of the likely GHG reductions as a result of mitigation efforts to the same level of detail and approach as described in the 'Inventory of annual emissions' above;
- b) analysis of costs, both financial and output related, of mitigation; and
- c) identification of any relevant voluntary partnerships between government and the proponent, and their links to mitigation.

3. Method

The proponent must identify, in a transparent manner, the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* method used in making the estimate. If no methodology exists, a methodology reflecting the principles of the NGER will be developed and agreed by the proponent and the Department.

4. Supporting Data

The following supporting data must be provided:

- a) the proponent must provide details on the emission factors used and activity data used, and
- b) the project's emission factors and activity data need to be compared with similar projects, including both Australian and international best practice. This analysis should include projects that use alternative fuel sources, processes, and technologies.

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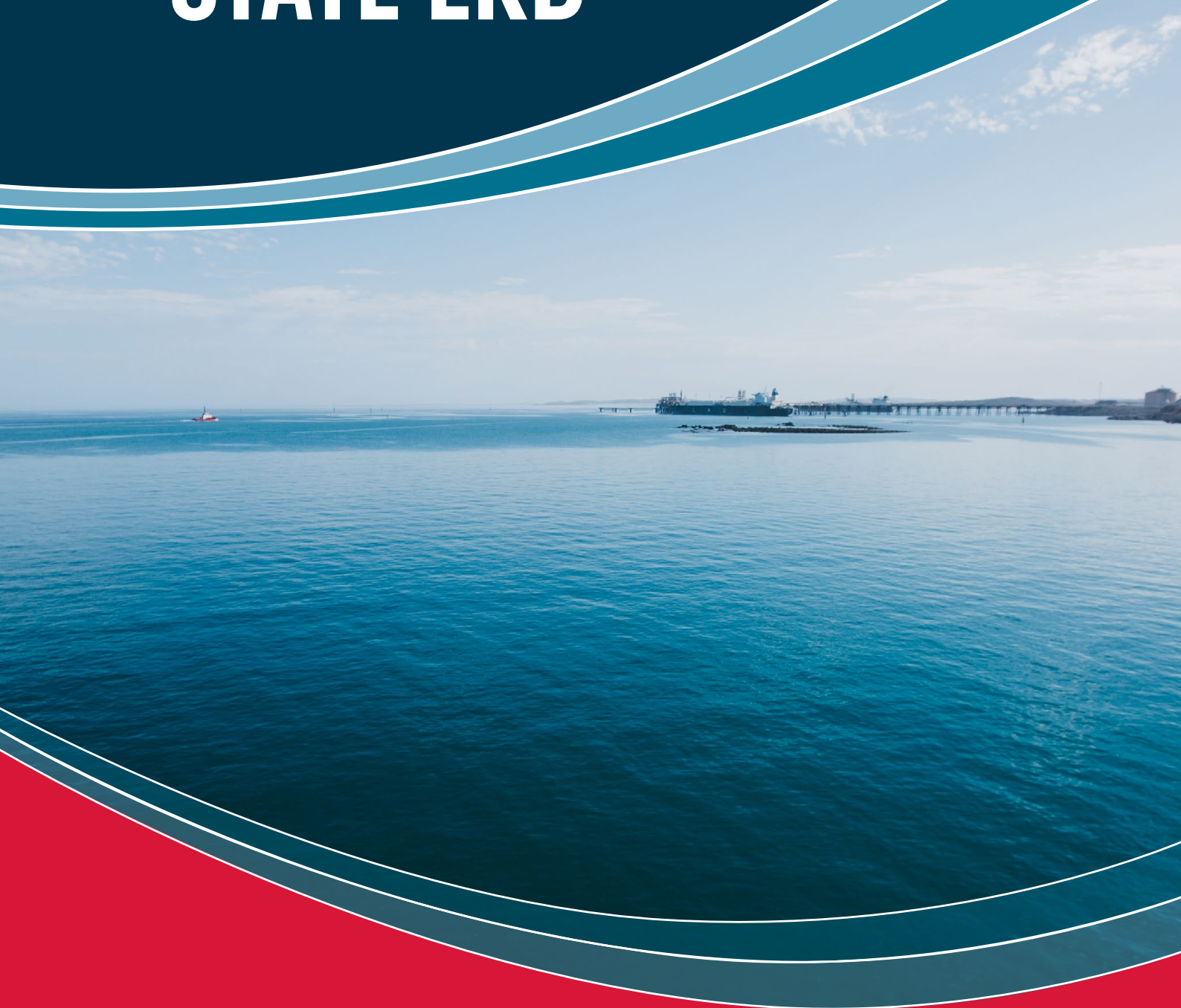
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CHAPTER 10, APPENDIX B

PROPOSED BROWSE TO NWS PROJECT STATE ERD



STATE ERD

1. PREAMBLE

This State Environmental Review Document (ERD) is an addendum to the draft Environmental Impact Statement (EIS)/ERD for the proposed Browse to North West Shelf (NWS) Project and has been prepared to provide proposed details and assessment conclusions specific to the State components of the proposed Browse to NWS Project (Proposal). The majority of the proposed Browse to NWS Project is located outside State jurisdiction. Most notably, the Floating Production Storage and Offloading facilities (FPSOs) and the entire length of the Browse Trunkline (BTL) are located in Commonwealth waters. However, a portion of the subsea wells and gathering system for the Torosa FPSO extend into State waters.

The draft EIS/ERD provides a 'whole of project' assessment as per the approved EIS Guidelines/Environmental Scoping Document (EISG/ESD). This document has been prepared to further assist readers of the draft EIS/ERD to clearly identify the activities, aspects, receptors, predicted impacts and potential risks that are applicable to the assessment of the State aspects of the Proposal under the *WA Environmental Protection Act 1986* only.

This State ERD focuses on State aspects of the Proposal and therefore does not repeat all information on the proposed Browse to NWS Project. This State ERD references the reader back to the draft EIS/ERD where relevant. As such, this State ERD is to be read in conjunction with the draft EIS/ERD. It should be noted that, unless stated otherwise, where content within the draft EIS/ERD is referenced within this State ERD, content in the draft EIS/ERD applies equally to State and Commonwealth jurisdictions.

2. INVITATION TO MAKE A SUBMISSION

The Western Australian (WA) Environmental Protection Authority (EPA) invites people to make a submission on the environmental review for the proposed Browse to NWS Project (Proposal).

Woodside Energy Ltd, as operator for and on behalf of the Browse Joint Venture, proposes to develop and operate the proposed Browse to NWS Project. This Environmental Review Document (ERD) has been prepared in accordance with the EPA's Procedures Manual (Part IV Divisions 1 and 2). The ERD is the report through which the proponent describes the Proposal,

assesses and documents its likely effects on the environment.

The ERD is available for a public review period of 8 weeks from 18 December 2019, closing on 12 February 2020.

Information on the Proposal from the public may assist the EPA to prepare an assessment report in which it will make recommendations on the Proposal to the Minister for Environment.

Why write a submission?

The EPA seeks information that will inform the EPA's consideration of the likely effect of the Proposal, if implemented, on the environment. This may include relevant new information that is not in the ERD, such as alternative courses of action or approaches.

In preparing its assessment report for the Minister for Environment, the EPA will consider the information in submissions, the proponent's responses and other relevant information.

Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992* (WA).

Why not join a group?

It may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on information in the ERD.

When making comments on specific elements in the ERD:

- + clearly state your point of view and give reasons for your conclusions
- + reference the source of your information, where applicable
- + suggest alternatives to improve the outcomes on the environment.

What to include in your submission

Include the following in your submission to make it easier for the EPA to consider your submission:

- + your contact details – name and address
- + date of your submission
- + whether you want your contact details to be confidential
- + summary of your submission, if your submission is long
- + list points so that issues raised are clear, preferably by environmental factor
- + refer each point to the page, section and, if possible, paragraph of the ERD
- + attach any reference material, if applicable. Make sure your information is accurate.

The closing date for public submissions is: 12 February 2020

The EPA prefers submissions to be made electronically via the EPA's Consultation Hub at <https://consultation.epa.wa.gov.au>

Alternatively, submissions can be:

- + posted to: Chairman, Environmental Protection Authority, Locked Bag 10, Joondalup DC WA 6919, or
- + delivered to: The Environmental Protection Authority, 8 Division Terrace, Joondalup WA 6027.

If you have any questions on how to make a submission, please contact the EPA Services at the Department of Water and Environmental Regulation (DWER) on (08) 6364 7000.

3. SCOPING CHECKLIST

Table 3-1 presents the completed scoping checklist which identifies the required work (as per the approved Environmental Scoping Document (ESD)) and reference to the location in the draft EIS/ERD and this State ERD where the requirement has been met.

Table 3-1 Scoping Checklist

Task No.	Required Work	Section and Page No.
<i>Benthic Communities and Habitats</i>		
1.	Determination of predicted temporary and permanent seabed disturbance within State waters.	Section 8.3.4.2 (pg. 915); Section 6.3.1 of the draft EIS/ERD
2.	Characterise the benthic habitats in the area potentially impacted using existing survey data and literature, including the preparation of habitat maps with demonstrated ground truthing for areas where proposed infrastructure will be installed on the seabed within State waters. Woodside has a good understanding of the benthic habitats expected to be disturbed within State waters and, as such, no further studies to characterise these benthic habitats is considered required.	Section 8.3.3 (pg. 912); Section 5.3.1 of the draft EIS/ERD
3.	Where significant benthic communities are identified in areas where infrastructure will be installed on the seabed, identify an appropriate Local Assessment Unit and assess cumulative loss of benthic communities and habitats in accordance with EPA's technical guidance.	Section 8.3.7 (pg. 922)

Task No.	Required Work	Section and Page No.
4.	Predict the likely fate of discharged drill cuttings using existing data and modelling and assess impact on benthic habitats. Woodside has a good understanding of the quantity and nature of the drill cuttings that are predicted to be generated and the drill fluids to be used. There is also a good understanding on the predicted fate of the discharges via drilling cuttings discharge modelling undertaken as part of the previously proposed Browse Development concepts. Drilling and completion activities required for the Proposal are expected to be broadly similar to that of the previously proposed development concepts. As such, the previous modelling is considered representative of the Proposal and sufficient for assessing the potential impacts.	Section 8.3.4.9 (pg. 917); Section 6.3.15 of the draft EIS/ERD
5.	Undertake hydrocarbon spill modelling to describe the dispersion and degradation characteristics of a range of hydrocarbon spill scenarios to inform the risk assessment and the development of mitigation measures.	Section 8.3.4.15 (pg. 920); Section 6.3.21 of the draft EIS/ERD
Marine Environmental Quality		
6.	Characterise the marine environmental quality in the area potentially impacted using existing survey data and literature. Woodside has a good understanding of the marine environment in the State waters within the Browse Development Area via numerous available studies and, as such, no further studies to characterise this marine environment is considered required.	Section 8.2.3 (pg. 892); Sections 5.2.9, 5.2.10, 5.3.1, 5.3.2, 5.3.3.3 and 5.4.2.2 of the draft EIS/ERD
7.	Characterise discharge type that has the potential to impact on State waters (e.g. vessel and MODU discharges, drill cuttings and fluids, produced water, cooling water, hydrotest fluid, subsea control fluids) in terms of volume, frequency, composition and ecotoxicity.	Section 8.2.4 (pg. 892); Sections 6.3.9, 6.3.10, 6.3.11, 6.3.12, 6.3.13, 6.3.15, 6.3.16, 6.3.17 of the draft EIS/ERD
8.	Present previously undertaken modelling or revised modelling where required as described in the workplan (Section 3.8.8 of the EISG/ESD) and describe the dilution and fate of the discharges to determine the spatial extent of potential impacts and appropriate mixing zones.	Section 8.2.4 (pg. 892); Sections 6.3.12, 6.3.13, 6.3.15, 6.3.17 of the draft EIS/ERD
9.	Based on characterisation of the existing marine environment and expected discharges and modelling, develop and present spatially proposed Environmental Quality Criteria (Environmental Quality Objectives and levels of ecological protection) for State waters within the Browse Development Area.	Section 8.2.6 (pg. 906);
10.	Outline a commitment to develop and implement a Marine Environmental Quality Management Plan (EQMP) for the State waters which identifies the Environmental Values to be protected and spatially defines the Environmental Quality Objectives and levels of ecological protection that Woodside aims to achieve in State waters.	Section 8.2.6 (pg.906);
11.	Undertake hydrocarbon spill modelling to describe the dispersion and degradation characteristics of a range of hydrocarbon spill scenarios to inform the risk assessment and the development of mitigation measures.	Section 8.3.4.15 (pg. 920); Section 6.3.21 of the draft EIS/ERD

Task No.	Required Work	Section and Page No.
Marine Fauna		
12.	Characterise the marine fauna in the area potentially impacted using existing survey data and literature. Woodside generally has a good understanding of marine mammals that may occur in the Browse Development Area via a large number of surveys undertaken in relation to the previously proposed Browse Development concepts which have included habitat association surveys, long-term sea noise logger deployment, aerial and vessel surveys and satellite tagging.	Section 8.4.3 (pg. 924); Section 5.3.2 of the draft EIS/ERD
13.	Characterise the predicted underwater noise emissions and potential impacts using existing and new modelling studies.	Section 8.4.4.6 (pg. 933); Section 6.3.8 of the draft EIS/ERD
14.	Characterise the predicted light emissions and potential impacts using existing modelling studies. Light modelling undertaken to support the FLNG draft EIS (EPBC 2013/7079 is considered representative of the Proposal facilities and, as such, no further modelling is considered necessary.	Section 8.4.4.2 (pg. 928); Section 6.3.3 of the draft EIS/ERD
15.	Predict the likely fate of discharged drill cuttings using existing data and modelling and assess impact on marine fauna.	Section 8.4.4.11 (pg. 935); Section 6.3.15 of the draft EIS/ERD
16.	Undertake a literature review on the impacts of electromagnetic emissions on marine fauna and utilise estimated direct electrical heating power demand to assess impacts.	Section 8.4.4.3 (pg. 931)
17.	Undertake hydrocarbon spill modelling to describe the dispersion and degradation characteristics of a range of hydrocarbon spill scenarios to inform the risk assessment and the development of mitigation measures. This includes the modelling of a condensate spill which will be used to assess the risk to Scott Reef that such a spill would present.	Section 8.4.4.18 (pg. 940); Section 6.3.21 of the draft EIS/ERD.
Air Quality		
18.	Woodside has sufficient understanding of the characteristics of the Browse resource and the combustion requirements to extract, process and export the gas to accurately quantify gaseous emissions. As such, no further studies are considered required.	Section 8.5 (pg. 942); Section 6.3.5 , 6.3.6 and Chapter 7 of the draft EIS/ERD.

4. INTRODUCTION

This State ERD is an addendum to the draft EIS/ERD for the proposed Browse to NWS Project to satisfy the requirements of the:

- + Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016 (EPA, 2016)
- + EPA's Instructions on how to prepare an Environmental Review Document (EPA, 2018a).

It has been prepared to assist the reader of the draft EIS/ERD to clearly identify the activities, aspects, receptors, predicted impacts and potential risks that are applicable to the assessment of the Proposal under the WA *Environmental Protection Act 1986* only.

The scope of the Proposal that is the subject of this State ERD is limited to the proposed activities within the State Proposal Area ([Section 5.3.1](#)) and vessel and helicopter movements occurring within State waters between the State Proposal Area and the potential supply chain and logistics support locations.

4.1 Proponent

Please refer to [Section 2.3](#) of the draft EIS/ERD for proponent details.

4.2 Environmental Impact Assessment Process

Please refer to [Section 2.9](#) of the draft EIS/ERD for the assessment process for the proposed Browse to NWS Project, including the Proposal.

4.3 Other Approvals and Regulation

4.3.1 Titles

The Browse Joint Venture (BJV) holds seven petroleum retention leases. Five of the leases (WA 28-R, WA-29-R, WA-30-R, WA-31-R and WA-32-R) are located in Commonwealth waters and are governed under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) (OPGGSA). The remaining two leases (TR/5 and R2) are governed under State legislation, the *Petroleum (Submerged Lands) Act 1982* (WA) (PSLA) and the *Petroleum and Geothermal Energy Resources Act 1967* (WA).

4.3.2 Decision Making Authorities

The decision making authorities for the Proposal are listed in [Table 4-1](#).

Table 4-1 Decision Making Authorities

Decision Making Authority	Relevant Western Australian Legislation
Minister for Mines and Petroleum	<i>Petroleum (Submerged Lands) Act 1982</i> and the <i>Petroleum and Geothermal Energy Resources Act 1967</i> (WA)
Chief Executive Officer, Department of Water and Environmental Regulation	<i>Environmental Protection Act 1986</i>
Chief Dangerous Goods Officer, Department of Mines, Industry Regulation and Safety	<i>Dangerous Goods Safety Act 2004</i>

4.3.3 Other Approvals

[Table 4-2](#) summarises the other approvals and regulations that apply to the Proposal.

Table 4-2 Other Approvals

Proposed Activities	Land tenure/access	Type of approval	Legislation regulating the activity
Subsea infrastructure development and operation	Petroleum titles	Environment Plans and Oil Spill Contingency Plans	<i>Petroleum (Submerged Lands) Act 1982</i> (WA) and associated regulations

5. THE PROPOSAL

5.1 Background

The Proposal was referred to the EPA under the *Environmental Protection Act* 1986 (EP Act) in October 2018. On 22 January 2019, the EPA determined the Proposal required assessment under Section 29 of the EP Act and set a Public Environmental Review (PER) level of assessment. The determination identified these EPA Environmental Factors as being relevant for the Proposal:

- + Marine Environmental Quality
- + Benthic Communities and Habitats
- + Marine Fauna
- + Air Quality.

The draft EIS/ERD conforms with the EIS Guidelines/Environmental Scoping Document (EISG/ESD) approved by the DoEE on 5 July 2019 and EPA on 4 July 2019, respectively ([Chapter 10, Appendix A](#) of the draft EIS/ERD). The EISG/ESD was made publicly available on the 8 July 2019.

The proposal is similar to the previously referred 'Torosa Subsea Development Proposal' that resulted in a 'Not Assessed – Public Advice Given' decision by the EPA in 2015 (CMS14397).

The proposed Browse to NWS Project continues to be subject to detailed design and refinement. Key modifications that have occurred since the referral of the Proposal and approval of the EISG/ESD include:

- + an increase in the number of wells within State waters from up to approximately 21 to up to approximately 24
- + a minor increase in seabed infrastructure related to the higher well count and design refinement.

Refer to [Chapter 2](#) of the draft EIS/ERD for an overview of the proposed Browse to NWS Project and background information, including details of the assessment process ([Section 2.9](#) of the draft EIS/ERD), the Browse resources, the proponent, the project objectives, current status and relationship with other developments.

5.2 Justification

Please refer to [Section 2.8](#) of the draft EIS/ERD for the development justification.

5.3 Proposal Description

This section provides an overview of the State components of the Proposed Browse to NWS Project Proposal. A full description of the proposed Browse to NWS Project is provided in [Chapter 3](#) of the draft EIS/ERD.

5.3.1 State Proposal Area

As described in [Chapter 2](#) of the draft EIS/ERD, the overall Project Area (encompassing both State and Commonwealth components) comprises:

- + the proposed Browse Development Area (in which the Brecknock, Calliance, and Torosa fields, the FPSO facilities and the subsea production systems, including wells, will be located) ([Figure 2-1](#) of the draft EIS/ERD)
- + the pipeline corridor within which the proposed BTL and inter-field spur line will be located ([Figure 2-2](#) of the draft EIS/ERD).

The State Proposal Area, which is the subject of the assessment under the EP Act, is located within the Browse Development Area and comprises all areas above the low water line (based on mean low water springs (MLWS)) and all waters within 3 nm of the low water line, as shown in [Figure 5-1](#).

It should be noted that, as detailed in [Chapter 4](#), the scope of this State ERD includes vessel and helicopter movements occurring within State waters outside of the State Proposal Area.

5.3.2 Overview

Activities in the State Proposal Area comprise a small subset of infrastructure and activities of the proposed Browse to NWS Project. Within State jurisdiction, activities include the development of up to an estimated 24 wells and associated subsea infrastructure targeting the hydrocarbon resources within the Torosa reservoir. The remaining facilities and infrastructure will be located in Commonwealth waters and are outside the scope of this State ERD. Extracted hydrocarbons will be transferred via subsea infrastructure, including Christmas trees, manifolds and flowlines, to the Torosa FPSO facility, located in Commonwealth waters.

The highest intensity of activities within the State Proposal Area is likely to occur during the drilling and completion activities, installation activities and future decommissioning phases. During this time, a mobile offshore drilling unit (MODU) and approximately ten vessels may be present. As all permanent infrastructure within the State Proposal Area is subsea, the operation of the wells will be controlled remotely via the FPSO facilities that are located in Commonwealth waters. Outside of drilling and completion and installation periods, surface activities in the State Proposal Area will comprise periodic inspection, maintenance and repair activities involving one or two vessels and later phase well construction and decommissioning (including well plug and abandonment). [Table 5-1](#) provides a summary of the Proposal.

Table 5-1 Summary of the Proposal

Proposal Summary	
Proposal Title	Proposed Browse to NWS Project (State component)
Proponent Name	Woodside Energy Ltd, as Operator for and on behalf of the Browse Joint Venture
Short Description	Drilling and completion, subsea installation, commissioning, operation, inspection, maintenance and repair and decommissioning of subsea wells and associated subsea infrastructure located in Western Australian State waters, to extract hydrocarbons from the Torosa reservoir, located approximately 425 km north of Broome and approximately 290 km off the Kimberley coast.

Table 5-2 Location and proposed extent of physical and operational elements of the Proposal

Element	Description	Proposed Authorised Extent
Physical Elements		
Drilling and completion activities of up to approximately 24 wells	Installation and physical presence of infrastructure within indicative field layout as per Figure 5-1 .	Approximately 0.31 km ² of direct seabed disturbance (including 25% contingency).
Associated subsea infrastructure (Christmas trees, manifolds, flowlines, and umbilicals)		
Temporary mooring of MODU		
Seabed preparation and flowline stabilisation		
Operational Elements		
Water supply (installation vessels, Inspection, Maintenance and Repair (IMR) vessels, MODUs and project vessels)	Water requirements sourced either from seawater (reverse osmosis plant) or loaded at port.	Limited water requirements to support drilling and completion activities, subsea installation activities (e.g. potential hydrotest), vessel and MODU water needs and potentially also for decommissioning activities.
Power supply (installation vessels, IMR vessels, MODUs and project vessels)	Power generated on board vessels and MODU.	As required for operations and safety.
Vessel discharges (installation vessels, IMR vessels, MODU, and project vessels).	Discharges from vessels and MODU include treated sewage, drain waters, cooling water, sullage, putrescible organic waste and desalination brine.	Limited volumes discharged in accordance with International Convention for the Prevention of Pollution from Ships MARPOL 73/78 Annex I, as applied in Australia under the Commonwealth <i>Protection of the Sea (Prevention of Pollution from Ships) Act 1983</i> (Part II Prevention of pollution from oil); Marine Orders 91 (Marine pollution prevention – Oil) 2014 as applicable to vessel class; <i>Pollution of Waters by Oil and Noxious Substance Act 1986</i> .
Drill cuttings and fluid discharges	Drill cuttings and drilling fluids.	Approximately 850 m ³ of cuttings per well, with up to approximately 24 wells to be developed in the State Proposal Area. Approximately 100-130 m ³ well discharge fluid per well during well unloading.

Element	Description	Proposed Authorised Extent
Hydrotest fluid discharges	Hydrotest fluids discharged at the seabed during integrity testing of the subsea infrastructure.	Oneoff discharges of up to approximately 950 m ³ of hydrotest fluid for the TRE flowline and up to approximately 250 m ³ at the TRF flowline.
Produced water	Low volumes of water that occurs naturally within the hydrocarbon-bearing geological formations.	Small volumes of formation water may result during well unloading activities by the MODU. These will be discharged directly from the MODU.
Subsea control fluid discharge	Control fluid discharged at the Christmas trees to maintain valve functionality.	Intermittent discharge of waterbased hydraulic control fluid when subsea valves are actuated (~0.1 L). Maximum volume of control fluid that will be released to the marine environment per manifold is 1,900 L per year of water based fluid containing approximately ~3% active ingredient (40–68 L of control fluid additive).
Underwater noise emissions	Underwater noise: + generated during drilling, completion and installation activities (including vessel movements using Dynamic Positioning (DP), vertical seismic profiling (VSP) and distributed acoustic sensing (DAS) + generated from subsea infrastructure during operations + from piling activities for mooring installation for the MODU (note that this is unlikely to be required) + from installation vessels, IMR vessels, MODUs and project vessels + from helicopter movements from the MODU + from IMR activities.	Noise related behavioural disturbance radius of up to approximately 10.5 km around drilling and installation activities. Noise related behavioural disturbance radius of up to approximately 500 m around subsea infrastructure during operations.
Light emissions – operational lighting	Artificial light emitted by installation vessels, IMR vessels, MODUs and project vessels.	Limited to functional lighting at levels that provide a safe working environment for personnel.
Light emissions – flaring	Intermittent flaring from the MODU during well unloading. This occurs only during well installation or intervention for repairs.	
Air emissions – offshore activities	Air emissions resulting from power generation on project vessels and MODU.	

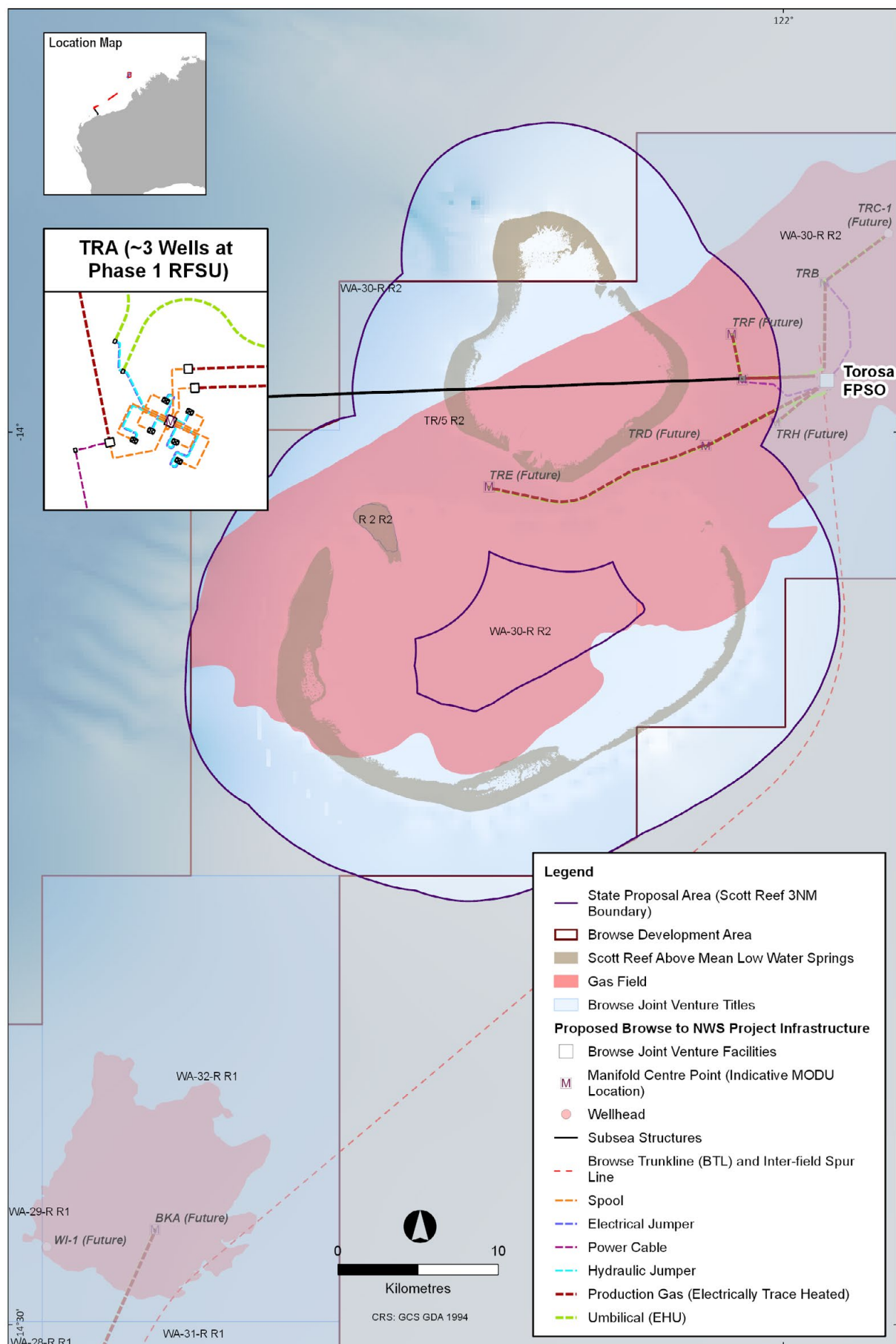


Figure 5-1 State Proposal Area

5.3.3 Project Infrastructure

Project infrastructure within the State Proposal Area is proposed to comprise the following:

- + 24 production wells
- + subsea infrastructure
- + temporary moorings for MODU anchoring.

It should be noted that the BTL, inter-field spur line and FPSO facilities will be located entirely in Commonwealth waters.

Production wells

It is anticipated the proposed Browse to NWS Project will require drilling and completion of up to 24 production wells in State waters at the Torosa reservoir over the life of the proposed Browse to NWS Project. This includes the drilling and completion of approximately three wells at the TRA drill centre for Phase 1 Ready for Start Up (RFSU). The remaining 30 production wells of the Browse to NWS Project will be located in Commonwealth waters (including five at the Torosa reservoir and 25 at the Brecknock and Calliance reservoirs).

A wellhead will be installed at the top of each well. The wellhead will hold the production well casing and will enable installation of the Christmas tree, complete with well control facilities. Christmas trees are steel structures with various valves and are used to:

- + control production, whereby hydraulically controlled valves on the Christmas trees are used to control flow rates and provide a well shut-off mechanism
- + manage chemical injection.

Surface controlled subsurface safety valves will be installed in the wells.

To optimise the layout of the subsea infrastructure, production wells will be arranged around drill centres (a cluster of wells around a central manifold) with up to four drill centres located within the State Proposal Area. Only one drill centre (TRA) will be installed in the State Proposal Area prior to start-up of the Torosa FPSO Facility – the residual will be installed in later years. The number and location of these wells and drill centres will depend on reservoir target areas, seabed bathymetry and features to optimise reservoir recovery. A notional field layout is provided in [Figure 5-1](#).

Subsea infrastructure

The wells at each drill centre will be connected to manifolds by well jumpers (a specially-designed piece of pipe used to transport production fluid between components of the subsea infrastructure) to allow reservoir fluids to be carried from the wells to the manifolds. The manifolds will connect the wells to corrosion resistant alloy clad (or lined) flowlines that will be routed back to the FPSOs, located in Commonwealth waters. An example of subsea infrastructure for illustrative purposes is provided in [Figure 3-1](#) of the draft EIS/ERD.

Subsea infrastructure will be powered, monitored and controlled from the FPSO facilities using a network of electro-hydraulic control umbilicals and subsea distribution units. Each drill centre will be serviced by an electro-hydraulic umbilical, which will follow a similar alignment as the infield flowlines. Some umbilicals may be integrated within the production flowline bundle. Umbilicals will also be tied back to the FPSO facilities (in Commonwealth waters) using a system of flexible risers.

Other subsea infrastructure may include pile installation and temporary mooring lines for MODU anchoring.

5.3.4 Development Activities

Development activities within the State Proposal Area will include:

- + pile installation
- + development drilling and completions
- + subsea umbilicals, risers and flowlines (SURF) installation and commissioning.

Pile installation

Pile installation may be required within State waters for temporary mooring of the MODUs. Data from the surveys undertaken by Woodside in 2014 has been analysed and demonstrates suction piling for moorings is feasible and will be the most likely option for pile installation.

Suction piles are installed by gently lowering the pile onto the seabed and using gravity to lower the pile into the soft substrate. Installation is completed by pumping out the entrapped water inside the pile, with the resulting differential pressure driving the pile into the seabed.

Should alternate piling methods be selected, options include drilling and cementing or impact piling, which involves the application of force to drive the pile into the seabed.

Development drilling and completions

The proposed Browse to NWS Project will require the drilling of up to 24 production wells within State waters. It is anticipated the drilling and completion activities will be completed in multiple phases. The first phase will be drilling and completion of approximately three wells at the TRA drill centre to achieve RFSU, with subsequent phases of drilling and completion of additional wells undertaken over the life of the Proposal to optimise reservoir recovery ([Figure 5-1](#)). The drilling and completions process will not differ between wells in State and Commonwealth waters and is described in detail in [Section 3.7.2](#) of the draft EIS/ERD.

Subsea Umbilicals, Risers and Flowlines (SURF) installation and commissioning

The process for the installation and commissioning of the SURF infrastructure, including site preparation, is described in detail in [Section 3.7.3](#) of the draft EIS/ERD.

5.3.5 Operations

Activities within the State Proposal Area during operations will be limited to:

- + hydrocarbon extraction
- + inspection, maintenance and repair (IMR) activities.

Hydrocarbon extraction

During operations, hydrocarbons extracted from the reservoirs will flow via the Christmas trees and manifolds through the flowlines and risers to the FPSO facilities in Commonwealth waters. The flow rate of hydrocarbons will be controlled by subsea choke valves at the Christmas trees. Subsea hydraulic control fluids will be used to operate subsea valves. Hydrocarbon extraction including the potential use of distributed acoustic sensing (DAS) surveys is described in [Section 3.7.6.1](#) of the draft EIS/ERD. Note that processing of the gas and condensate on the FPSO facilities and subsequent condensate offload and gas export will occur in Commonwealth waters.

Inspection, maintenance and repair (IMR)

The subsea infrastructure will be designed to require only minor degrees of intervention. Inspection and maintenance will be undertaken to ensure the integrity of the infrastructure and identify any problems before they present a risk of loss of containment. Intervention

may be required to repair identified problems. A detailed description of the planned IMR activities is provided in [Section 3.7.7](#) of the draft EIS/ERD.

5.3.6 Decommissioning

At the end of the proposed Browse to NWS Project life, the infrastructure will be decommissioned in accordance with good oilfield practice and relevant legislation and practice at the time. This is likely to include well suspension, plugging and abandoning wells and removing the subsea infrastructure. All infrastructure installed above the seabed will be designed to allow removal.

Given the expected life of the project, the decommissioning of the proposed Browse to NWS Project is not likely for many years. Given the possible improvements in technology that may occur between now and the time of decommissioning, it is not possible to fully scope the decommissioning strategy that will be employed at that time however all infrastructure above the seabed has been designed to allow removal. The strategy demonstrated through activity-specific Environment Plans will be developed in consultation with the EPA and other stakeholders closer to the time ([Table 4-2](#)).

5.3.7 Support Activities and Infrastructure

5.3.7.1 Logistics support

The proposed Browse to NWS Project will require supply chain and logistics support during construction and operations, as described in [Section 3.7.9](#) of the draft EIS/ERD.

Requirements for supply chain and logistics support for the proposed Browse to NWS Project may include:

- + port access for supply and support vessels to transfer people, equipment, materials and waste to and from the Project Area
- + airport access for fixed-wing aircraft and helicopters to transfer people and supplies to and from the Project Area
- + search and rescue capabilities
- + onshore support for receiving, storing, and distributing materials and equipment.

The proposed Browse to NWS Project is not dependent on the development of new onshore supporting infrastructure to proceed. Supply chain and logistics

support locations that have existing services and infrastructure for ongoing regular support over the whole life of the proposed Browse to NWS Project are being considered, with the assessment and selection focused on using supply chain services and infrastructure within WA.

Potential supply chain and logistics support locations in Australia include:

- + Broome
- + Djarindjin
- + Dampier/Karratha
- + Exmouth
- + Perth.

Facilities in Broome include the Port of Broome, which is the main deep water port servicing the Kimberley region. The port supports livestock export, offshore oil and gas, supply vessels, pearling, fishing charter boats, cruise liners and is the main fuel and container receiving point for the Kimberley. Facilities at the port include an outer berth, two inner berths, fuel and potable water distribution facilities, a laydown area, lighting suitable for night work and a slipway. Other facilities include the Broome International Airport which is located in Broome and includes a runway for fixed wing operations and a heliport which opened in 2008. A helipad is also available on site with space for four larger helicopters and 10 additional helicopter parking positions are available near the airport.

The King Bay Supply Base is located in the Port of Dampier and is operated by Woodside (Woodside 2014). The facility is suitable for a wide range of vessels varying in size and configuration such as harbour tugs, supply vessels, crew and utility vessels and transportation/heavy lift vessels.

Facilities in Djarindjin include a fixed and rotary wing aviation base which supports existing offshore oil and gas facility crew change operations.

As the proposed Browse to NWS Project will be using existing supply and logistics services and infrastructure which are managed by third parties, such services and infrastructure are not considered further as part of this assessment. The scope of this assessment is limited to vessel and helicopter movements between the State Project Area and the potential supply chain and logistics support locations. Any activity at supply chain and logistics support locations is outside the scope of this assessment.

In addition, there may be a requirement to conduct short term, discrete logistical support activities from time to time at various port and airport locations along the coast of WA, Australia and internationally to support activities throughout the life of the proposed Browse to NWS Project. These activities are likely to be consistent with general shipping activities.

5.3.7.2 Project vessels and helicopters

The drilling and completion, subsea installation and commissioning phases will be supported by project vessels including barges, tugs, survey vessels, supply vessels and installation vessels.

During the operations phase, vessel presence in the State Proposal Area will primarily be limited to IMR activities and environmental monitoring purposes.

Personnel transfer to offshore facilities from Broome will be either via helicopter or vessel. If helicopters are used, it is anticipated that up to five personnel transfers a week per FPSO facility will be required during normal operations. Helicopters will not enter the State Proposal Area under normal operations, however they will traverse State Waters near the mainland.

Fast crew transfer vessels (FCTVs) may be used for crew transfer. These crew transfer vessels are capable of travelling at 50 – 55 knots. It is anticipated one transfer per day will occur during normal operations, with additional transfers during shut downs and major maintenance. FCTVs will not enter the State Proposal Area around Scott Reef under normal operations. They will traverse coastal State waters near the logistical base.

Vessel requirements during the decommissioning phase are unknown at this stage as decommissioning plans have not been finalised. However, it can be expected decommissioning may use similar vessels to those engaged for installation activities.

5.4 Local and Regional Context

The local context for the proposed Browse to NWS Project is provided in [Chapter 5](#) of the draft EIS/ERD. Specifically, values relating to the State Proposal Area include the following:

- + the Scott Reef Nature Reserve ([Section 5.3.3.3](#) of the draft EIS/ERD)
- + the Seringapatam Reef and Commonwealth waters in the Scott Reef Complex and the Continental Slope Demersal Fish Communities KEFs, which overlap the State Proposal Area ([Section 5.3.3.1](#) of the draft EIS/ERD)

- + Biological Important Areas (BIAs) (green turtle, hawksbill turtle, little tern, pygmy blue whale; [Section 5.3.2.2](#) of the draft EIS/ERD) and habitat critical to the survival of a species (green turtle; [Section 5.3.2.3](#))
- + Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Listed species ([Section 5.3.2.1](#) and [Section 5.3.2.4](#) of the draft EIS/ERD)
- + socio-economic values including commercial, traditional and recreational fishers ([Sections 5.4.2.2](#) and [Section 5.4.2.3](#) of the draft EIS/ERD) and scientific research ([Section 5.4.2.7](#) of the draft EIS/ERD).

Regional context and values relevant to the proposed Browse to NWS Project, such as Commonwealth Managed Fisheries and State and Australian Marine Parks (AMPs), are also detailed in [Chapter 5](#) of the draft EIS/ERD.

6. STAKEHOLDER ENGAGEMENT

6.1 Key Stakeholders

Refer to [Table 4-1](#) in [Section 4.3](#) of the draft EIS/ERD for a list of the identified stakeholders in relation to the proposed Browse to NWS Project.

6.2 Stakeholder Engagement Process

Refer to [Chapter 4](#) of the draft EIS/ERD for an overview of the stakeholder engagement process, including historical stakeholder engagement relating to the development of the Browse resource, stakeholder engagement undertaken specific to the proposed Browse to NWS Project and planned ongoing stakeholder engagement.

6.3 Stakeholder Consultation

Refer to [Table 4-2](#) in [Section 4.3](#) of the draft EIS/ERD for an outline of engagements undertaken in relation to the proposed Browse to NWS Project following the referral of the proposed Browse to NWS Project in October 2018.

7. IDENTIFYING IMPACTS AND RISKS

The environmental impact and risk assessment process undertaken in relation to the proposed Browse to NWS Project is described in [Section 6.2.3](#) of the draft EIS/ERD. This process included the identification of impacts and risks as well as associated receptor groups, as presented in [Table 6-2](#), which shows the project wide aspect-receptor relationships. To inform the assessment in relation to the EPA's environmental objectives, the aspect-receptor relationships specific to activities occurring within the State jurisdiction have been identified and are shown in [Table 7-1](#). Within [Table 7-1](#), aspects that present a potential impact from a planned activity are identified with an 'I'. Where the aspect presents a risk from an unplanned event or incident they are identified with an 'R'. Where both an impact and a risk apply, this is identified by 'I/R'. As application of the EPA Factors inherently result in overlap between aspects some repetition is necessary. This has been minimised wherever possible by subdividing aspects between Factors and cross referencing to the draft EIS/ERD.

[illegible]

Aspects	Impact/Risk	Sediment Quality	Water Quality	Air Quality	Ambient Light	Ambient Noise	Plankton Communities	Deepwater Benthic Communities and Habitats (>75 m depth)	Shallow Water Benthic Communities and Habitats (<75 m depth)	Coastal Habitats	Seabirds and Migratory Shorebirds	Fish	Marine Mammals	Marine Reptiles	State Marine Parks & Nature Reserves	State Managed Fisheries
Marine Discharges: Produced water	Change in water quality		I/R					I/R							I/R	
	Change in sediment quality	I/R														
	Injury or mortality to fauna						I/R					I/R	I/R	I/R	I/R	
	Changes to the functions, interests or activities of other users															I/R
Marine Discharges: Cooling Water	Change in water quality		I/R					I/R							I/R	
	Injury or mortality to fauna						I/R					I/R	I/R	I/R		
	Changes to the functions, interests or activities of other users															I/R
Marine Discharges: Drilling and completions discharges	Change in water quality		I/R													
	Change in sediment quality	I/R														
	Injury or mortality to fauna						I/R	I/R	I/R			I/R	I/R	I/R		
	Change in habitat							I/R	I/R							
Marine Discharges: Subsea control fluids	Changes to the functions, interests or activities of other users															I/R
	Change in water quality		I/R					I/R	R							
	Change in sediment quality	I/R														
	Injury or mortality to fauna						I/R					I/R	I/R	I/R		
	Changes to the functions, interests or activities of other users															I/R

Aspects	Impact/Risk	Sediment Quality	Water Quality	Air Quality	Ambient Light	Ambient Noise	Plankton Communities	Deepwater Benthic Communities and Habitats (>75 m depth)	Shallow Water Benthic Communities and Habitats (<75 m depth)	Coastal Habitats	Seabirds and Migratory Shorebirds	Fish	Marine Mammals	Marine Reptiles	State Marine Parks & Nature Reserves	State Managed Fisheries
Marine Discharges: Hydrotest Fluid	Change in water quality		I					I	I							
	Change in sediment quality	I						I								
	Injury or mortality to fauna						I	I				I	I	I		
	Changes to the functions, interests or activities of other users															I
Production Activities: Seabed Subsidence	Change in habitat							I	I		I			I	I	
Marine Discharges: Hazardous and Non-Hazardous Inorganic Waste	Change in water quality		R						R							
	Change in sediment quality	R														
	Injury or mortality to fauna						R	R			R	R	R	R	R	
	Changes to the functions, interests or activities of other users															R
Unplanned Vessel Interactions with Fauna	Injury or mortality to fauna											R	R	R		
Physical Presences (Unplanned): Invasive Marine Species	Change in ecosystem dynamics							R	R			R			R	
	Changes to the functions, interests or activities of other users															R
Unplanned Hydrocarbon Releases	Change in water quality		R					I	I						R	
	Change in sediment quality	R								R					R	
	Injury or mortality to fauna															
	Changes to the functions, interests or activities of other users							R			R	R	R	R		R

8. ENVIRONMENTAL PRINCIPLES AND FACTORS

8.1 Principles

Consideration of the Proposal in relation to the Environmental Protection Principles and objects of the EP Act are presented in [Table 8-1](#).

Table 8-1: Consideration of Environmental Protection Principles

Principle	Consideration
The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by: - careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and - an assessment of the risk-weighted consequences of various options.	Credible and defensible science has been at the core of the environmental assessment of the proposed Browse to NWS Project. This science is underpinned by over 25 years of studies and research at Scott Reef in partnership with the Australian Institute of Marine Science (AIMS). This scientific knowledge has been incorporated into the selection of the concept for the proposed Browse to NWS Project, as well as into design during the concept definition phase. Scientific knowledge will continue to be a key input into the detailed engineering phase and the implementation of the environmental mitigation, management and monitoring programs. Studies completed were determined to be adequate for the purposes of impact assessment and management planning purposes based on the lack of significantly altered regional cumulative impacts since collection, ability to extrapolate population trends using existing literature, and conservative interpretation of available data where applied. The existing baseline data will be updated by targeted monitoring programs to verify impact predictions and inform adaptive management approaches at relevant times throughout the project life cycle. Woodside has committed to the continuation of the Scott Reef longterm monitoring program to monitor the functionality and status of the reef system throughout the full lifecycle of the proposed Browse to NWS Project. As described in the Chapter 6 of the draft EIS/ERD, serious or irreversible damage to the environment associated with the Proposal is not predicted to occur. The ongoing integrity of all ecological and socio-economic values of the Scott Reef system is central to the considerations of the State Proposal Area. Serious or irreversible damage to the environmental value of the Scott Reef system will be avoided by locating the FPSO facilities, BTL and interfield spur line well away from Scott Reef (outside of State waters) and by locating the subsea infrastructure within the State Proposal Area in deep waters, well away from Scott Reef shallow water habitat. No activities related to petroleum recovery are planned to occur on Scott Reef (<75 m water depth). The assessment presented here and in the draft EIS/ERD was conducted based on environmental objectives defined by Woodside, in accordance with relevant legislative requirements, corporate standards, benchmarking and industry best practice. Where relevant, additional management and mitigation measures have been identified for implementation to reduce the level of risk associated with aspects of the Proposal. These proposed management and mitigation measures have been developed using Woodside's adaptive management framework (Eliminate/Substitute/Prevent/Reduce/Mitigate). The adaptive management approach encompasses a range of measures to address uncertainties over environmental impacts and ensure that the EPA's environmental objectives are met. As such, it is considered this environmental protection principle has been and will continue to be met.

Principle	Consideration
The principle of intergenerational equity The present generation should ensure that the health, diversity, and productivity of the environment is maintained and enhanced for the benefit of future generations.	As described above, serious or irreversible damage to the environment is not predicted to occur as a result of the Proposal. In addition, environmental risks have been reduced to an acceptable level with the likelihood of impacts occurring as a result of unplanned events or incidents considered highly unlikely to remote. It is considered maintenance of the health, diversity and productivity of the environment will not be adversely impacted by the Proposal and access to the Scott Reef natural environment for future generations will be maintained. As such, it is considered this environmental protection principle has been and will continue to be met.
Principles relating to improved valuation, pricing, and incentive mechanisms 1. Environmental factors should be included in the valuation of assets and services. 2. The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance, and abatement. 3. The users of goods and services should pay prices based on the full lifecycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. 4. Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.	In line with Woodside's HSEQ Policy, Woodside has drawn from its operating experience in Australian offshore environments and its knowledge of the existing environment of the State Proposal Area to identify a range of design features and management measures to prevent or mitigate impacts to the environment. The selection of these measures for implementation included the following key aspects: + In line with its corporate policies and procedures, Woodside will use valuation, pricing and incentive mechanisms during procurements associated with the proposed Browse to NWS Project with the aim of balancing economic and HSE outcomes. + Net environmental benefits will be compared against a range of alternative measures. + Costs involved with the implementation of management measures at various stages of the lifecycle of the Proposal will and have been compared. + Key environmental objectives will be established, to maximise environmental benefits in a cost-effective way. As such, it is considered that this environmental protection principle has been and will continue to be met.

Principle	Consideration
The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	As part of the development of the State ERD, management and mitigation measures have been identified to reduce the level of risk for each of the environmental aspects associated with the Proposal. These proposed measures have been developed using Woodside's adaptive management framework (Eliminate/Substitute/Prevent/Reduce/Mitigate), with the overall objective to conduct activities associated with the proposed Browse to NWS Project in a manner which does not affect Ecological Sustainable Development outcomes. This includes the principles of the EP Act, including the principle of 'biological diversity and ecological integrity'. Woodside has developed a range of design features, as well as management and mitigation measures to avoid impacts to Scott Reef (refer to Section 8). These have been developed in consideration of the environment of Scott Reef. In addition, Woodside has committed to the continuation of the Scott Reef long-term monitoring program to monitor the functionality and status of the reef system, throughout the full lifecycle of the proposed Browse to NWS Project. As such, it is considered this environmental protection principle has been and will continue to be met.
The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Woodside is committed to managing its activities to reduce the adverse effects on the environment while balancing economic and social needs of sustainable development. A key principle of Woodside's HSEQ Policy is to use energy, water and other resources efficiently and reduce greenhouse gas (GHG) emissions and waste. This principle is reflected in the various design features and waste management measures to be implemented by Woodside. In the development of its management approach for the Proposal, Woodside has specifically focused on reduction at source and efficiency maximisation for emissions and discharges to the environment, as follows: + There will be no routine discharge of non-hazardous solid waste at sea. + Chemicals that may be operationally released or discharged to the marine environment will be subject to Woodside's chemical selection and assessment process and approved prior to use. + The flowline length and subsea infrastructure installation schedule will be optimised to reduce the volume of hydrotest fluid discharged. + There will be no discharge of untreated sewage within three nautical miles (nm) of Scott Reef. + The number of wells has been, and will continue to be, optimised to meet hydrocarbon recovery objectives and operational requirements and thereby reduce unnecessary use of drilling fluids and generation of drill cuttings. Solids control equipment will be available on board the MODU to reduce the amount of residual drill fluids on cuttings prior to discharge. Drill cuttings will be tested to confirm that the average oil on cuttings for the entire well (sections using non water based fluids (NWBFs)) will not exceed 6.9% by wet weight. + Dry commissioning is being pursued for the BTL + A hybrid subsea control system has been designed to return fluids to the FPSO for reuse during normal operations. Woodside has set performance criteria to be monitored as part of the Proposal to ensure the effective management of waste. As such, it is considered this environmental protection principle has been, and will continue to be, met.

8.2 Key Environmental Factor – Marine Environmental Quality

8.2.1 EPA Objective

The EPA objective for marine environmental quality is “to maintain the quality of water, sediment and biota so that environmental values are protected” (EPA, 2016a).

The EPA Environmental Factor Guideline for Marine Environmental Quality defines the term ‘environmental quality’ as “the level of contaminants in water, sediments or biota or to changes in the physical or chemical properties of waters and sediments relative to a natural state. It does not include noise pollution, which is dealt with separately under the marine fauna factor.” (EPA, 2016a).

8.2.2 Policy and Guidance

The following policy and guidance have been considered in relation to the EPA environmental factor - marine environmental quality.

- + EPA Policy and Guidance
- + Statement of Environmental Principles, Factors and Objectives (EPA, 2016b)
- + Environmental Factor Guideline – Marine Environmental Quality (EPA, 2016a)
- + Technical Guidance – Protecting the Quality of Western Australia’s Marine Environment (EPA, 2016c).

Other Policy and Guidance

- + Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018).

8.2.3 Receiving Environment

The characteristics of the marine environment of the Browse Development Area are described in detail in [Chapter 5](#) of the draft EIS/ERD.

Water quality and seabed sediment quality in the deep waters (below the 75 m bathymetric contour) within the State Proposal Area are well aligned with that of the broader Browse Development Area and typical of a pristine tropical offshore environment reflective of the anthropogenically undisturbed waters of the region.

The findings of three surveys have been used to characterise water quality in the State Proposal Area (Brinkman et al., 2009; Gardline Marine Services Pty Ltd, 2009a; URS Australia Pty Ltd, 2007) as described in [Section 5.2.9](#) of the draft EIS/ERD.

These studies have also been used to characterise the deepwater seabed sediments within the Browse Development Area, as described in [Section 5.2.10](#) of the draft EIS/ERD. These surveys found no evidence of hydrocarbons within the sediment in the Browse Development Area, generally low levels of metals (majority below guideline levels), and nutrient levels well within the normal baseline values expected for carbonate-dominated sediments in remote tropical settings.

Biota associated with the deepwater seabed habitats within the Browse Development Area are described in [Section 5.3.1](#) (ecological communities) and [Section 5.3.2](#) (fauna) of the draft EIS/ERD. Planktonic communities within the open waters of the State Proposal Area are expected to be consistent with the remainder of the Browse Development Area. A description of the shallow water benthic habitats associated with the Scott Reef system (above the 75 m bathymetric contour) is provided in [Section 8.3.3](#). A description of the marine fauna found in the State Proposal Area is provided in [Section 8.4.3](#). As described in [Section 6](#) of the draft EIS/ERD, for the purposes of this State ERD, Scott Reef is considered as the area above the 75 m bathymetric contour within the 3 nm State waters boundary.

State marine parks and nature reserves are described in [Section 5.3.3.3](#) of the draft EIS/ERD. State managed fisheries are described in [Section 5.4.2.2](#) of the draft EIS/ERD.

8.2.4 Potential Impacts

8.2.4.1 Summary of identified impacts and risks

[Table 8-2](#) summarises the sources of potential impact to marine environmental quality in the State Proposal Area from the Proposal. [Table 8-2](#) is followed by a detailed description of the potential direct, indirect and cumulative impacts. An assessment of the significance of these impacts on marine environmental quality and a conclusion on the acceptability of the impacts in relation to the EPA environmental objective is presented in [Section 8.2.5](#). It should be noted that a discussion of the impacts from the predicted activities on marine fauna and benthic ‘biota’ as a component of marine environmental quality is presented in [Sections 8.2](#) and [Section 8.4](#).

Table 8-2 Sources of Potential Impact to Marine Environmental Quality from the Proposal

Aspect	Proposal Phase ¹					Source (in State jurisdiction)
	Dr	I	C	O	De	
Planned (routine and non-routine activities)						
Physical presence: light emissions	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area Intermittent flaring from the MODU
Physical presence: seabed disturbance and disturbance to other users	✓	✓		✓	✓	Development of the production wells Installation of subsea infrastructure Wet storage of infrastructure prior to installation MODU anchors IMR activities
Marine discharges: sewage and sullage	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area
Marine discharges: treated utility water, chemical and deck drainage	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area
Marine discharges: produced water	✓					MODU during well unloading activities
Marine discharges: cooling water	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area
Marine discharges: drilling or completions discharges	✓					MODU during drilling activities
Marine discharges: subsea control fluids	✓	✓		✓	✓	Subsea infrastructure BOP during drilling Remotely Operated Vessels (ROVs)
Marine discharges: hydrotest fluid	✓	✓	✓	✓		Temporary production system on MODU Integrity testing of subsea infrastructure
Unplanned events and incidents						
Marine discharges: hazardous and non-hazardous inorganic waste	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area
Unplanned hydrocarbon releases	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area Subsea infrastructure

¹ Dr = Drilling; I = Installation; C = Commissioning; O = Operation; De = Decommissioning

8.2.4.2 Physical presence: seabed disturbance

As described in [Section 6.3.1.6](#) of the draft EIS/ERD, seabed disturbance as a result of the installation of subsea infrastructure (including pre-lay activities, placement and post lay rectification of infrastructure), wet storage (which involves temporarily placing equipment on the seabed), anchoring of the MODU and IMR activities within the State Proposal Area is expected to be approximately 4.15 km² in area of which 0.31 km² will constitute direct disturbance resulting in permanent impact. The 3.84 km² balance is the result of indirect disturbance and is considered reversible. Seabed disturbance is likely to result in temporary and localised displacement of naturally-occurring sediments

for the duration of the activity (ranging in the order of minutes to a few hours) and limited to the immediate disturbance area. This is likely to result in increases in turbidity levels at the seabed that will quickly disperse in the oceanic marine environment due to prevailing hydrodynamic conditions. As such, any reduction in water quality will be temporary (ranging in the order of minutes to a few hours) and will be limited to the water column immediately surrounding the disturbance area. The sediments that may be displaced are naturally occurring and, based on baseline surveys as described in [Section 5.2.10](#) of the draft EIS/ERD, do not contain any contaminants of concern. Due to the temporary and localised nature of changes in water quality, impacts to plankton are negligible.

Further, the small volumes of sediment mobilised, the water depth at which the seabed disturbance will occur, and the dynamic nature of the marine environment means that it is highly unlikely that any mobilised sediments will deposit on Scott Reef shallow water benthic habitats (<75 m water depth).

Given this, turbidity and associated sedimentation generated by seabed disturbances is not expected to result in any lasting change to the physical or chemical properties of water or sediments; or result in any lasting adverse impact to biota. As such minor impacts are expected to deep-water benthic communities and habitats (>75m water depth) are predicted. No impacts to Scott Reef shallow water benthic communities and habitats (<75 m water depth) located well away from the closest proposed location of the subsea infrastructure are predicted.

8.2.4.3 Physical presence: light

Potential impacts to plankton from light emissions are described in [Section 6.3.3](#) of the draft EIS/ERD.

Zooplankton often display diurnal vertical movements (Leach and Johnsen, 2003) within the ocean, migrating to surface waters at night to feed. Artificial light has, therefore, the potential to reduce the amplitude of their migration if lighting levels are sufficiently high at night (Moore et al., 2000). Artificial light emissions can influence the migration of zooplankton from deepwater to the surface, thereby affecting the food supply of nocturnal plankton-feeders. Alternatively, as most studies have demonstrated, the illumination of marine waters at night has the effect of increasing feeding opportunities for predators due to better visualisation of prey rather than resulting in potential plankton density reduction, however, these effects are expected to be highly localised and given the high turnover rate of plankton populations (ITOF, 2011) in open oceanic water there will be no lasting impact.

It is likely that plankton in the immediate vicinity of the FPSO facilities, MODU and project vessels that are within the light spill area (within hundreds of metres) will be impacted by light, based on the light emissions modelling. Given the highly localised effects of light emissions from the FPSO facilities, MODU and vessels associated with the proposed Browse to NWS Project, the proportion of the plankton population affected and the high turnover and recovery of plankton populations, no discernible impact on plankton communities at a population level is expected.

8.2.4.4 Marine discharges: sewage and sullage

A detailed description of the planned discharge of sewage and sullage and an assessment of the potential impacts and risks associated with the discharge are provided in [Section 6.3.9](#) of the draft EIS/ERD.

There are no planned discharges of untreated sewage or sullage within the State Proposal Area; however, discharges of treated sewage and sullage from project vessels, installation vessels and the MODU within the State Proposal Area will occur. These discharges will be primarily related to drilling activities and installation of the subsea infrastructure, with no permanent vessel presence in the State Proposal Area during operations. Under normal operating conditions, drilling and vessel activity (and associated marine discharges) will be limited to the deep waters in close proximity to the location of the proposed development wells and subsea infrastructure. Drilling activities are expected to take 2-3 months per well, with up to 24 wells in the State Proposal Area. It must be noted that all 24 wells will not be drilled in a continuous sequence. Approximately 3 wells will be installed at RFSU at the TRA drill centre, then remaining wells will be installed over subsequent years.

A review of current petroleum activities shows that vessels and MODUs typically generate around 5–15 m³ of waste water (consisting of sewage and sullage) per day (NERA, 2017). Using a rate of 0.375 m³/person/day as a guide (NERA, 2017), installation vessels may discharge approximately 22.5 m³/day, based on 60 persons aboard.

The discharge of treated sewage and sullage has the potential to result in the temporary (minutes to hours) and localised (tens of metres) reduction in water quality via eutrophication as a result of increased nutrient levels (e.g. ammonia, nitrite, nitrate and orthophosphate). This has the potential to cause adverse changes to the ecosystem, such as increased growth of primary producers (e.g. phytoplankton) which can deplete oxygen in the water column and result in changes in biological processes.

Sewage and sullage may also include some particulate matter which can cause an increase in the turbidity of the receiving waters close to the point of discharge. Discharges will disperse and dilute rapidly, with concentrations of wastes significantly dropping with distance from the discharge point. Several studies have quantified the high levels of dilution, including Loehr et al. (2006). A study by the US EPA (2002) found that discharge plumes behind cruise ships moving at between 9.1 and 17.4 knots are diluted by a factor of between 200,000:1 and 640,000:1. The discharges and level of effluent dilution in the studies did not present significant localised toxicity impacts to marine biota from any changes in water quality.

As described in [Section 6.3.9](#) of the draft EIS/ERD, monitoring of sewage and sullage discharge during the drilling campaign for the Torosa-6 well in 2008 determined discharges were rapidly diluted in the upper (less than 10 m) water layer to 1% of their

original concentration within 50 m, with no elevations above background in nutrients or metals recorded at any sampling station (ERM and SKM, 2008). As such, changes to the physical and chemical properties of the marine water will be temporary and highly localised. No change to the physical or chemical properties of sediments are expected due to the depth of the water where treated sewage and sullage would be discharged.

Although organic materials from the discharges will likely exert biological oxygen demand on the receiving waters, this is unlikely to reach levels below background ambient dissolved oxygen concentrations. Similarly, while the nutrient inputs from discharged effluent will rapidly be taken up by phytoplankton, pronounced increases in productivity as evidenced by increased chlorophyll a concentration are not expected. This is largely due to the assimilative capacity of the open ocean, with any potential additive nutrients not expected to accumulate in the vicinity of the discharge location. As such no lasting impacts to planktonic communities are expected.

Given the relatively small volume of treated sewage and sullage to be discharged, the distance from the discharge to Scott Reef and the expected rapid dilution of the discharge, the temporary and highly localised changes to water quality are not expected to have any impacts to biota or the environmental values of the Scott Reef system.

Though unlikely, discharges of sewage and sullage at levels significantly above the discharge specifications may result from human error or equipment failure. This would potentially result in a larger area being impacted (a temporary larger mixing zone), although the plume would still be expected to rapidly disperse. The subsequent temporary (i.e. limited to the duration of the unplanned discharge) and localised reduction in water quality would be unlikely to lead to subsequent impacts to deepwater receptors due to the depth of water; or to the Scott Reef system due to the distance from where the discharges would occur.

8.2.4.5 Marine discharges: treated utility water, chemical and deck drainage

A detailed description of the planned discharge of treated utility water, chemical and deck drainage and an assessment of the potential impacts and risks associated with the discharges is provided in [Section 6.3.10](#) of the draft EIS/ERD.

Within the State Proposal Area, treated utility water, chemical and deck drainage will be limited to deck drainage, treated bilge water and desalination brine from project vessels, installation vessels and the MODU. As described in [Section 6.3.10](#) of the draft EIS/ERD, potentially contaminated deck drainage discharges would occur from the MODU during periods of heavy rain, with potentially contaminated drainage routed

to slops tanks for treatment prior to discharge. Bilge water from within machinery spaces will be captured separately in a bilge tank for treatment.

As described in [Section 6.3.10](#) of the draft EIS/ERD, an oil-in-water separator will be available onboard the MODU and vessels (as applicable to vessel class), which will be maintained and operated so that bilge water is treated to reduce hydrocarbon concentrations below 15 ppm in accordance with MARPOL 73/78 Annex. Under normal operating conditions, drilling and vessel activity (and associated marine discharges) will be limited to the deep waters in proximity to the location of the proposed development wells and subsea infrastructure.

Considering the composition of the drain discharges (i.e. small quantities of hydrocarbons and detergents) and assimilative capacity of the receiving environment, it is expected that drain discharges will rapidly dilute within the surrounding waters. As such, these discharges will result in temporary (lasting a few minutes) change to water quality in the immediate vicinity of the discharge. Given the water depth (>300 m) and distance to Scott Reef from where these discharges would occur, this change to water quality is not expected to have any impacts to sediment, biota or the environmental values of the Scott Reef system.

Desalination brine discharge is expected to be 20 to 50% more saline than the intake seawater (depending on the desalination process used) and therefore only a small number of dilutions will be required to achieve ambient salinity levels. Studies undertaken by the US EPA (Frick et al., 2001) determined that brine discharges from the surface dilute 40-fold approximately 4 m from the source. This modelling can be used as an indicator for predicting horizontal attenuation and diffusion of brine discharges. Given the proposed discharge volumes from the FPSO facilities (21.5 m³/hr), which is the largest source of such discharges, dilution to ambient levels is likely to be achieved within a very short distance from the discharge point (<100 m). Therefore, owing to the likely high number of dilutions achieved following discharge from the proposed sources (i.e. FPSO, vessels and MODU), elevated salinity levels (above ambient) will be highly localised at the discharge point and unlikely to have a perceptible effect on ambient salinity concentrations in the water column.

Though unlikely, unplanned discharges resulting from human error or equipment failure on project vessels or the MODU may occur. This would potentially result in a larger area being impacted (a temporary larger mixing zone), although the plume would still be expected to rapidly disperse. The subsequent temporary (i.e. limited to the duration of the unplanned discharge) and localised reduction in water quality would be unlikely to lead to subsequent impacts to deepwater receptors due to the depth of water; or to Scott Reef system due to the distance from where the discharges would occur.

8.2.4.6 Marine discharges: produced water

A detailed description of the planned discharge of produced water (PW) and an assessment of the potential impacts and risks associated with the discharge of PW is provided in [Section 6.3.12](#) of the draft EIS/ERD.

Low levels of PW may be discharged from the MODU at the well locations, including within deep water areas of the State Proposal Area during well unloading. This PW would be condensed water generated in the hydrocarbon gas stream during well unloading and would be discharged as part of the discharge of well clean up fluids, which would include drilling fluids (addressed below). The PW component of the discharge will constitute a very small proportion of the discharge stream, with the discharge dominated by suspension fluids and associated PW generally limited to small volumes of condensed water. Well unloading is anticipated to take 1-2 days per well (i.e. the amount of time that the well is flowing). The PW component of the discharge may contain inorganic salts from geological formations, dissolved organic compounds, dissolved gases (including H₂S and CO₂), dissolved and dispersed hydrocarbons, metals and low levels of Naturally Occurring Radioactive Material (NORMs).

Given the PW component is a fraction of the overall discharge during well unloading, this discharge is addressed below under drill cuttings and fluids.

8.2.4.7 Marine discharges: cooling water

A detailed description of the planned discharge of cooling water and an assessment of the potential impacts and risks associated with the discharge is provided in [Section 6.3.13](#) of the draft EIS/ERD.

Cooling water discharge from project vessels and the MODU at the well locations may impact marine environmental quality due to thermal impacts (increased water temperature) and toxicity impacts relating to the residual chlorine concentration within the cooling water discharge.

Relatively low levels of cooling water will be discharged from project vessels and the MODU (approximately 50 m³/day depending on vessel size). Under normal operating conditions, drilling and vessel activity (and associated marine discharges) will be limited to the deep waters near the location of the proposed development wells and subsea infrastructure.

To put this discharge volume in context, the FPSO facilities are expected to discharge up to approximately 720,000 m³/day (discharge to Commonwealth waters). Modelling undertaken of the FPSO facilities cooling water discharge indicated a rapid dilution would be expected ([Section 6.3.13](#) of the draft EIS/ERD). Given the markedly smaller discharge volumes from the

vessels and MODU, these small volumes are expected to rapidly disperse and dilute (within tens of metres) with impacts expected to be a highly localised change in water quality. This reduction in water quality would be primarily limited to the construction phase, with vessel activities in the State Proposal Area during operations primarily limited to intermittent IMR activities. Due to the distance of proposed cooling water discharge to Scott Reef, the reduction in water quality is not expected to have any impacts to sediment, biota or the environmental values of the Scott Reef system.

8.2.4.8 Marine discharges: drilling or completions discharges

A detailed description of the planned discharge associated with the drilling activities and an assessment of the potential impacts and risks associated with the discharge are provided in [Section 6.3.15](#) of the draft EIS/ERD. The impact assessment in the draft EIS/ERD focuses largely on activities in the State Proposal area however they are repeated here in order to provide a standalone assessment of impacts within State jurisdiction.

Development drilling activities within the State Proposal Area associated with the proposed Browse to NWS Project involve the drilling and completion of up to 24 wells. Drilling of production wells will generate drill cuttings, require cementing of the casing, and require the use of a range of fluids, that may be discharged to the marine environment, typically at the seabed and at or near the sea surface depending on the hole section.

During the life of the proposed Browse to NWS Project, well components will require maintenance, repair or replacement. This will require well intervention activities which generally occur within the wellbore and may include but not limited to well logging activities (slickline, wireline, coil tubing), well testing and flowback; and well workovers. Relevant discharge types generated from these activities may include subsea control fluid (control of subsea tree) (refer to [Section 6.3.16](#) of the draft EIS/ERD), completions fluids and well annular fluids.

In addition, well abandonment activities can result in discharges to the marine environment including but not limited to installation and pressure testing of the blow out preventer (BOP), cutting/perforation of casing or production tubing; and installation of permanent reservoir and surface barrier (cementing). Relevant discharge types generated from these activities may include subsea control fluids (refer to [Section 6.3.16](#) of the draft EIS/ERD), well annular fluids and cement.

Drilling and completion activities required for the proposed Browse to NWS Project are expected to be broadly similar to that of the previous development concepts ([Section 2.7.1](#) of the draft EIS/ERD).

Drill cuttings

Drilling generates drill cuttings due to the breakup of solid material from within the borehole. The resultant drill cuttings are basically rock particles of various shapes, with sizes typically ranging from very fine to very coarse. Cuttings generated during drilling of the top-hole sections are typically discharged to the seabed at the well site.

Once the top-hole sections are complete, installation of the riser and BOP provides a conduit back to the MODU, forming a closed circulating system. The bottom hole sections will be drilled with a marine riser in place that enables cuttings and drilling fluids to be circulated back to the MODU, where the cuttings are separated from the drilling fluids by the solids control equipment (SCE). The SCE comprises equipment such as shale shakers, cuttings dryer(s) and centrifuges. The SCE uses shale shakers to remove coarse cuttings from the drilling fluid. The recovered fluids from the cuttings may then be directed to centrifuges, which are used to remove fine solids (4.5 to 6 µm). The cuttings are usually discharged below the water line and the fluid is recirculated into the fluid system.

The drilling fluid retained on cuttings is determined by the SCE and typically, treated water based fluid (WBF) cuttings may retain 5 to 25% of the drilling fluid after passage through SCE (Neff, 2005) and treated cuttings when drilling with non water based fluid (NWBF) may retain 5 to 15% of the drilling fluid (Neff et al., 2000). The cuttings with retained NWBF will also pass through a cuttings dryer and associated SCE, to reduce the average oil on cuttings to 6.9% wt/wt or less on wet cuttings, prior to discharge.

The fate and dispersion of the cuttings once discharged into the marine environment is determined by particle size and the density of the unrecoverable fluids. The larger cuttings particles will drop out of suspension and deposit in close proximity to the well site (tens of metres) with potential for localised spreading downstream. In contrast, the finer particles will remain in suspension and be transported away from the well site, rapidly diluting and eventually depositing over a widespread area (hundreds of metres) downstream of the well site.

Drill cuttings and unrecoverable fluids are discharged at the seabed at the well site for the top-hole sections drilled riser-less (no closed loop with the MODU). This results in a localised area of sediment deposition (known as a cuttings pile) in close proximity to the well site. The spread of cuttings and associated water based fluids is expected to be up to 50-200 m downstream from the discharge location based on a review of seven studies summarised by International Association of Oil and Gas Producers (IOGP, 2016). Drill cuttings and retained NWBF (<6.9% OOC) released at or below the

surface after treatment on the MODU for the bottom-hole well sections are generally dispersed and settle within a seabed area confined to a maximum of 500 m distance of the discharge point (IOGP, 2016).

Drilling fluids

Drilling fluids (also termed drilling muds) serve many purposes including maintaining borehole stability and hydrostatic pressure, reducing friction and cleaning/cooling of the drill bit, in addition to acting as a medium to carry cuttings from the well bore and return them to the surface at seabed or on the MODU. Drilling fluids are either mixed on the MODU or received pre-mixed, then stored and maintained in a series of mud pits aboard the MODU or a suitable vessel. There are two main types of drilling fluids, including water based fluids (WBF) and non-water based fluids (NWBF).

Water based drilling fluids

The proposed Browse to NWS Project will use WBF as the preferred option. WBF consists mainly of seawater with the addition of chemical and mineral additives to aid in its function. Drilling additives typically used may include chlorides (e.g. sodium, potassium), bentonite (clay), cellulose polymers, guar gum, barite or calcium carbonate. These additives are either completely inert in the marine environment, naturally occurring benign materials, or readily biodegradable organic polymers with a very fast rate of biodegradation in the marine environment.

WBF will be discharged to the marine environment at the location of the well being drilled under the following scenarios:

- + at the seabed when drilling the top-hole (riser less) sections
- + below sea surface as fluid remaining on drill cuttings, after passing through SCE (bottom-hole sections, drilled with riser in place)
- + from the mud pits via a discharge pipe below the sea surface. If WBF cannot be re-used due to bacterial deterioration or does not meet required drilling fluid properties, it may be discharged to the marine environment using seawater flushing. WBF may not be able to be reused between drilling sections due to the drilling sequence, technical requirements of the fluid (i.e. no tolerance for deterioration of fluid during storage) and maintenance of productivity/injectivity. Unused or spent WBFs may be disposed from the MODU as a bulk discharge (defined as a discrete discharge of large quantities) at the end of each well section.

Additional products such as barite and bentonite may be discharged in bulk/single discharge at the end of the activity if they cannot be reused or taken back to shore. Use and discharge of all chemicals will be

performed in line with Woodside's internal guidelines. Discharge may be in the form of dry bulk or as a slurry; however, discharges will not be contaminated with hydrocarbons. Planned bulk discharges at wells within the State Proposal Area will be managed as described in the **Management approach - Torosa wells in the State Proposal Area** section below.

Non water based drilling fluids

Non-water-based fluids (NWBF) refers to drill fluids that are hydrocarbon rather than water based fluid. NWBF may be used to manage well stability to safe levels based on the offset history, geohazards assessment and borehole stability studies. Like a WBF system, a range of standard solid and liquid additives may be added to alter specific fluid properties for each section of the well, dependent on the conditions encountered while drilling. NWBFs will be selected in accordance with Woodside's chemical selection and assessment process on the basis of lowest health, safety and environmental risks while meeting operational requirements.

During drilling operations, the NWBF (like WBF) are pumped by high pressure pumps down the drill string and out through the drill bit, returning via the annulus between the drill string and the casing of the well bore, and back to the MODU via the riser. Discharge scenarios are much the same as that described for WBF, however NWBF will not be used for top-hole section drilling (riserless); therefore, no direct seabed discharge of NWBF will occur.

The NWBF that cannot be re-used (i.e. do not meet required drilling fluid properties or are mixed in excess of required volumes) are recovered from the mud pits and returned to the shore base for onshore processing for recycling and/or disposal. The mud pits and associated equipment/ infrastructure are cleaned when NWBF is no longer required, with wash water discharged with mud pit washings, or returned to shore for disposal if discharge criteria cannot be achieved.

There are typically a number of mud pits (tanks) on the MODU that provide a capacity to mix, maintain and store fluids required for drilling activities. The mud pits form part of the drilling fluid circulating system. The mud pits, any supply vessel storage tanks carrying WBF or NWBF, and associated equipment/infrastructure are cleaned out during and at the end of drilling and completions operations. Mud pit wash residue is operationally discharged from the MODU with less than 1% oil contamination by volume. Where the mud pit residue exceeds 1% by volume, the residue will be retained and disposed onshore.

Drilling fluids toxicity

Components of the WBF system have a low toxicity. Bentonite and guar gum are listed as 'E' category fluids under the OCNS and is included on the Oslo Paris

(OSPAR) Commission PLONOR (chemicals that 'pose little or no risk to the environment') list (OSPAR, 2019). They may, however, cause physical damage to benthic organisms by abrasion or clogging, or through changes in sediment texture that can inhibit the settlement of planktonic larvae, such as polychaete and mollusc early life stages (Swan et al., 1994). However, these impacts are not expected to be significant due to the rapid biodegradation and dispersion of WBFs (Terrens et al., 1998).

NWBF may contain a range of synthetic hydrocarbons, such as paraffins and olefins; however, such additives are designed to be low in toxicity and biodegradable, as well as not being readily bioavailable or likely to bioaccumulate amongst the deepwater benthic biota that live within the seabed (infauna) or on the seabed (epifauna). However, it is noted that microbial biodegradation can result in oxygen reduction within sediments. Nedwed et al. (2006) however, found that depth is an important factor for residual concentrations of NWBF once they reach the seabed, suggesting that loss of base fluid during settling acted to significantly reduce chemical effects from discharges. It is also noted that NWBF cuttings tend to clump and settle to the seabed rapidly adding to the cuttings pile in proximity to the well site. The Nedwed et al. (2006) study concluded that NWBF discharged in deep water caused very limited environmental impacts (from analysis of differences in benthic fauna between pre- and post-drilling samples).

Cement

Once each of the top-hole sections are drilled, casing is installed in the wellbore and secured in place by pumping cement into the annular space and may involve a discharge of excess cement at the seabed ($\sim 80 \text{ m}^3/\text{well}$). Wherever possible, the cement line flush volumes are included in the planned cement jobs. When a job is completed, the cement unit is cleaned, and the residual cement discharged overboard. The discharge volumes of residual cement products are approximately 1 m^3 .

At the commencement of the drilling campaign there may be a requirement to run a cement unit test to test the functionality of the cement unit and the cement bulk delivery system prior to performing an actual cement job. This test would result in a small volume of approximately 10 m^3 of cement slurry being discharged at surface to sea. The slurry is usually a mix of cement and water however may sometimes contain stabilisers or chemical additives. Excess cement (dry bulk) after well operations are completed, will be held onboard and used for subsequent wells, provided to the next operator at the end of the program, or discharged to the marine environment. Planned bulk discharges at wells within the State Proposal Area will be managed as described in the **Management approach - Torosa wells in the State Proposal Area** section below.

Completion fluids

Completion fluids are usually brines (i.e. a mixture of seawater or formation water) with additives that can include chlorides (often sodium, potassium or calcium), bromides, hydrate inhibitor (MEG), biocide and/or oxygen scavenger. They are designed to have the proper density and flow characteristics to be compatible with the reservoir formation. Completion fluids may also include solids-free fluid, gravel pack carrier fluid and loss circulation material. Completion fluids are used during wellbore clean-up, while running completions, and may be returned to surface during well unload activities. Most of the gravel pack carrier fluid is bulk discharged.

Wellbore and casing clean-up are required at various stages of the operations to ensure the contents of the well are free of contaminants before the next stage of well construction. A chemical wellbore cleanout fluid train may be used to remove residual fluids (including NWBF, if used) from the wellbore. The wellbore cleanout fluid is usually brine (similar to completion fluid) that can include several chemicals, such as biocide and surfactant. During the wellbore clean-out process, fluids are circulated back to the MODU, and, if required, analysed before they are discharged overboard. Discharge volume would be ~400 m³ (based on the designs of the proposed production wells).

A brine of adequate density to control formation pressure may also be used during well suspension or well abandonment.

Well unload

During well unloading activities, all completion and reservoir fluids will be flared or discharged to the environment. The base oil column, completion fluid, some drilling fluid remnants, hydrocarbons and produced/condensed water will be measured, handled, separated, treated for overboard discharge (non-hydrocarbon) and flared/burned (hydrocarbon) through the temporary production system on the MODU.

The well test water treatment package will be used to treat produced/reservoir water before discharge. Prior to discharging, the fluids are cycled through an oilbond filtration system and gauge tank. Water filtration is standard practice for well unloading operations.

Discharges will occur during well unloading to a MODU or suitable vessel. These discharges will constitute leftover drilling fluids, completion fluids and small amounts of produced water (PW; refer to [Section 8.2.4.6](#)) Well unloading is anticipated to take 1-2 days per well, and discharge of fluids during this time has been indicatively estimated at approximately 100 m³ to 130 m³ per well.

Well annular fluids

Annular fluids fall within the category of completion fluids and refer to the fluids that remain in the annular spaces between the casing and previous casing strings or formation. It may consist of weighted drilling fluid and cement-contaminated mud, seawater, barite, cement, polymer, and may include small amounts of hydrocarbon. For the proposed Browse to NWS Project, the reference case annular fluid is base oil with no additives apart from a demulsifier.

If a well is underperforming, or surveillance indicates debris is contained within the well, the contents of the wellbore may be flowed to a MODU. This displaces the well fluids (i.e. suspension/completion fluids). These are discharged overboard, as potential gas content makes it too dangerous for personnel to filter or treat them.

WBF used during riserless drilling will be released to the marine environment when the well head is removed during abandonment. Upon wellhead removal, small volumes (~ 1 m³) of fluid exchange between the annular spaces and the ocean may occur. The exchange will not be instantaneous as the annular spaces are small and the fluids are typically heavier than seawater, however, as the fluids are released it is expected that they will be rapidly diluted within metres of the release location.

Overview of drill cuttings and drilling fluids

An indicative well profile is shown in [Table 8-3](#). During drilling of the top-hole well sections drill cuttings (~ 625 m³) and drilling fluids (~ 1,095 m³) based on a typical well profile are generated and will be released from the well directly onto the seabed. During drilling of the bottom-hole well sections, drill cuttings (~ 225 m³) and drilling fluids (~ 1,020 m³) based on a typical well profile are generated and may be discharged at or below the sea surface.

Table 8-3 Indicative cuttings volumes and fluid type for a typical Browse well

Indicative well section diameter	Indicative Drill Length (m)	Indicative Cuttings Volume (m ³)	Indicative Fluids Volume (m ³)	Indicative Fluid Type
42"	100	89 m ³	427	Seawater with bentonite sweeps
26"	440	151 m ³	1327	Seawater with bentonite sweeps
16"	2970	385 m ³	965	Weighted Gel (Bentonite) WBF
12 ¼"	2799	213 m ³	925	WBF or NWBF
9 ⅞"	243	12 m ³	790	WBF or NWBF
Total per well	6,552 m	850 m³	4,435 m³	

Contingent drilling activities include well side-track and well respud. If either of these activities are required, they will result in additional volumes of drilling discharges equal to the re-drilled sections of the well. The impacts of these unlikely scenarios are broadly covered by the base case impact assessment considerations.

It should be noted that the detailed impact evaluation with modelling is based on the primary drilling discharges (cuttings and residual fluids) due to the nature, scale and duration of the discharge compared to other sources (e.g. completion fluids). These results have been used to support impact and risk assessment and in the determination of acceptability in the context of the receiving environment and relevant receptors.

Modelling

Modelling of surface discharge of drill cuttings was undertaken for the previous development concepts and is presented in [Section 6.3.15.3](#) of the draft EIS/ERD.

The modelling indicated that, at all three drill centre locations, the sea surface discharge of drill cuttings from bottom hole sections of wells resulted in incursions of sediment plumes and associated increased deposition at some parts of North and South Scott Reef including within the lagoons. As a result, Woodside has committed to manage drilling discharges (in particular bottom hole discharges) at drill centre locations in the State Proposal Area (i.e. TRA, TRD, TRE and TRF) in such a manner to avoid impacts to Scott Reef shallow water benthic communities and habitats (<75 m water depth). This management approach is further described in [Section 8.2.6](#).

In contrast, the seabed discharge of drill cuttings from top-hole well sections may result in sediment plumes and associated deposition of sediment to the surrounding seabed and was confined to the deeper layers of the water column with no contact with deeper water or shallow water coral habitats at Scott Reef. As outlined in [Section 5.2.5.7](#), while there is some evidence

of localised intrusions of cooler water around the western and eastern entrances to the channel between North and South Scott Reef during spring tides, there is no evidence of persistent upwelling or downwelling currents around Scott Reef (Green et al., 2019) and therefore, no transport mechanisms to mobilise drill cuttings from deep waters to the shallower waters of the reef system. As such, given the location of the drill centres in deep water, which experience strong surface and subsurface currents, drill cuttings and fluid discharge disposal at seabed would be expected to settle rapidly. Therefore, any reduction in water quality such as elevated TSS is expected to occur in a localised area around the drill centre and will be temporary in nature.

To further inform the impact assessment, for the seabed discharge of drill cuttings generated from the top-hole sections of the wells, the modelling results indicated that at the:

- + previously proposed TRE drill centre location (water depths of 360 m):
 - + Sediment plume predominantly extended westward, driven by the stronger ebb tide, with some eastward extension during the flood tide ([Figure 6-34](#) of the draft EIS/ERD).
 - + Cuttings sedimentation would be limited to the deep seabed and water layers of the channel, with no sedimentation on Scott Reef shallow water benthic communities and habitats (<75 m water depth) including in the lagoons of North and deeper water coral habitat of South Scott Reef.
 - + Maximum net sediment deposition over the duration of the 12-month drilling program is estimated at approximately 46 cm at the previously proposed TRE drill centre location ([Figure 6-34](#) of the draft EIS/ERD).

- + previously proposed TRD drill centre location (water depths of 400 m):
 - + Sediment plume confined to the deepwater layers of the water column (Figure 6-41 of the draft EIS/ERD).
 - + Modelling did not predict elevated suspended sediment concentrations or net sedimentation at Scott Reef shallow water benthic communities and habitats (<75 m water depth) including in the lagoons of North and deeper water coral habitat of South Scott Reef.
 - + Net sediment deposition over the duration of the drilling program is approximately 35 cm at the previously proposed TRD drill centre location (Figure 6-35 of the draft EIS/ERD).
- + previously proposed TRA/TRB drill centre location (water depths of 460 m):
 - + Sediment plume confined to the deep-water layers and was not expected to reach Scott Reef shallow water benthic communities and habitats (<75 m water depth) including in the lagoons of North and deeper water coral habitat of South Scott Reef (Figure 6-36 of the draft EIS/ERD).
 - + Sedimentation was predicted to extend eastwards of Scott Reef, influenced by the north-west south-east tidally-induced currents.
 - + Net sediment deposition at seabed over the duration of the drilling program is approximately 21 cm at the previously proposed TRA/TRB drill centre location (Figure 6-42 of the draft EIS/ERD).

Maximum suspended sediment concentrations in the water column in the vicinity of the release points (near the seabed) was predicted to reach 1250 mg/L at TRE, 1530 mg/L at TRD and 2500 mg/L at the previously proposed TRA/TRB drill centre location.

Management approach - Torosa wells in the State Proposal Area

Modelling indicated that the sea surface discharge of drill cuttings from the bottom-hole sections generated at the previously proposed TRE and TRD drill centre locations would potentially result in incursions of sediment plumes and associated increased sedimentation to portions of North and South Scott Reef including within the lagoons.

Given the potential sensitivities of Scott Reef shallow water benthic habitat (<75 m bathymetry) to sedimentation from drilling discharges, Woodside has committed to managing the drilling discharges (in particular, bottom-hole section discharges) at drill centre locations in the State Proposal Area (i.e. TRA, TRD, TRE

and TRF) in such a manner to avoid potential impacts to Scott Reef shallow water benthic communities and habitats (<75 m water depth). This approach is as follows:

1. For each identified drill centre, drilling discharge modelling will be completed using final design data to assess the dispersion and fate of drill cuttings, residual drilling fluids on cuttings, as well as bulk discharge (collectively referred to as drilling or completions discharges). This information will be provided in the relevant Environment Plan.
 - a. Where modelling can demonstrate that the discharge techniques and operational parameters (e.g. depth, rate and duration) are such that no impact to Scott Reef shallow water benthic communities and habitats (<75 m water depth) are predicted, drilling will be undertaken accordingly.
 - b. For those scenarios where modelling suggests impact to Scott Reef shallow water benthic communities and habitats (<75 m water depth) may occur, alternative drilling discharge techniques and operational parameters (e.g. depth, rate and duration) will be assessed and selected to avoid potential impacts.
2. Where bottom-hole section drilling discharges are planned to be undertaken at the specified drill centre locations based on outcomes from the drilling discharge modelling, monitoring at discharge source will be undertaken to verify the model predictions and ensure they are appropriately conservative.
3. For those scenarios where modelling predicts impact to Scott Reef shallow water benthic communities and habitats (<75 m water depth), and no alternative discharge techniques and operational parameters are available, then the relevant drilling or completions discharges predicted to cause the impact will be transported to a suitable location (e.g. at a sufficient distance from the reef or onshore) for disposal.
4. For those scenarios where verification monitoring at the discharge point indicates a potential impact to Scott Reef shallow water benthic communities and habitats (<75 m water depth), then the management of drilling or completions discharges (as predicted to cause the impact) will be addressed by transportation to a suitable location (e.g. at a sufficient distance from Scott Reef or onshore) for disposal.

These management objectives are supported by a range of both feasible and industry proven management measures.

Assessment

The impacts of drilling or completion discharges on water and sediment properties, and benthic communities are well documented. The United Kingdom Offshore Operators Association (UKOOA) sponsored an extensive initiative to assess the issue of cuttings piles in the North Sea from operations between 1970 and 2000 (Danielsson et al., 2005). More recently, the International Association of Oil and Gas Producers (IOGP) published a report which reviews scientific literature on the fate and effects of ocean discharge of drill cuttings and associated drilling fluids from offshore oil and gas operations (IOGP, 2016). Drill cuttings have been studied specifically on the NWS of Australia (Oliver and Fisher, 1999; SKM, 2007). The effects of turbidity and sediment deposition on sensitive ecological receptors such as corals have also been the subject of many peer-reviewed studies (e.g. Fabricius, 2005).

Drilling or completions discharges have the potential to impact the marine environment through:

- + temporary increase in TSS in the water column
- + attenuation of light penetration as an indirect consequence of the elevation of TSS and the rate of sedimentation
- + sediment deposition to the seabed leading to the alteration of the physio-chemical composition of sediments, and burial and potential smothering effects to sessile benthic biota
- + potential contamination and toxicity effects to benthic and in-water biota from drilling fluids.

It should be noted that the following assessment is restricted to potential impacts to deepwater habitats around Scott Reef, given Woodside's commitment (see [Section 8.2.6](#)) to not undertake sea surface discharge from the bottom-hole sections that could potentially affect Scott Reef shallow water benthic habitats (<75 m water depth).

Change in sediment quality

Cuttings discharged at the seabed will result in localised cuttings piles on the seabed surrounding the wellhead, with a greater spread of cuttings expected to occur down current from the well site. Sediment quality can be impacted by drilling or completions discharges as the drill cuttings alter the particle size distribution and physico-chemical composition of sediments and from the introduction of contaminants (e.g. hydrocarbons and metals) from drilling fluids. This in turn can have an impact on benthic communities through sediment deposition causing burial and smothering, or toxicity effects from drilling fluids.

The modelling indicates that sediment deposition would potentially occur to a distance in the order of a couple of hundred metres from each well location (in the direction of the prevailing current). This assessment aligns with

several studies which indicate that the spread of cuttings can be expected to be up to about 150 m from the discharge location (IOGP, 2016).

Change in water quality

The discharge of drill cuttings and unrecoverable fluids is expected to increase turbidity and TSS levels in the water column. Drilling or completions discharges are generally intermittent and of short duration during the drilling of a well. Nelson et al (2016) identified <10 mg/L as no effect or sub lethal minimal effect concentration, with Boesch and Rabalais (1987) demonstrating that surface discharges are likely to be confined to within 350 m - 1,500 m downstream from the discharge location.

The modelling ([Section 6.3.15.3](#) of the draft EIS/ERD) indicates that both seabed and surface drilling discharges would result in impacts to water quality as a result of elevations in TSS and the introduction of low toxicity contaminants. This reduction in water quality will be temporary (i.e. limited to the duration of the activity, restricted to deep water (for Torosa drill centres in the State Proposal Area) and subject to rapid dispersion and dilution by prevailing currents, due to the open oceanic waters of the State Proposal Area.

Overall, given the predicted rapid dispersion of suspended sediments within the open ocean environment of the State Proposal Area, the short period of intermittent discharge and the generally low concentration of TSS within tens of metres of the discharge, any change in water quality and sediment associated with drill cutting discharge are expected to be temporary with a slight effect and with no long-term reduction in the environmental values of the State Proposal Area. In addition, the implementation of the proposed management approach for the proposed Torosa drill centres should ensure that impacts to Scott Reef shallow water benthic habitats (<75 m depth) are avoided.

Further discussion on the potential impacts to benthic habitats from drill cuttings discharge is presented in [Section 8.3.5](#).

8.2.4.9 Marine discharges: subsea control fluids

A detailed description of the proposed discharge of subsea control fluids and an assessment of the potential impacts associated with the discharge is provided in [Section 6.3.16](#) of the draft EIS/ERD.

The subsea hydraulic control system will have high pressure (HP) and low pressure (LP) circuits. The HP system will operate the downhole safety valve and the LP system will operate all other subsea valves. An open loop subsea control system will be adopted for the HP control systems, whereby the control fluid is pressurised on the FPSO facilities by the hydraulic accumulators and delivered to subsea valves via umbilicals. For the LP control system, a hybrid solution will be used.

The open loop HP hydraulic system will discharge a small amount (0.1 L) at the Christmas tree when testing or operating the downhole safety valve. The release will be at the wellhead subsea control module, typically at 350 m water depth or greater. The hybrid LP hydraulic system will utilise a contingency injection line in the umbilical in order to achieve a closed loop configuration. This hybrid system has no planned discharges and will only release hydraulic fluid if the system leaks or the contingency injection line is required due to failure of the primary injection line.

Control fluids are sourced from proprietary suppliers and are composed of low toxicity, water-based fluids. The specific control fluid has not yet been selected; however, such fluids are typically waterbased with additives such as monoethylene glycol (MEG) (usually about 40% of the total volume), lubricants, corrosion inhibitors, biocides and surfactants.

During drilling activities, control fluids will be discharged during function and pressure testing of the BOP control system. The maximum volume of control fluid that will be released to the marine environment per manifold is 1,900 L per year of water-based fluid containing ~3% active ingredient (40–68 L of control fluid additive).

Given the small volumes and solubility of the proposed water-based discharges, it is anticipated the fluids would be rapidly diluted (within tens of metres) in the prevailing currents adjacent to the discharge location on the seabed. Hence, the intermittent discharge of small volumes of subsea control fluid may result in a reduction in water quality that will be temporary (limited to the duration of the activity), restricted to deep water; and subject to rapid dispersion and dilution by prevailing currents due to the open oceanic waters of the State Proposal Area.

Due to the expected rapid dispersion and dilution by prevailing currents, and fact that discharged subsea fluid is not predicted to accumulate in sediments, no lasting change to sediment quality is predicted.

Given the minimum water depth at potential discharge locations (greater than 350 m), and the expected rapid dispersion and dilution by prevailing currents, exposure of plankton to the discharge is predicted to be negligible. In addition, the wide spread nature and rapid turn-over of plankton populations leading to relatively quick recovery times, ensures that any impact on local communities would be expected to recover relatively quickly (within weeks or months) (ITOPF, 2011).

Given this and the sparse nature of the deepwater benthic habitats in the State Proposal Area, no impacts to biota are predicted. Further, given the distance from the subsea infrastructure to Scott Reef and the depth of the discharge, this reduction in water quality is not expected to result in any lasting impacts to the environmental values of the State Proposal Area, including the Scott Reef system.

8.2.4.10 Marine discharges: hydrotest fluid

Hydrotest fluids are used for two distinct purposes; testing of the integrity of the flowlines and for preservation of the flowlines prior to the introduction of reservoir fluids. Hydrotest fluids may consist of a combination of seawater, biocides, corrosion inhibitors, oxygen scavenger, MEG and fluorescent dye.

The period of time the hydrotest fluid is left within the infrastructure as a preservation fluid will depend on the type of fluid selected and the proposed Browse to NWS Project schedule for construction and installation activities. It may be necessary to discharge and replace the hydrotest fluid if it is not providing an effective mitigation against integrity threats.

For the SURF infrastructure, the flowline and riser hydrotest fluid will most likely be returned to the FPSO facility and then discharged to sea in Commonwealth waters. However, discharge may occur in deep water at the manifolds or riser base FLETS for rigid flowlines.

For flowlines where the manifold is in the State Proposal Area, discharge will occur at the FPSO location (either from the FPSO or from the riser base FLETS) in order to maximise distance of the discharge from Scott Reef. However, for flowlines which are terminated at both ends within the State Proposal Area (specifically for TRE and TRF manifolds only), discharge of flowline hydrotest fluid in the State Proposal Area may be unavoidable. Given that the TRE and TRF manifolds are daisy-chain connected to other manifolds in the State Proposal Area and are not part of Torosa Phase 1 RFSU equipment, future engineering will consider the viability of alternatives to flowline hydrotest fluid discharge in the State Proposal Area, which will be described in a future Environment Plans. Minor hydrotest discharges associated with smaller pieces of subsea equipment may also occur in situ.

For the SURF flowlines (including those in the State Proposal Area), hydrotest fluids may consist of chemically treated seawater or a MEG/water mixture. The combination of constituents for the SURF flowlines are dependent on the flowline material type and on the period of preservation required.¹

Hydrotest fluid volumes being discharged to the marine environment will vary depending on the flowline section to be tested. Volumes are estimated to be up to approximately 950 m³ of hydrotest fluid for the TRE flowline and up to approximately 250 m³ for TRF flowline. A subsea flowline hydrotest discharge is likely to take less than a day to complete. These discharges will occur for each piece of infrastructure during pre-commissioning.

¹ While the majority of subsea infrastructure will be flooded with hydrotest fluid post installation, some components will be pre-flooded with hydrotest fluid prior to installation.

Previous modelling of SURF infrastructure

The size of the mixing zone associated with a hydrotest discharge from flowlines is dependent on the discharge characteristics (e.g. rate, volume, density etc.) and prevailing hydrodynamics. Woodside has previously performed hydrotest modelling for a range of discharge rates (4.8 m³/min, 3.7 m³/min, 1.85 m³/min and 1.5 m³/min), in water depths ranging from 130 m to 830 m on the North West Shelf, which is considered appropriate to support the impact assessment, in recognition that further hydrotest modelling will be completed to support the relevant Environment Plan.

The nearfield dispersion modelling indicated that due to the momentum of the discharges a turbulent mixing zone is created in the immediate vicinity of the discharge points. Following this initial mixing, the negatively-buoyant plumes are predicted to travel laterally in the water column and remain close to the seabed.

The far-field dispersion modelling indicated that based on an in-pipe chemical concentration of 600 ppm, the plume would achieve 600 dilutions to dilute to below 1 ppm (based on LC50 over 96 hours) in proximity to the discharge location, ranging at a distance from 50 m (130 m water depth; 1.5 m³/min; summer; 95th percentile) to 300 m (844 m water depth; 4.8 m³/min; summer; 95th percentile) downstream of the discharge point. Given the negative buoyancy of the plume, bathymetry of the location (steep reef slopes surrounding the discharge location), and lack of upwelling processes from the depth of discharge, regardless of the size of the mixing zone the zone of influence will remain restricted to depth and avoid Scott Reef shallow water benthic habitat (<75 m bathymetry).

While the modelling for the planned dewatering discharges are not directly comparable with regards to depth of discharge, the typical density and nearfield mixing profile near the seabed provides a good indication that potential impacts to benthic communities, fish or pelagic invertebrates would be limited and restricted to the deepwater location where the SURF infrastructure is located. Noting the results presented are also conservative as they assume that no processes other than dilution would reduce the source concentrations over time, and therefore can be considered as conservative outcomes.

MODU

The temporary production system on the MODU will be hydrotested for well unloading activities. This will be conducted using hydrotest fluids, whereby the temporary production system on the MODU flowlines will be pressurised with fluids and the pressure will be monitored to detect leaks, prior to discharge of the hydrotest fluids.

Contingency discharge

Contingency discharge of hydrotest fluids during construction (e.g. buckling and leaking of the flowline during installation) are possible but are a contingent planned activity to be undertaken due to an unplanned event. The requirement for contingency discharge is determined by the technical design specifications and performance criteria of the subsea infrastructure. Should these be compromised (i.e. failed welding joint) various repair strategies will be assessed and a decision made should the contingency be required. The volume of hydrotest fluid that would be discharged in the event of a wet buckle depends on the location, extent and repair method. The planned hydrotest discharge would not occur at the same time as contingency discharge. As such, it is considered that the impacts relating to this contingency activity (as a worst case) are consistent with the below assessment and no cumulative impacts would occur.

Hydrotest fluid toxicity

Due to the proposed chemical additives with the hydrotest fluid (i.e. biocides, corrosion inhibitors, oxygen scavenger, fluorescent dyes and MEG), the discharges have the potential to impact sensitive receptors within the discharge area of influence, primarily through toxicological effects ranging from the inhibition of key biological processes (e.g. reproduction) to mortality. In considering the potential impacts to receptors it should be noted that the activity is planned during commissioning, with no ongoing discharge of hydrotest fluids during the normal operations.

MEG, which may be used in the SURF flowlines, is commonly used as a hydrate inhibitor within oil and gas developments. The chemical itself is clear and colourless, with a low volatility and miscible with water; however, no hydrolysis of the compound is expected in surface waters (WHO, 2000). MEG is listed as 'E' category fluids under the Offshore Chemical Notification Scheme (OCNS) and are listed on the Oslo Paris Commission (OSPAR) PLONOR ('pose little or no risk to the environment') list. In addition, the compound has little or no capacity to bind to particulates and will be mobile in soil (WHO, 2000). Rapid degradation has been reported in surface waters, with a generally low toxicity to aquatic organisms. Direct toxicity testing of neat MEG, on eight, mainly tropical species, representing seven taxonomic groups, established the lowest no observable effect concentration (NOEC) for sea urchin fertilisation of 130 mg/L (Jacobs, 2019). While MEG may result in highly localised, temporary and minor change in water quality in the immediate vicinity of the discharge point, it will dilute rapidly below levels that could cause impacts to marine biota.

Fluorescein dye is typically selected for use as a leak detection dye due to its low toxicity, availability, low cost, water solubility and stability, and ease of detection. In addition, rapid breakdown of fluorescein dye following exposure to sunlight suggests that concentrations likely to be encountered by organisms in the receiving environment would be low (Walthall and Stark, 1999). During discharge the dye may result in a temporary localised discoloration in the immediate vicinity of the discharge point on the seabed; however, as the dye is water soluble, it will rapidly dilute in the marine environment with no anticipated toxicity effects on marine organisms.

Due to the addition of oxygen scavengers within the hydrotest fluid, the discharge will have a lower dissolved oxygen level than the surrounding seawater. However, oxygen levels are anticipated to rapidly achieve background levels soon after discharge with any impacts on the surrounding waters expected to be temporary and highly localised. In addition, as the hydrotest fluid is planned to remain inside the pipelines and infrastructure for several months, the toxicity of residual chemicals will be markedly reduced over time, through natural decay and degradation, further reducing the potential impacts associated with the discharge.

Assessment of impacts

The presence of chemical additives in discharged hydrotest fluids is expected to result in a temporary decline in water quality around the discharge locations. For the SURF discharges, the plume is expected to travel in close proximity to the seabed which means the temporary change in water quality will be restricted to deep waters. As outlined in the draft EIS/ERD [Section 5.2.5.7](#), while there is some evidence of localised intrusions of cooler water around the western and eastern entrances to the channel between North and South Scott Reef during spring tides, there is no evidence of persistent upwelling or downwelling currents around Scott Reef (Green et al., 2019b). Hence, the discharge would be subject to rapid dispersion and dilution by prevailing currents, due to the open oceanic waters of the Project Area. In addition, the low toxicity hydrotest fluids will degrade and decay once released. As such no lasting effect on water quality is predicted.

8.2.4.11 Unplanned marine discharges: hazardous and non-hazardous inorganic waste

A detailed assessment of the potential risks associated with the unplanned discharge of hazardous and non-hazardous inorganic wastes is provided in [Section 6.3.14](#) of the draft EIS/ERD.

There is no planned discharge of hazardous or non-hazardous inorganic waste within the State Proposal Area and, as such, no impact to marine environmental quality is expected from such discharge. As described in [Section 6.3.14](#) of the draft EIS/ERD, however, an unplanned loss of hazardous and non-hazardous inorganic waste during transfer, handling and storage may be caused by human error, equipment or poor

weather conditions, resulting in an accidental release of waste to the State Proposal Area.

In the event of an accidental discharge to the marine environment, discharged materials in liquid or sludge form would be subject to rapid dispersion and dilution by prevailing currents, due to the open oceanic waters of the State Proposal Area. Given the typically small volumes and temporary duration of accidental discharge events, these would result in a temporary and highly localised reduction in water quality. Under normal operating conditions, drilling and vessel activity will be limited to the deep waters in proximity to the location of the proposed development wells and subsea infrastructure so any accidental discharge to the marine environment is unlikely to impact the Scott Reef system.

8.2.4.12 Unplanned hydrocarbon releases

A detailed assessment of the potential risks associated with unplanned hydrocarbon releases is provided in [Section 6.3.21](#) of the draft EIS/ERD. Quantitative hydrocarbon spill modelling of various worst-case hydrocarbon release scenarios is presented in [Section 6.3.21.3](#) of the draft EIS/ERD. This included modelling of a loss of well integrity scenario at the TRA-C well (Scenario 1), which represents the worst-case scenario for activities within the State Proposal Area. The summarised result of the modelling of Scenario 1 are presented in [Table 6-158](#) and [Figure 6-51](#) of the draft EIS/ERD.

Based on the outcomes of quantitative spill modelling, hydrocarbon spills resulting from the proposed Browse to NWS Project have the potential to significantly impact regional water and sediment quality including within the State Proposal Area. However, the occurrence of hydrocarbon spills is considered highly unlikely and the extent of impacts would depend on the exposure concentration, duration and degree of weathering of the hydrocarbons.

8.2.4.13 Cumulative impacts

Given the distance of the State Proposal Area from other operating developments in the region, it is not considered credible that cumulative impacts from the proposed Browse to NWS Project (or the Proposal) and other developments will occur.

With respect to the Commonwealth waters component of the proposed Browse to NWS Project, other than potentially hydrotest discharges, it is not expected that planned marine discharges to Commonwealth waters will contribute to impacts on marine environmental quality within the State Proposal Area ([Chapter 6](#) of the draft EIS/ERD). Operational discharges (i.e. PW and cooling water) from the FPSO will be managed in Commonwealth waters to ensure the defined threshold values (e.g. 99% species protection or no effect concentrations) at the State waters 3 nm boundary are met 95% of the time, based on dispersion modelling results.

While not considered the base-case, the potential discharged of hydrotest fluids from the BTL at the Torosa pipeline end terminal ([Section 6.3.17](#) of the draft EIS/ERD) may result in a temporary reduction in water quality within the State Proposal Area. Modelling ([Section 6.3.17.3](#) of the draft EIS/ERD) indicates this would be restricted to deep waters surrounding the pipeline end terminal (>400 m depth). Given this, and the fact this discharge would be a one-off event that would occur prior to the commencement of operations, the discharge of hydrotest fluid from the BTL at the Torosa PLET would not be expected to contribute significantly to cumulative impacts to marine environmental quality within the State Proposal Area.

8.2.5 Assessment of Impacts

Reductions in water quality and sediment quality are predicted to occur in the State Proposal Area as a result of increased turbidity and the introduction of contaminants via marine discharges. These impacts are predicted to arise primarily from the discharge of drill cuttings and fluids during development drilling, with less significant impacts predicted to occur throughout the duration of the proposed Browse to NWS Project activities (e.g. through subsea discharges from the subsea infrastructure).

There is a large body of knowledge indicating a discharge of cuttings with adhered fluids dilutes rapidly. These studies have found that that within 100 m of the discharge point, a drilling cuttings and fluid plume released at the surface will have diluted by a factor of at least 10,000, while J.M. Neff (2005) stated that in well-mixed oceans waters (as is likely to be the case within the drilling area), drilling fluid was diluted by more than 100-fold within 10 m of the discharge.

The majority of planned marine discharges would be subject to rapid dispersion and dilution by prevailing currents, due to the open oceanic waters of the State Proposal Area. As such, reductions in water and sediment quality would be temporary and highly localised, with no subsequent impact to marine biota predicted. The exception to this would be the discharge of drill cuttings that would result in the smothering of benthic biota in the immediate vicinity (within a distance in the order of 200 m) of the drilling locations.

Given the proposed location of the wells and subsea infrastructure will be in deep waters (>300 m), away from Scott Reef and that under normal operating conditions the drilling and vessel activity will be limited to the immediate vicinity of the subsea infrastructure, it is considered unlikely that marine discharges will impact Scott Reef shallow water benthic communities and habitats (<75 m water depth). In accordance with the precautionary principle, however, given the potential sensitivities of Scott Reef benthic communities and habitats to sedimentation from surface drill cuttings discharges, Woodside has committed to managing the discharges of drill cuttings and fluids at TRA, TRD,

TRE and TRF drill centre locations in such a manner that impacts to Scott Reef shallow water benthic communities and habitats (<75 m water depth) are avoided. [Section 8.2.6](#) outlines a range of proven mitigation measures capable of achieving this outcome.

In summary, given the low toxicity of the discharges, the localised scale and temporary nature of potential changes to water and sediment quality, these changes are not expected to result in any subsequent impacts to biota or the environmental values of the Scott Reef system. Impacts will be largely confined to the benign deep-water seabed between North and South Scott Reef. No long-term change in water or sediment quality or last adverse impacts to biota is expected to occur and aside from the drill cuttings accumulation in the immediate vicinity of the wells, no lasting changes to the physical or chemical properties of waters and sediments relative to a natural state are predicted.

Given no lasting impacts are expected to water quality or biota, no subsequent impact to State managed fisheries are expected. In addition, the localised and temporary nature of the predicted reduction in water and sediment quality mean that no impacts to State marine parks (the closest being over 400 km from the State Proposal Area) are anticipated to occur. As no impacts to the Scott Reef system are expected, no impacts are expected to the Scott Reef Nature Reserve.

Given the minimal extent and magnitude of changes to marine environmental quality within the State Proposal Area as a result of the proposed Browse to NWS Project (or Proposal), impacts are expected to be consistent with the EPA objective for the environmental factor - marine environmental quality.

8.2.6 Mitigation

[Chapter 8](#) of the draft EIS/ERD presents the overarching HSE management approach Woodside will implement for the proposed Browse to NWS Project.

Environmental Quality Management Plan

As recommended in the WA EPA Technical Guidance – Protecting the Quality of Western Australia’s Marine Environment (EPA, 2016c), an Environmental Quality Management Plan (EQMP) will be prepared and implemented for the Proposal. The EQMP will only apply to the State Proposal Area. The EQMP will be developed using the principles and approaches outlined in the EPA’s technical guidance.

The EPA’s technical guidance outlines the following elements within an Environmental Quality Management Framework (EPA, 2016c):

- + **Environmental Values (EVs):** These are values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and which require protection from the effects of pollution, waste discharges and deposits.

- + **Environmental Quality Objectives (EQOs):** These are high level management objectives that describe what must be achieved to protect each EV.
- + **Levels of Ecological Protection (LEPs):** Four levels of ecological protection (LEPs) are provided for the EQO maintenance of ecosystem integrity so that areas identified as important for conservation and biodiversity protection can be maintained in their natural state while recognising that in other parts of the marine environment there are societal uses that may preclude a high level of ecological protection from being achieved (e.g. port operations or use of marine waters for waste disposal). LEPs are not defined by current condition but are intended to represent long-term objectives for environmental quality.
- + **Environmental Quality Criteria (EQC):** These represent scientifically based limits of acceptable change to a measurable environmental quality indicator that is important for the protection of the associated EV. EQC are divided into relatively simple and easy to measure environmental quality guidelines (EQGs) and more robust environmental quality standards (EQSs).

Environmental Values, EQOs and LEPs for the State Proposal Area component of the proposed Browse to NWS Project have been identified as part of the development of the draft EIS/ERD. When determining the proposed LEPs, consideration has been given to potential impacts to marine environmental quality during construction, commissioning and operations, and the planned staged development of the proposed Browse to NWS Project, where construction and commissioning activities such as drilling and completions of future drill centres may occur simultaneously with operations. As such, separate LEPs have been proposed for construction activities (including commissioning) and for operations. The following LEPs are proposed:

Construction activities

- + **Moderate LEP** – Moderate LEPs are proposed for all areas within a 1,000 m radius of each drill centre and 500 m around all subsea infrastructure. A moderate LEP has been proposed in this area given the predicted deposition of drill cuttings above ecological thresholds for a radius in the order of a couple of hundred meters from each well, the discharge of cement for a radius of approximately 50 m from each well; the installation of the subsea infrastructure (including seabed preparation); and one-off hydrotest fluid discharge from the flowlines.
- + **High LEP** - A high LEP is proposed for the deep waters of the State Proposal Area where the subsea infrastructure will be located (except where designated a moderate LEP). A high LEP is also proposed along the eastern edge of the State Proposal Area where there is potential for one off hydrotest discharge from the BTL (in Commonwealth waters) to temporarily incur into the State Proposal Area. Seabed disturbance may occur from anchoring within the high LEP.
- + **Maximum LEP** - A maximum LEP is proposed for all other areas within the State Proposal Area. This includes all Scott Reef shallow water benthic communities and habitats (<75 m water depth).

Operations

- + **Moderate LEP** – Moderate LEPs are proposed for all areas within a 1,000 m radius of each drill centre. A moderate LEP has been proposed in these areas given the predicted deposition of drill cuttings and cement during construction, as well as the physical presence of the wells and manifolds and subsea fluid discharge from the wells during operations.
- + **High LEP** - A high LEP is proposed for the deep waters of the State Proposal Area where the subsea infrastructure will be located (except where designated a moderate LEP).
- + **Maximum LEP** - A maximum LEP is proposed for all other areas within the State Proposal Area. This includes all Scott Reef shallow water benthic communities and habitats (<75 m water depth).

The Proposed LEPs are shown in [Figure 8-1](#) and [Figure 8-2](#).

The limits of acceptable change for each of the LEPs are detailed in [Table 8-4](#).

Table 8-4 Limits of Acceptable Change to State Proposal Area Marine Environmental Quality

Key elements	Limits of acceptable change	Maximum LEP	High LEP	Moderate LEP
Ecosystem processes (e.g. primary production, nutrients cycles, food chains)	Ecosystem processes are maintained within the limits of natural variation (no detectable change)	✓	✓	
	Small changes in rates, but not types of ecosystem processes			✓
Biodiversity (e.g. variety and types of naturally occurring marine life)	Biodiversity as measured on both local and regional scales remains at natural levels (no detectable change)	✓	✓	✓
Abundance and biomass of marine life (e.g. number or density of individual animals, the total weight of plants)	Abundances and biomasses of marine life vary within natural limits (no detectable change)	✓	✓	
	Small changes in abundances and/or biomasses of marine life			✓
The quality of water, biota and sediment (e.g. types and levels of contaminants such as heavy metals, dissolved oxygen content, water clarity)	Levels of contaminants and other measures of quality remain within limits of natural variation (no detectable changes)	✓		
	Small detectable changes beyond limits of natural variation but no resultant effect on biota		✓	
	Moderate changes beyond limits of natural variation but not to exceed specified criteria			✓

The purpose of the EQMP will be to detail how the EQO outlined in [Table 8-4](#) will be met, including planned management, monitoring and reporting. In accordance with the EPA's technical guidance (EPA, 2016) the EQMP will include:

- + a description of the system to be monitored
- + the pressures or threats to environmental quality
- + an objective outlining the reason for monitoring and management
- + duration of the monitoring program
- + the indicators to be measured with a rationale for their use
- + monitoring/sampling methodology and rationale (including site locations, frequency, depth, equipment, etc.)
- + analytical methods and limits of reporting for samples
- + clear, measurable and auditable EQC for each indicator and the statistical methods for interpreting monitoring data against the EQC
- + the actions triggered when an EQG is exceeded
- + management responses triggered when an EQS is exceeded
- + reporting mechanisms and timing.

Specific proposed measures to mitigate and manage unavoidable impacts from planned activities and reduce the environmental risk associated with unplanned events and incidents are presented in [Chapter 6](#) of this draft EIS/ERD and these will be incorporated into the EQMP where relevant. Measures presented in the draft EIS/ERD will also be incorporated into activity-specific Environment Plans to be submitted for acceptance by DMIRS prior to the activity commencing within the State Proposal Area.

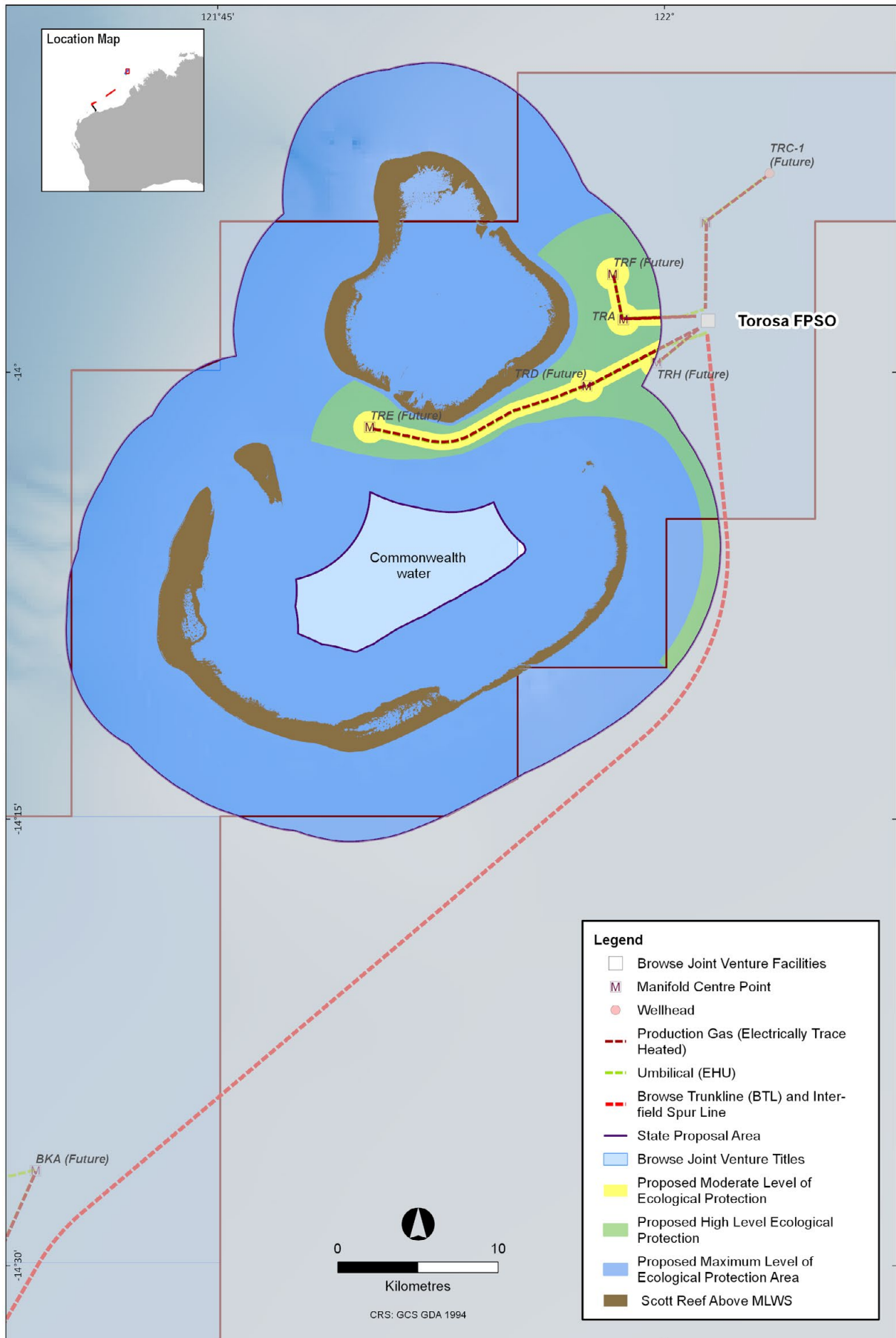


Figure 8-1 Proposed State Proposal Area Levels of Ecological Protection (LEPs) - Construction activities



Figure 8-2 Proposed State Proposal Area Levels of Ecological Protection (LEPs) – Operations

8.2.7 Predicted Outcome

Impacts to marine environmental quality within the State Proposal Area have been reduced by locating the FPSO facilities, BTL and inter-field spur line outside the State Proposal Area and siting infrastructure within the State Proposal Area in deep waters off Scott Reef.

Impacts will be further reduced by implementing mitigation and management measures, the majority of which are standard maritime and offshore oil and gas industry practice. However, given the potential sensitivities of Scott Reef shallow water benthic communities and habitats to sedimentation from drilling discharges, Woodside has committed to managing the drilling discharges (in particular bottom hole discharges) at drill centre locations in the State Proposal Area (i.e. TRA, TRD, TRE and TRF) in such a manner that avoids impacts to Scott Reef shallow water benthic communities and habitats (<75 m water depth) (refer to [Section 8.2.6](#)). Implementation of this management approach will be assured through activity specific Environment Plan(s) under Petroleum Legislation.

Taking proposed mitigation and management measures into account and considering the limited scope and scale of the Proposal (with no permanent surface facility or vessel presence in the State Proposal Area) plus the overall phasing of Proposal, impacts to water quality, sediments and biota as a result of the Proposal are not predicted to result in any reduction of the environmental values of the Scott Reef shallow water benthic communities and habitats (<75m water depth).

As described in [Section 8.2.6](#), it is expected a maximum LEP will be achieved in the majority of the State Proposal Area during construction and operations. A high LEP will be achieved for the deep waters of the State Proposal Area where subsea infrastructure will be located, except where a moderate LEP is proposed within a 1000 m radius of each drill centre during construction and operations; and 500 m around subsea infrastructure during construction. Further, an area of moderate LEP is proposed during construction where the potential discharge of hydrotest fluid from the BTL (in Commonwealth waters), may incur into the State Proposal Area. An EQMP will be prepared and implemented to achieve this outcome.

The EPA Technical Guidance for Protecting the Quality of Western Australia's Marine Environment (EPA, 2016c) states that the objective for LEPs are:

- + A maximum level of ecological protection would require activities to be managed so that there were no changes beyond natural variation in ecosystem processes, biodiversity, abundance and biomass of marine life or in the quality of water, sediment and biota.

- + The objective for a high level of ecological protection is to allow for small measurable changes in the quality of water, sediment and biota, but not to a level that changes ecosystem processes, biodiversity or abundance and biomass of marine life beyond the limits of natural variation.
- + A moderate level of ecological protection may be applied to relatively small areas within inner ports and adjacent to heavy industrial premises where waste discharges from current and/or historical activities may have compromised a high level of ecological protection.

Given the majority of the State Proposal Area will be maintained at a maximum or high LEP and the moderate LEP portion corresponding with deep water benign seabed, it is expected that the WA EPA environmental objective *"To maintain the quality of water, sediment and biota so that environmental values are protected"* will be achieved for the Proposal; and the predicted impacts on marine environmental quality within the State Proposal Area are considered **Acceptable**.

8.3 Key Environmental Factor – Benthic Communities and Habitat

8.3.1 EPA Objective

The EPA objective for benthic communities and habitat is *"to protect benthic communities and habitats so that biological diversity and ecological integrity are maintained"* (EPA, 2016c).

8.3.2 Policy and Guidance

The following policy and guidance have been considered in relation to the EPA environmental factor - benthic communities and habitats.

EPA Policy and Guidance

- + Statement of Environmental Principles, Factors and Objectives (EPA, 2016b)
- + WA EPA Environmental Factor Guideline - Benthic Communities and Habitats (EPA, 2016b)
- + WA EPA Technical Guidance - Protection of Benthic Communities and Habitats (EPA, 2016c)
- + Technical Guidance - Protecting the Quality of Western Australia's Marine Environment (EPA, 2016c).

Other Policy and Guidance

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018).

8.3.3 Receiving Environment

The characteristics of the marine environment of the Browse Development Area are described in detail in [Chapter 5](#) of the draft EIS/ERD. The benthic communities and habitats within the State Proposal Area can broadly be delineated into two areas, Scott Reef benthic communities and habitats and the deepwater benthic communities and habitats. As described in [Chapter 6](#) of the draft EIS/ERD, for the purpose of the environmental impact and risk assessment undertaken for the proposed Browse to NWS Project, Scott Reef is considered as the area above the 75 m bathymetric contour within the 3 nm State waters boundary. The deepwater communities are defined as those communities below the 75 m bathymetric contour and make up the remainder of the State Proposal Area. It should be noted that, as shown in [Figure 5-1](#), all proposed subsea infrastructure will be located within the deepwater habitats away from Scott Reef. As such, no direct disturbance of the Scott Reef benthic communities and habitats will occur, with disturbance limited to the deepwater habitats of the State Proposal Area.

Scott Reef habitats and communities

The Scott Reef system consists of two shelf atolls, North Scott Reef and South Scott Reef, separated by a deep channel. The Scott Reef system is characterised by extensive benthic primary producer habitat (i.e. corals, seagrass, macroalgae and filter feeders). At least 14 distinct benthic habitat types have been defined that can broadly be grouped into shallow water habitats (<30 m), deep lagoonal habitats (between 30-70 m) and deepwater slope habitats (70-500 m) ([Figure 8-3](#)). The shallow water habitats occupy 170.5 km² and 147.1 km² at the South and North Scott Reef, respectively, and include reef crests, flats and slopes, patch reefs and the shallow water lagoons. These habitats support more diverse coral communities than deeper waters; however, they are more susceptible to natural impacts such as thermally induced coral bleaching and cyclone damage. The deepwater lagoonal habitats of South Reef are extensive, covering approximately 289 km².

The Scott Reef system is largely unaffected by many of the anthropogenic stressors that affect coral reefs close to the coast, due to its isolation, distance from shore and the absence of human settlement. However, the reef and its benthic communities and habitats are not without exposure to physical disturbances and pressures including tropical cyclones, anomalous sea surface temperatures and disease.

[Section 5.3.2.2](#) of the draft EIS/ERD provides further details on the status of the benthic communities and habitats within the Scott Reef system.

Deepwater habitats and communities

The deepwater benthic habitats of the State Proposal Area are consistent with the remainder of the Browse Development Area. Survey findings for the benthic communities inhabiting the predominantly soft sediments of the deep water benthic habitats where the subsea infrastructure will be installed demonstrated that these areas were characterised by fine sediments with infaunal polychaetes dominant and sparsely distributed epifauna observed (i.e. bryozoans, brittlestars, basketstars and sea anemones) (Gardline Marine Services Pty Ltd, 2009b). [Section 5.3.2.1](#) of the draft EIS/ERD provides further details of these communities and habitats.

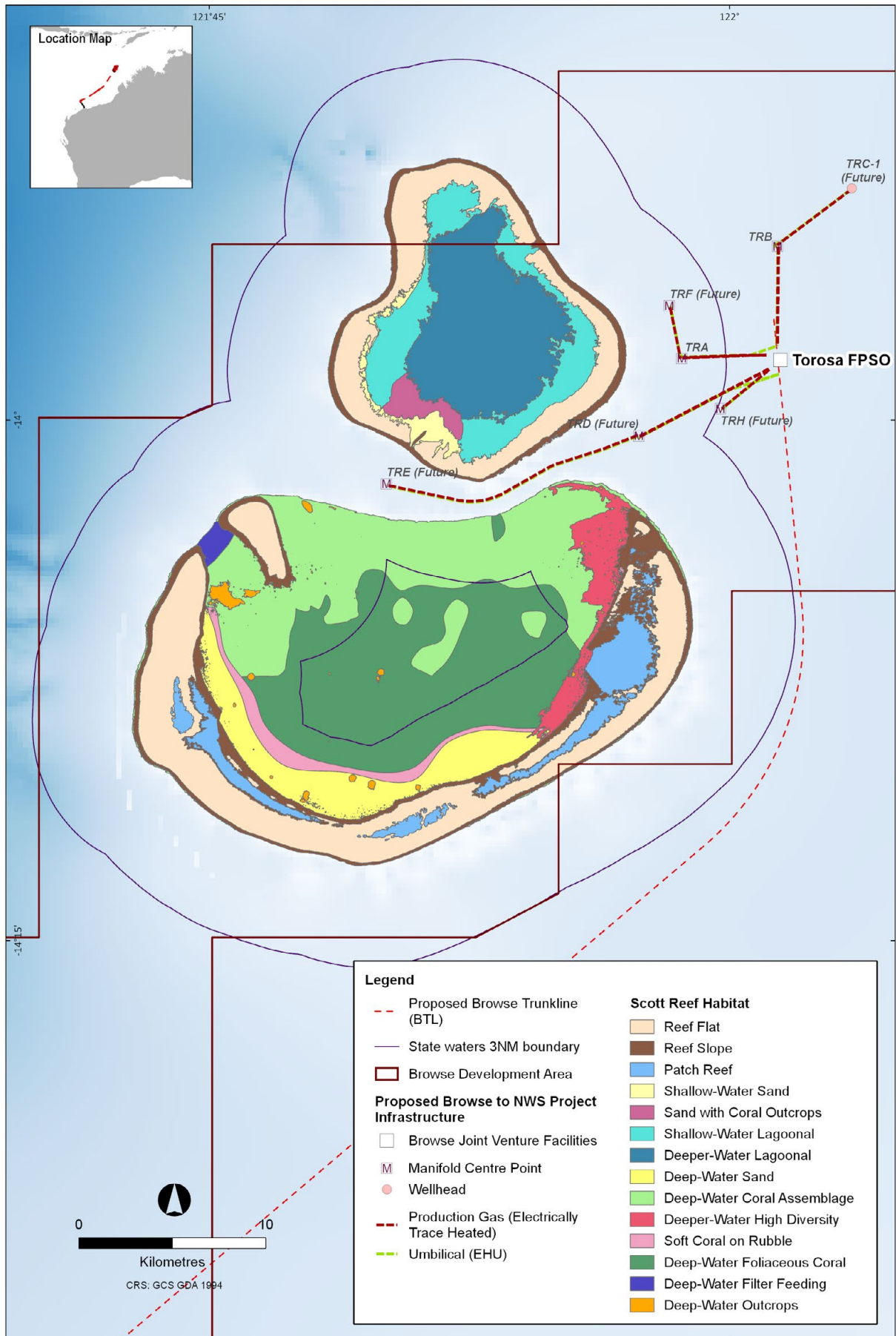


Figure 8-3 Scott Reef Habitat Map (Smith et al., 2006)

8.3.4 Potential Impacts

8.3.4.1 Summary of Identified Impacts and Risks

Table 8-5 summarises the sources of potential impact to benthic communities and habitats arising from the Proposal. **Table 8-5** is followed by a detailed description of the potential direct, indirect and cumulative impacts. An assessment of the significance of these impacts on benthic communities and habitats and a conclusion on the acceptability of the impacts in relation to the EPA environmental objective is presented in **Section 8.3.5**.

Table 8-5: Sources of Potential Impact to Benthic Communities and Habitats from the Proposal

Aspect	Proposal Phase ¹					Source (in State jurisdiction)
	Dr	I	C	O	De	
Planned (routine and non-routine activities)						
Physical presence: light emissions	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area Intermittent flaring from the MODU
Physical presence: seabed disturbance and disturbance to other users	✓	✓		✓	✓	Development of the production wells Installation of subsea infrastructure Wet storage of infrastructure prior to installation MODU anchors IMR activities
Underwater noise	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area VSP/DAS during well development Piling for MODU anchor installation (if required) Seabed preparation Helicopter movements
Marine discharges: sewage and sillage	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area
Marine discharges: treated utility water, chemical and deck drainage	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area
Marine discharges: produced water	✓					MODU during well unloading activities
Marine discharges: cooling water	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area
Marine discharges: drilling and completion discharges	✓					MODU during drilling activities
Marine discharges: subsea control fluids	✓	✓	✓	✓	✓	Subsea infrastructure BOP during drilling ROVs
Marine discharges: hydrotest fluid	✓	✓	✓	✓		Temporary production system on MODU Integrity testing of subsea infrastructure
Production Activities: Seabed Subsidence				✓		Extraction of reservoir fluids
Unplanned events and incidents						
Marine discharges: hazardous and non-hazardous waste inorganic waste	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area

Aspect	Proposal Phase ¹					Source (in State jurisdiction)
	Dr	I	C	O	De	
Unplanned hydrocarbon releases	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area Subsea infrastructure
Physical Presences (Unplanned): Invasive Marine Species	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area

¹ Dr = Drilling; I = Installation; C = Commissioning; O = Operation; De = Decommissioning

8.3.4.2 Physical presence: seabed disturbance

Where present, benthic epifaunal and infaunal communities in the deep waters of the State Proposal Area will be impacted by the temporary and permanent installation of physical infrastructure on the seabed, resulting in modification of habitats, smothering of biota and temporary reductions in water quality from sediment re-suspension and sedimentation. Due to the distance of the proposed subsea infrastructure to Scott Reef, no impacts to the environmental values of the Scott Reef system will occur as a result of seabed disturbance.

A detailed description of the planned seabed disturbance and an assessment of the potential impacts associated with seabed disturbance is provided in [Section 6.3.1](#) of the draft EIS/ERD.

The WA EPA Technical Guidance - Protection of Benthic Communities and Habitats provides the following definitions with respect to impacts to benthic communities and habitats (EPA, 2016c):

- + Permanent loss refers to direct removal or destruction of benthic communities and/or their habitats. Permanent loss of benthic communities and their associated habitats would commonly be associated with activities such as excavation or burial. In almost all cases these activities directly modify the benthic community and its habitat so significantly that the impacted community would not recover to the pre-impact state.
- + ‘Serious damage’ means damage to benthic communities and/or their habitats that is effectively irreversible or where any recovery, if possible, would be unlikely to occur for at least 5 years. Serious damage is most often associated with indirect effects of development activities such as alteration of natural groundwater hydrology (e.g. leading to impacts on dependent mangroves) or chronically elevated suspended sediment levels in the water column (e.g. leading to reduced benthic light and impacts on dependent seagrass or coral communities).
- + ‘Reversible impacts or loss’ refer to the situation where impacts or losses of benthic communities occur, but there is confidence that the community, and the ecological services it provides, will fully recover within five years.

Seabed disturbance in the State Proposal Area is expected to be approximately 4.15km² and will be limited to deep water habitats and communities. No disturbance of the Scott Reef shallow water benthic communities and habitats (<75 m water depth) is planned. [Table 8-6](#) provides an overview of the extent of seabed disturbance in the State Proposal Area. Note that these disturbance estimates include indirect disturbance from drilling discharges which are address in [Section 8.3.4.9](#).

This disturbance will result in the permanent loss of up to 0.31km² (including 25% contingency) of deepwater habitat for the development of the wells and installation of subsea infrastructure. This is the area lost directly due to the infrastructure footprint. It should be noted that this permanent loss may be partially compensated by the creation of artificial hard substrate habitat (i.e. subsea infrastructure) which may be colonised by epifaunal organisms.

The contingency includes allowance for temporary wet storage during construction, pre lay and post lay of subsea infrastructure activities, allowance for a broader well radius for potential cementing and sedimentation, and other disturbance associated with MODU piling/anchoring (if required). The remaining 3.84 km² (including 25% contingency) of seabed disturbance will result from temporary indirect impact associated with wet storage of temporary infrastructure and the installation of subsea infrastructure. This will result in reversible loss of deepwater benthic habitat, with benthic biota expected to recolonise the area once the permanent infrastructure is installed and the temporary infrastructure is removed. Studies indicate that benthic infauna and epifauna recover relatively quickly, with substantial recovery in deepwater benthic communities within three to ten years (Jones et al., 2012).

Given the relatively sparse nature of the deep water benthic communities and habitats of the area to be disturbed ([Section 5.3.1.2](#) of the draft EIS/ERD), the small area of permanent disturbance (relative to the total area of similar habitat available regionally); and expected recolonisation of the seabed with similar benthic biota after the removal of temporary infrastructure, seabed disturbance within the deep waters of the Project Area is not predicted to impact biological diversity or ecological integrity.

Table 8-6 Indicative extent of seabed disturbance within the State Proposal Area

Description		No.	Direct Disturbance (km ²) (Permanent Loss)	Indirect Disturbance (km ²) (Reversible Loss)	Total (km ²)
Drilling and Completions					
Wells	Torosa	24	0.19	2.83	3.02
SURF Footprint					
Flowline network	Torosa	1	0.06	0.24	0.30
Total Expected			0.25	3.07	3.32
Contingency (25%)			0.06	0.77	0.83
Total (including Contingency)			0.31	3.84	4.15

Basis:

1 Wells have a direct impact radius of 50 m and a total radius of 200 m.

2 Flowlines have a 2 m corridor direct impact and a 10 m corridor total impact.

This estimate includes subsea disturbance from all major infrastructure sources. The contingency includes allowance for temporary wet storage during construction, pre lay and post lay of subsea infrastructure activities, allowance for a broader well radius for potential cementing and sedimentation, and other disturbance associated with piling/anchoring (if required)

8.3.4.3 Physical presence: light

Potential impacts to shallow benthic communities and habitats (i.e. corals) from light emissions are described in [Section 6.3.3](#) of the draft EIS/ERD. Theoretically, there is the potential for impacts to shallow water coral communities from light emissions from the MODU and vessels within the State Proposal Area, with coral colonies particularly sensitive to changes in ambient environmental conditions, with natural factors such as nocturnal moonlight cycles and daily light/dark cycles providing cues for reproduction (i.e. spawning) (Harrison and Wallace, 1990).

Light modelling results ([Section 6.3.3](#) of the draft EIS/ERD) indicate that Scott Reef is expected to receive light emission levels of less than 0.01 Lux from the MODU operating in the channel between North Scott Reef and South Scott Reef. Such light levels are less than a comparable full moon and therefore it is not considered that light emissions from the MODU or vessels associated with the proposed activities within the State Proposal Area will be of sufficient intensity to affect coral reproduction or spawning events. In addition, no permanent surface facilities to emit light will be present in the State Proposal Area during operations.

8.3.4.4 Underwater noise

Potential impacts to shallow benthic communities and habitats (i.e. corals) from underwater noise emissions are described in [Section 6.3.8](#) of the draft EIS/ERD. As discussed in [Section 6.3.8.3](#) of the draft EIS/ERD, Woodside's Maxima Study on seismic noise on Scott Reef estimated that corals would require received levels of PK-PK exceeding 260 dB re 1 µPa (SPL) to induce injury (Hastings, 2010). The modelling indicates that sound levels reaching Scott Reef from the proposed

activities do not reach these levels and as such no impact to corals from underwater noise resulting from the proposed activities is predicted to occur. Likewise modelling of the VSP activities indicates that the sound level associated with no effect (Heyward et al., 2018) was not reached. As such, no impacts to corals are expected to occur.

8.3.4.5 Marine discharges: sewage and sillage

An assessment of the potential impact on marine environmental quality from the discharge of sewage and sillage from project vessels and the MODU is presented in [Section 8.2.4](#). This assessment concluded that changes to the physical and chemical properties of the marine water would be temporary and highly localised (discharge diluted to 1% of its original concentration with 50 m). No change to the physical or chemical properties of sediments are expected due to the depth of the water where treated sewage and sillage would be discharged.

Given the water depth at the discharge locations (>300 m), it is not predicted that the this change in water quality will affect the deepwater benthic habitats of the State Proposal Area. Given the distance from the discharge to Scott Reef and rapid dispersion predicted (refer to [Section 8.2.4.4](#)), no effect on Scott Reef benthic communities and habitats is expected to result from the discharge of treated sewage and sillage in the State Proposal Area.

8.3.4.6 Marine discharges: treated utility water, chemical and deck drainage

An assessment of the potential impact on marine environmental quality from the discharge of treated utility water, chemical and deck drainage from project vessels, installation vessels and the MODU is presented in [Section 8.2.4](#). This assessment concluded that treated utility water, chemical and deck discharges would result in temporary change in water quality in the immediate vicinity of the discharge. Given the water depth at the discharge location (>300 m) and distance to Scott Reef from where these discharges would occur, this temporary and highly localised change to water quality is not expected to have any impacts to either the deepwater benthic communities and habitats of the State Proposal Area or the benthic communities and habitats associated with Scott Reef.

8.3.4.7 Marine discharges: produced water

As detailed in [Section 8.2.4](#), given the small percentage that the PW component makes of the overall discharge from the MODU during well unloading, this discharge is addressed as part of the assessment of discharges during drill cuttings and fluids.

8.3.4.8 Marine discharges: cooling water

An assessment of the potential impact on marine environmental quality from the discharge of cooling water from project vessels, installation vessels and the MODU is presented in [Section 8.2.4](#). This assessment concluded that cooling water discharges would result in temporary change in water quality in the immediate vicinity of the discharge. Given the water depth at the discharge location (>300 m) and distance to Scott Reef from where these discharges would occur, this temporary and highly localised change to water quality is not expected to have any impacts to either the deepwater benthic communities and habitats of the State Proposal Area or the benthic communities and habitats associated with Scott Reef.

8.3.4.9 Marine discharges: drilling and completions discharges

A detailed description of the planned discharge of drill cuttings and fluids is provided in [Section 8.2.4.8](#). [Section 8.2.4.8](#) focuses largely on the water quality and sedimentation aspects of this impact whereas this section focuses largely on benthic fauna impacts associated with the aspect.

Change in water quality

The assessment of the potential impact on marine environmental quality (water quality, sediments and biota) from the discharge of drill cuttings and fluids from the MODU during drilling and completions activities presented in [Section 8.2.4](#) concluded that change in to water quality (through elevated TSS and the introduction of contaminants) would be temporary and localised with no subsequent impacts to biota predicted.

Cement discharge

Once each of the top hole sections are drilled, casing will be inserted into the wellbore and secured in place by pumping cement into the annular space back to approximately 300 m above the casing shoe, which may involve a discharge of excess cement at the seabed (~80 m³/well). Overspill of cement will permanently alter physical sediment properties immediately adjacent to the well (within <50 m). The potential disturbance area is 0.8 ha per well; giving a total potential disturbance footprint of 0.19km² within the State Proposal Area. This will result in the permanent loss of the benthic communities and habitats in the disturbance area.

Sediment deposition

Following the discharge of drill cuttings and fluids, the coarser fractions (sand and gravel-sized particles), will rapidly settle to the seabed. Where cuttings are discharged to the seabed, a cuttings pile will develop immediately around the well site. The nature and size of the pile will depend on a number of factors including particle size of the cuttings, tidal and current forces and water depth. Discharge of cuttings at the surface will result in a sediment plume with the dispersion and settlement of cuttings dependent on the particle sizes of cuttings, water depth, as well as the prevailing wind, tidal influence and current directions.

Potential impacts are expected to be confined to sessile biota such as sediment burrowing infauna and epifauna where present in or on the seabed in immediate proximity to the well location. Ecological impacts to such biota are predicted when sediment deposition is equal to or greater than 6.5 mm (in thickness) (IOGP, 2016). Modelling ([Section 6.3.15.3](#) of the draft EIS/ERD) indicated that such deposition would potentially occur out from the well location to approximately 200 m (following the direction of the prevailing current). This aligns with (IOGP, 2016) review of seven studies, which indicated that the spread of drill cuttings and WBFs is expected to be up to about 150 m from the discharge location. It should also be noted that sedimentation was modelled concurrently for multiple wells at the drill centres, resulting in a likely overestimation of net sedimentation given that in reality wells will be drilled sequentially and therefore further dispersion of deposited sediments will occur in between individual well drilling activities.

This deposition may result in the reversible loss in the order of 0.12 km² of deepwater benthic habitat per well based on an assumption of an expected spread radius of 150 m from each well (in addition to the irreversible loss of 50 m associated with cement – described above). Balcom et al., (2012) concluded that impacts associated with the discharge of cuttings and NWBFs are minimal, with impacts highly localised to the area of the discharge. Changes to benthic communities are normally not severe. Organic enrichment can occur leading to anoxic conditions in the surface sediments and a loss of

infauna species that have a low tolerance to low oxygen concentrations, and to a lesser extent chemical toxicity near the well location. These impacts are highly localised with short-term recovery that may include changes in community composition with the replacement of infauna species that are hypoxia-tolerant (IOGP et al., 2016).

Recovery of affected benthic infauna, epifauna and demersal communities is expected to occur quickly, given the short duration of sediment deposition and the widely represented benthic and demersal community composition. Jones et al., (2012) compared pre and post-drilling ROV surveys and documented physical smothering effects from WBM cuttings within 100 m of the well. Outside the area of smothering, fine sediment was visible on the seafloor up to at least 250 m from the well. After three years, there was significant removal of cuttings, particularly in the areas with relatively low initial deposition (Jones et al., 2012). The area impacted by complete cuttings cover had reduced from 90 m to 40 m from the drilling location, and faunal density within 100 m of the well had increased considerably and was no longer significantly different from conditions further away. As such, the impacts to the deepwater benthic habitats are considered reversible, with benthic biota are expected to recolonise the area rapidly on completion of the drill cuttings discharge at each well.

Based on the modelling (Section 6.3.15.2 of the draft EIS/ERD), the sedimentation footprint associated with discharge of drilling or completions discharges at the seabed, indicates that away from the immediate area around the well (i.e. 50 m radius associated with the permanent impact from well casing cement overspill), sedimentation over the course of the drilling program would be low, equating to a thin veneer of settled drilling discharges away from the immediate deposition area around the well (in the order of 200 m from the well) which will likely be naturally reworked into surficial sediment through processes including bioturbation (US EPA, 2002). Ecological impacts in these areas are not expected for mobile benthic fauna such as crabs and shrimps or pelagic and demersal fish, given their mobility (IOGP, 2016).

These impacts are considered reversible, with benthic biota expected to recolonise once the cause of the temporary disturbance is removed. Studies indicate that benthic infauna and epifauna recover relatively quickly, with substantial recovery in deep water benthic communities within three to ten years (Jones et al., 2012). IOGP (2016) found that recovery of the benthic communities generally occurred by the recruitment of new colonising organisms and migration from undisturbed sediments, with recovery beginning shortly after the completion of drilling and well underway within a year.

The assessment of the potential impact on marine environmental quality (water quality, sediments and

biota) from the discharge of drill cuttings and fluids from the MODU during drilling and completions activities presented in [Section 8.2.4](#) concluded that change in to water quality (through elevated TSS and the introduction of contaminants) would be temporary and localised with no subsequent impacts to biota predicted.

Summary

In summary, likely impacts to benthic communities and habitats from drill cuttings and fluids discharge and cement discharge will be restricted to the localised burial of deepwater benthic habitats and likely changes to sediment quality within the immediate vicinity each well (in the order of 200 m). However, outside this area, little to no impact to the deepwater benthic communities and habitats is expected. The proposed further modelling, assessment and selection of management measures for TRA, TRD, TRE and TRF drill centres described above will inform the drill cuttings disposal method to ensure impacts to Scott Reef benthic communities and habitats are avoided.

Overall, the localised smothering of biota associated the deepwater habitats that are well represented both in the State Proposal Area and regionally is not expected to reduce biological diversity and ecological integrity within the State Proposal Area.

8.3.4.10 Marine discharges: subsea control fluids

An assessment of the potential impact on marine environmental quality from the discharge of subsea control fluids during operation of the subsea infrastructure is presented in [Section 8.2.4](#). This assessment concluded that the intermittent discharge of small volumes of subsea control fluid may result in a reduction in water quality that would be temporary (limited to the duration of the activity), restricted to deepwater (i.e. not affecting Scott Reef benthic communities or habitats) and subject to rapid dispersion and dilution by prevailing currents, due to the open oceanic waters of the State Proposal Area. While benthic biota associated with the deepwater habitats of the State Proposal Area may come into contact with these discharges, given that the discharges will disperse rapidly close to the discharge point and that any contact with the discharge with benthic biota will be of extremely short duration, it is not considered credible that toxic affects to benthic biota will occur as a result of the discharge of subsea fluids within the State Proposal Area.

8.3.4.11 Marine discharges: hydrotest fluid

A description and assessment of the potential impact on marine environmental quality from the discharge of hydrotest fluid during integrity testing of the subsea infrastructure and the temporary production system on the MODU is presented in [Section 8.2.4](#). This assessment concluded that given the low volume of hydrotest fluid to be discharged, the low toxicity of the fluid, and the water depth at which the discharge will occur, hydrotest

discharges within the State Proposal Area would be not expected to result in any lasting impacts to biota. As such, while modelling ([Section 6.3.17](#) of the draft EIS/ERD) predicts that the plume would travel in close proximity to the seabed and therefore may result in localised and temporary decline in sediment quality, no lasting effect to the deepwater habitats are predicted.

As described in [Section 8.2.4.10](#), previous modelling of hydrotest fluid discharge from SURF infrastructure has been used to inform this impact assessment. From this modelling it is concluded that given the negative buoyancy of the plume, bathymetry of the location (steep reef slopes surrounding the discharge location), and lack of upwelling processes from the depth of discharge, regardless of the size of the mixing zone the zone of influence will remain restricted to depth and avoid Scott Reef shallow water benthic habitat (<75 m bathymetry).

8.3.4.12 Production Activities: Seabed Subsidence

A detailed description of the subsea subsidence that may manifest as a result of production activities and an assessment of the potential impacts that may result is provided in [Section 6.3.20](#) of the draft EIS/ERD. This includes peer reviewed modelling ([Section 6.3.20.3](#) of the draft EIS/ERD) which provides a high level of confidence that any production-related subsidence at Scott Reef would be in the order of less than 10 cm over field life.

As described in [Section 6.3.20](#) of the draft EIS/ERD, AIMS (2012) assessed the impact of net sea level rise (from subsidence and climate change induced sea level rise) and its predicted impacts on reef flat habitat (0 to 5 m depth), shallow water coral habitats (5 to 30 m), deepwater coral habitat (30 to 70 m) and Sandy Islet, for three scenarios (worse case, intermediate case and best case).

Overall, the study concluded that minor seabed subsidence over the life of the Torosa reservoir affecting a part of Scott Reef and Sandy Islet would not significantly contribute to sea level changes and associated impacts. As such, no reduction in biological diversity or ecological integrity within the State Proposal Area is predicted to occur as a result of seabed subsidence. Subsidence will be monitored throughout the life of the Project as detailed in [Section 6.3.20](#) of the draft EIS/ERD.

8.3.4.13 Unplanned marine discharges: hazardous and non-hazardous inorganic waste

A description and assessment of the potential impact on marine environmental quality from unplanned discharge of hazardous and non-hazardous inorganic wastes is presented in [Section 8.2.4](#). This assessment concluded that in the unlikely event of an unplanned discharge, discharged materials in liquid or sludge form would be subject to rapid dispersion and dilution by prevailing

currents, due to the open oceanic waters of the State Proposal Area. This would result in a temporary and highly localised change in water quality that would be highly unlikely to impact the deepwater benthic habitats of the State Proposal Area. Accidentally discharged non-buoyant waste would have the potential to sink to the seabed and impact epifauna, however, given the sparse nature of deepwater habitats that are well represented both in the State Proposal Area and regionally, any impacts are highly unlikely to reduce biodiversity or ecological integrity within the State Proposal Area.

Under normal operating conditions, drilling and vessel activity will be limited to the deep waters in proximity to the location of the proposed development wells and subsea infrastructure away from Scott Reef so any accidental discharge to the marine environment is highly unlikely to impact the Scott Reef benthic communities and habitats.

8.3.4.14 Physical presences (unplanned): invasive marine species (IMS)

Non-indigenous Marine Species (NIMS) are species which are translocated into a recipient environment where they are not historically found. Invasive marine species are NIMS that are translocated into a marine environment where they have the potential to establish and disrupt the natural balance of marine ecosystems.

Not all NIMS that are translocated to a receiving location will survive through to establishment and only a subset of these species that become established will impact on social/cultural, human health, economic and/or environmental values are considered IMS (Wells, 2018).

IMS can be introduced through a variety of natural and human mediated vectors. The key pathways for introduction of IMS to the State Proposal Area is within biofouling on external surfaces of vessels and within internal niche areas and systems, and through vessel's ballast water. The vectors for translocation are via project vessels and MODU(s).

A detailed assessment of the potential risks associated with unplanned introduction of IMS is provided in [Section 6.3.21](#) of the draft EIS/ERD. This includes an overview of the potential pathways of introduction, the process of the establishment of an IMS, an assessment of project specific pathways of IMS introduction and potential impact to ecosystem dynamics that could occur as a result of the introduction and establishment of an IMS.

The majority of the State Proposal Area consists of deep offshore open waters, away from shallow habitats, that are not conducive to the settlement and establishment of IMS, due to the lack of benthic light (required to support the photosynthetic processes required for many NIMS) or suitable hard substrates to allow attachment and growth.

The primary receptors with respect to IMS in the State Proposal Area are shallow-water marine habitats, species and ecosystem function at Scott Reef. Shallow water marine habitats, such as coral reefs, are considered susceptible to the introduction and subsequent establishment of IMS due to the availability of light and complex habitats. IMS introduced to shallow water marine habitats are, therefore, much more likely to successfully establish than those introduced to deep oceanic waters.

Shallow water benthic habitats, such as coral reefs, are considered susceptible to the introduction and subsequent establishment of IMS due to the availability of light and available substrate for establishment. IMS introduced into shallow water marine habitats are, therefore, much more likely to successfully establish than those introduced to deep oceanic waters (i.e. the deepwater habitat of the reef system).

Sites subject to existing disturbance such as Scott Reef are also considered to be more susceptible to IMS. This includes artificial structures (e.g. the two shipwrecks at Scott Reef; [Section 5.4.3.2](#) of the draft EIS/ERD), sites effected by coral bleaching and/or extreme weather events (as described for Scott Reef in [Section 5.3.1.3](#) of the draft EIS/ERD), and those areas impacted by tourism or fishing (e.g. tourism and Indonesian fishers at Scott Reef). The cumulative pressure of these disturbances may lead to weakened ecosystem function and reduced resilience to external pressures such as IMS. An IMS surveillance program at Scott Reef is proposed to be undertaken, with a survey completed prior to the commencement of the proposed Browse to NWS Project activities in the State Proposal Area to verify baseline condition, and periodic surveys over the life of the proposed Browse to NWS Project.

As described in [Table 6-146](#) of the draft EIS/ERD, given this sensitivity and the regional significance of Scott Reef, the consequence of the introduction and successful establishment of an IMS has been determined to represent a consequence level of Major due to the potential for regionally significant impacts to high value habitat. However, given the legislative and Woodside management controls in place to prevent translocation and establishment of IMS in the Project Area it is considered that the likelihood that IMS would be introduced, establish a self-sustaining population and cause environmental impacts to sensitive ecological communities within the vicinity of Project Area, including the State Proposal Area (e.g. Scott Reef) is remote.

8.3.4.15 Unplanned hydrocarbon releases

A detailed assessment of the potential risks associated with unplanned hydrocarbon releases is provided in [Section 6.3.21](#) of the draft EIS/ERD. Quantitative hydrocarbon spill modelling of various worst-case hydrocarbon release scenarios is presented in

[Section 6.3.21.3](#) of the draft EIS/ERD. This included modelling of a loss of well integrity scenario at the TRA-C well (Scenario 1) which represents the worst case impacts to Scott Reef. The summarised result of the modelling of Scenario 1 are presented in [Table 6-158](#) and [Figure 6-51](#) of the draft EIS/ERD.

Based on the outcomes of quantitative spill modelling, hydrocarbon spills resulting from the Proposal have the potential to significantly impact shallow benthic communities and habitats within the State Proposal Area. However, given existing legislative and management controls the occurrence of hydrocarbon spills is considered highly unlikely.

8.3.4.16 Cumulative impacts

Given the distance of the State Proposal Area from other operating developments in the region, it is not considered credible cumulative impacts from the proposed Browse to NWS Project (or the Proposal) and other developments will occur.

With respect to the Commonwealth waters component of the proposed Browse to NWS Project, other than potentially hydrotest discharges (discussed below), it is not expected that planned marine discharges to Commonwealth waters would contribute to cumulative impacts on benthic communities and habitats within the State Proposal Area. Operational discharges (i.e. produced water and cooling water) from the FPSO facilities (in Commonwealth waters) have been designed and will be managed to ensure the defined threshold values (e.g. 99% species protection or no effect concentrations) at the State waters boundary are met (95% of the time based on dispersion modelling results).

While not considered the base-case, the potential discharge of hydrotest fluids from the BTL at the Torosa pipeline end terminal ([Section 6.3.17](#) of the draft EIS/ERD), may result in a temporary reduction in water quality within the State Proposal Area and thus a potential impact on adjacent benthic communities and habitats. The modelling results ([Section 6.3.17.3](#) of the draft EIS/ERD) indicate this would be restricted to deep waters surrounding the pipeline end terminal (461 m depth) and therefore impacts would be restricted to a small proportion of sparsely distributed epifauna. Given this, and the fact this discharge would be a one-off event that would occur prior to the commencement of operations, the discharge of hydrotest fluid from the BTL at the Torosa pipeline end terminal would not be expected to contribute significantly to cumulative impacts to benthic communities and habitats within the State Proposal Area.

8.3.5 Assessment of Impacts

The assessment of the predicted impacts to benthic communities and habitats in the State Proposal Area (i.e. deepwater habitats and Scott Reef habitats) demonstrates predominately temporary and minor

impacts to the deepwater habitats on a localised scale associated with some of the proposed activities. Such impacts are associated with the direct disturbance resulting from the installation of the subsea infrastructure and the discharge of drill cuttings and fluids during development drilling.

Given the proposed location of the wells and subsea infrastructure will be in deep waters (>300 m), away from Scott Reef and that under normal operating conditions the drilling and vessel activity will be limited to the immediate vicinity of the subsea infrastructure, it is considered unlikely that marine discharges will impact Scott Reef shallow water benthic communities and habitats (<75 m water depth). Given the potential sensitivities of Scott Reef benthic communities and habitats to sedimentation from surface drill cuttings discharges, Woodside has committed to managing the discharges of drill cuttings and fluids at TRA, TRD, TRE and TRF drill centre locations using established and proven techniques such that impacts to Scott Reef shallow water benthic communities and habitats (<75 m water depth) are avoided.

In summary, given the localised scale and temporary nature of potential impacts to deepwater benthic communities and habitats, and no predicted impact to Scott Reef benthic communities and habitats, there is not expected to be any reduction in diversity or ecological integrity within the State Proposal Area.

In addition, the localised and temporary nature of the predicted sediment deposition mean that no impacts to benthic communities and habitats associated with State marine parks (the closest being over 400 km from the State Proposal Area) are expected to occur.

Given the above, impacts to benthic communities and habitats within the State Proposal Area as a result of the proposed Browse to NWS Project (or the Proposal) are expected to be consistent with the EPA objective for the environmental factor – benthic communities and habitats.

8.3.6 Mitigation

Level of Ecological Protection

As described in [Section 8.2.6](#), and EMQP will be prepared and implemented to achieve the proposed LEPs ([Figure 8-1](#) and [Figure 8-2](#)). With the implementation of the EMQP, it is expected a maximum LEP will be achieved in the majority of the State Proposal Area, including all Scott Reef shallow water benthic communities and habitats (<75 m water depth) during construction and operations. A high LEP will be achieved for the deep waters of the State Proposal Area where subsea infrastructure will be located, except where a moderate LEP is proposed within a 1000 m radius of each drill centre during construction and operations; and 500 m around subsea infrastructure during construction. Further, an area of moderate LEP is proposed during construction where the potential discharge of hydrotest fluid from the BTL (in Commonwealth waters), may incur into the State Proposal Area.

Specific proposed measures to mitigate and manage unavoidable impacts from planned activities and reduce the environmental risk associated with unplanned events and incidents are presented in [Chapter 6](#) of the draft EIS/ERD and these will be incorporated into the EQMP where relevant. Measures presented in the draft EIS/ERD will also be incorporated into activity specific Environment Plans to be submitted for acceptance by DMIRS prior to the activity commencing within the State Proposal Area.

Drilling discharge management

As detailed in [Section 8.2.4.8](#), modelling indicated that the sea surface discharge of drill cuttings from the bottom-hole sections generated at the previously proposed TRE and TRD drill centre locations would potentially result in incursions of sediment plumes and associated increased sedimentation to portions of North and South Scott Reef including within the lagoons.

Given the potential sensitivities of Scott Reef shallow water benthic communities and habitats to sedimentation from drilling discharges, Woodside has committed to managing the drilling discharges (in particular bottom hole discharges) using established and proven techniques (e.g. disposal at alternative locations if necessary) at drill centre locations in the State Proposal Area (i.e. TRA, TRD, TRE and TRF) in such a manner that avoids impacts to Scott Reef shallow water benthic communities and habitats (<75 m water depth). This approach is outlined in [Section 8.2.6](#).

8.3.7 Predicted Outcome

Cumulative loss assessment

WA EPA Technical Guidance - Protection of Benthic Communities and Habitats, requires the establishment of a local assessment units (LAUs) to establish the spatial context for the calculation and assessment of recoverable impacts and cumulative losses (EPA, 2016c).

The following five LAU representing the broad benthic community and habitat types are proposed for the State Proposal Area.

- + Scott Reef south lagoon deepwater coral habitats
- + Scott Reef north deepwater sediment habitat
- + Scott Reef south deepwater sediment habitat
- + Scott Reef north shallow water benthic communities and habitats
- + Scott Reef south shallow water benthic communities and habitats.

As per the EPA technical guidance “Calculating cumulative losses relies on three fundamental pieces of information – 1) estimates of the areas of benthic communities and their habitats present before European habitation, 2) estimates of the extent of historic and approved losses, and 3) predictions of the additional losses associated with the current proposal (EPA, 2016c).” In this regard:

- + Original spatial extent is considered to be the entire spatial extent of the two above defined broad habitat types.
- + No historical losses have been recorded. While Woodside has drilled seven previous wells within the State Proposed Area, impacts from the associated drill cuttings discharge are considered reversible (as described in [Section 8.3.4.9](#)), with benthic biota expected to have recolonised the area once drilling is completed.
- + Proposed extent of permanent loss (0.31km²) from proposal has been estimated based on the planned seabed disturbance for the installation of subsea infrastructure.
- + Up to 3.84 km² of reversible loss may occur as a result of indirect impact from subsea infrastructure. Reversible loss is not included in the cumulative loss estimates.

Table 8-7 summarises the cumulative benthic communities and habitat loss estimates for the State waters around Scott Reef LAU.

Table 8-7 Cumulative permanent benthic communities and habitat loss assessment for State waters around Scott Reef LAU

Benthic communities and habitat type	Original spatial extent (pre-European habitation)	Historic and approved losses	Current % remaining	Proposed extent of permanent loss from proposal	Spatial extent of cumulative loss	% remaining after proposal
Scott Reef south lagoon deepwater coral habitats	213.47 km ²	0 km ²	100%	0 km ²	0 ha	100%
Scott Reef north deepwater sediment habitat	311.26 km ²	0 km ²	100%	0.31 km ²	0.31 km ²	99.90 %
Scott Reef south deepwater sediment habitat	379.16 km ²	0 km ²	100%	0 km ²	0 km ²	100%
Scott Reef north shallow water benthic communities and habitats	179.51 km ²	0 km ²	100%	0 km ²	0 km ²	100%
Scott Reef south shallow water benthic communities and habitats	147.14 km ²	0 km ²	100%	0 km ²	0 km ²	100%

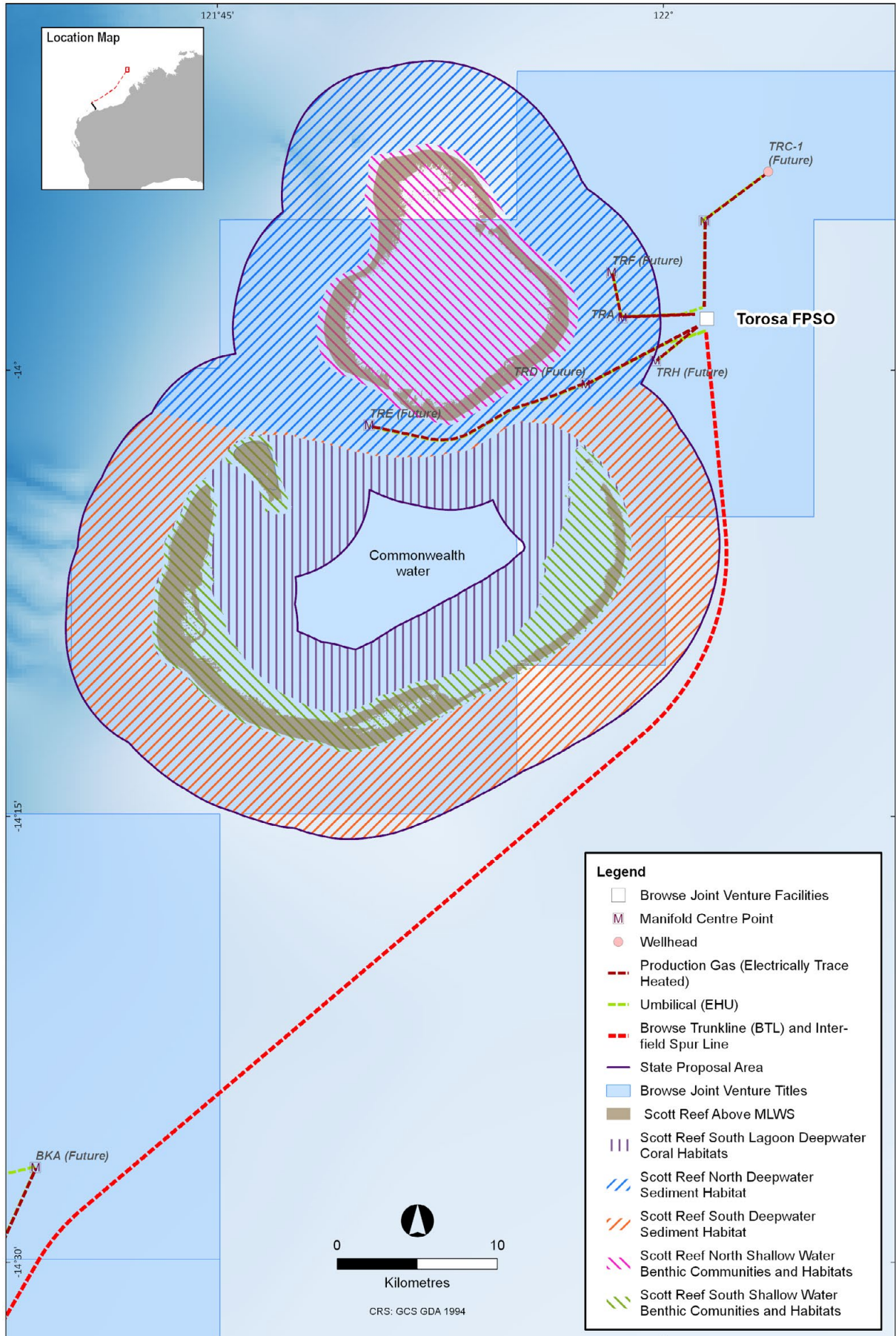


Figure 8-4 Proposed State Proposal Area Local Assessment Units

Summary

Impacts to benthic communities and habitats within the State Proposal Area have been reduced by locating the FPSO facilities, BTL and inter-field spur line outside of the State Proposal Area, and siting infrastructure within the State Proposal Area in deep waters off Scott Reef. This will result in any impacts being restricted to the deepwater benthic habitats, with no impacts to Scott Reef benthic communities or habitats.

Impacts will be further reduced by implementing mitigation and management measures, the majority of which are standard maritime and offshore oil and gas industry practice. However, given the potential sensitivities of Scott Reef shallow water benthic communities and habitats to sedimentation from drilling discharges, Woodside has committed to managing the drilling discharges (in particular bottom hole discharges) at drill centre locations in the State Proposal Area (i.e. TRA, TRD, TRE and TRF) in such a manner to avoid impacts to Scott Reef shallow water benthic communities and habitats (<75 m water depth) (refer to [Section 8.2.6](#)). Implementation of this management approach will be assured through activity specific Environment Plan(s) under Petroleum Legislation.

Given cumulative losses (historical plus proposed) of benthic communities and habitats will be limited to a small portion that are well represented both in the State Proposal Area and regionally (approximately 0.11% of Scott Reef north deepwater sediment habitat LAU with no losses in any of the other four proposed LUA), the Proposal is not predicted to result in any reduction of biological diversity and ecological integrity within the State Proposal Area.

As such, the WA EPA environmental objective “to protect benthic communities and habitats so that biological diversity and ecological integrity are maintained” will be achieved for the Proposal; and the predicted impacts on benthic communities and habitats within the State Proposal Area are considered **Acceptable**.

8.4 Key Environmental Factor – Marine Fauna

8.4.1 EPA Objective

The EPA objective for marine fauna is “To protect marine fauna so that biological diversity and ecological integrity are maintained” (EPA, 2016b).

8.4.2 Policy and Guidance

The following policy and guidance have been considered in relation to the EPA environmental factor - marine fauna:

EPA Policy and Guidance

- + Statement of Environmental Principles, Factors and Objectives (EPA, 2016b)
- + Environmental Factor Guideline – Marine Fauna (EPA, 2016b).

Other Policy and Guidance

- + *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales (Department of the Environment, Water, Heritage and the Arts, 2008)
- + Conservation Management Plan for the Blue Whale - A Recovery Plan under the EPBC Act (Commonwealth of Australia, 2015a)
- + Conservation advice *Anous tenuirostris melanops* Australian lesser noddy (Threatened Species Scientific Committee, 2015a)
- + Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (Threatened Species Scientific Committee, 2015b)
- + Recovery plan for marine turtles in Australia (Commonwealth of Australia, 2017a)
- + Conservation advice *Rhincodon typus* whale shark (DEWHA, 2015c).

8.4.3 Receiving Environment

Marine fauna that may occur within the Browse Development Area are described in detail in [Chapter 5](#) of the draft EIS/ERD. Marine fauna that may occur in the State Proposal Area are summarised below, with cross references to specific sections of [Chapter 5](#) of the draft EIS/ERD provided for further detail.

Seabirds and migratory shorebirds

Seabirds have been observed in low numbers at Scott Reef, as described in [Section 5.3.2.4.1](#) of the draft EIS/ERD. Sandy Islet (the only permanently emergent land mass at Scott Reef) may be used by nesting seabirds and is known to provide roosting habitat for low numbers of individuals but it is not large enough to support large numbers of seabirds at any one time. Scott Reef is recognised as part of a resting Biologically Important Area (BIA) for the little tern (*Sterna albifrons*) ([Section 5.3.2.2](#) of the draft EIS/ERD). This species is widely distributed within Australia and is expected to occur within the State Proposal Area.

Migratory shorebirds may also use Scott Reef as a staging ground during migrations, for nesting and roosting and have occasionally been observed in very low numbers, as detailed in [Section 5.3.2.4.2](#) of the draft EIS/ERD.

Marine mammals

Marine mammals have wide distributions that are associated primarily with seasonal feeding and migration patterns that are linked to their reproductive cycles. A number of marine mammal species have been identified as potentially occurring within the wider Project Area, as described in [Section 5.3.2.5](#) of the draft EIS/ERD. A number of surveys have been undertaken in recent years to establish baseline data for marine mammals, primarily humpback whales and pygmy blue whales, within proximity of the Browse Development Area, including the State Proposal Area. These are summarised in [Section 5.3.2.5](#) of the draft EIS/ERD. The species discussed below are considered likely to occur within the State Proposal Area.

- + Humpback whale - the humpback whale (*Megaptera novaengliae*) is listed under the EPBC Act as Vulnerable, Migratory and Marine, and as Conservation Dependant under the *Biodiversity Conservation Act* (BC Act). This species has a wide global distribution and displays migratory behaviours, as described in [Section 5.3.2.5.1](#) of the draft EIS/ERD. Recent studies have indicated that this species travels less than 46 km from the coastline and within waters less than 50 m deep (RPS Environment and Planning, 2010b; 2012). Sightings have, however, been recorded around Scott Reef. There are no known BIAs for this species within the State Proposal Area and only low numbers of humpback whales are expected to be present in the area.

There are also key calving areas for the humpback whale between Broome and the northern end of Camden Sound, as described in [Section 5.3.2.5](#) of the draft EIS/ERD. Additionally, there is a migration BIA for the species ([Section 5.3.2.2](#) of the draft EIS/ERD) which encompasses State waters around Broome.

- + Pygmy blue whale - the pygmy blue whale (*Balaenoptera musculus*) subspecies is listed under the EPBC Act as Endangered, Migratory and Marine, and as Endangered under the BC Act. As described in [Section 5.3.2.5.2](#) of the draft EIS/ERD, this migratory subspecies is widely distributed from Indonesia to the south west of Australian and east along the Great Australian Bight to the Bass Strait. Noise logger data and historic observations have recorded this species within the waters of and surrounding Scott Reef, including the channel between North and South Scott Reef (McCauley, 2011). A possible foraging area has been documented at Scott Reef (although individuals

have not been directly observed feeding) and the reef is recognised as part of a foraging BIA for this species in the Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015b) ([Section 5.3.2.2](#) of the draft EIS/ERD). Migration and distribution BIAs for this species also encompass the State Proposal Area ([Section 5.3.2.2](#) of the draft EIS/ERD). The distribution BIA for the pygmy blue whale also encompasses State waters at Broome.

Given the historical observations (Blue Planet Marine, 2019) and noise logger data (McCauley, 2011), it is expected that pygmy blue whales will occur in low numbers within the Browse Development Area, particularly within and around the waters of Scott Reef. It is acknowledged that pygmy blue whales have been recorded in the channel between North and South Scott Reef and they may forage opportunistically in and around Scott Reef during their migration to and from recognised aggregation areas.

- + Bryde's whale - the Bryde's whale (*Balaenoptera edeni*) is listed under the EPBC Act as Migratory. The species is not listed under the BC Act. As described in [Section 5.3.2.5](#) of the draft EIS/ERD, noise loggers were deployed in and around Scott Reef from 2006 to 2009 and this species was found to be present in low numbers throughout the year. Data indicated this species was typically present as individuals, with occasional calls from multiple whales. Bryde's whales are subsequently expected to occur in low numbers within the State Proposal Area.
- + Spinner dolphin - the spinner dolphin (*Stenella longirostris*) is a listed Cetacean under the EPBC Act and Priority 4 under the BC Act. This species is known from both oceanic and coastal habitats and has been recorded near Scott Reef in 2008 and 2009, as described in [Section 5.3.2.5](#) of the draft EIS/ERD. This species is likely to be found in or within the vicinity of the State Proposal Area.

Marine turtles

Marine turtles may occur within the Project Area, as described in [Section 5.3.2.6](#) of the draft EIS/ERD. As marine turtles are highly migratory it is possible that all six marine turtle species may occur within the State Proposal Area. The green turtle (described in [Section 5.3.2.6](#) of the draft EIS/ERD) and hawksbill turtle (described in [Section 5.3.2.6](#) of the draft EIS/ERD) are considered most likely to occur within the State Proposal Area as these species are known to nest at Sandy Islet. Both species are listed as Vulnerable under the EP Act and the EPBC Act. The internesting, nesting and post-nesting migratory behaviour of the green turtle at Scott Reef and surrounds has been studied in some detail and is summarised in [Section 5.3.2.6](#) of the draft EIS/ERD.

There are nesting/interbreeding BIAs for the green and hawksbill turtle at Scott Reef (described in [Section 5.3.2.2](#) of the draft EIS/ERD) due to nesting habitat on Sandy Islet. While green turtles are known to nest each season at this location in low numbers, only one hawksbill turtle has been recorded nesting at this location. Habitat Critical to the Survival of a Species has also been designated for the green turtle at Scott Reef ([Section 5.3.2.3](#) of the draft EIS/ERD), in order to preserve the genetic stock of the nesting population associated with these locations.

Sea snakes

Comprehensive surveys of sea snakes were undertaken at Scott Reef in February, September and November of 2006. A number of sea snake species were identified as part of these surveys (listed in [Section 5.3.2.7](#) of the draft EIS/ERD). Sea snakes were typically associated with complex reef habitats and survey results indicated that these individuals were likely residential to Scott Reef. Sea snakes are expected to occur within the State Proposal Area.

Fish

Demersal and pelagic fish communities and species that may occur within the Project Area are listed and described in [Section 5.3.2.8](#) of the draft EIS/ERD. Surveys of shallow water fish communities were undertaken at Scott Reef in 2006. The overall composition of fish fauna at Scott Reef was found to be generally similar to oceanic reefs in the tropical Indo-west Pacific, with a stronger affinity to the islands of eastern Indonesia than to the adjacent Australian

mainland. Studies were also undertaken using Baited Remoted Underwater Video Systems (BRUVs) in the deeper waters of South Scott Reef lagoon and found herbivorous and coral feeding species to be widespread.

Species of sharks and rays identified as potentially occurring within the Project Area include the whale shark, shortfin mako, longfin mako, green sawfish and largetooth sawfish. There are no BIAs or known important habitat for these species within the State Proposal Area. The whale shark is a widely distributed migratory species and may occur within the vicinity of Scott Reef whilst undertaking migratory movements. The shortfin and longfin mako are widely oceanic species and, subsequently may occur within the vicinity of the State Proposal Area. The green and largetooth sawfish are not considered likely to occur within the State Proposal Area as they exhibit a preference for/reliance on inshore, shallow, sandy/muddy bottomed and estuarine habitats.

8.4.4 Potential Impacts

8.4.4.1 Summary of identified impacts and risks

[Table 8-8](#) summarises the sources of potential impact to marine fauna from the Proposal. [Table 8-8](#) is followed by a detailed description of the potential direct, indirect and cumulative impacts. An assessment of the significance of these impacts on marine environmental quality and a conclusion on the acceptability of the impacts in relation to the EPA environmental objective is presented in [Section 8.4.5](#).

Table 8-8 Sources of Potential Impact to Marine Fauna from the Proposal

Aspect	Proposal Phase ¹					Source (in State jurisdiction)
	Dr	I	C	O	De	
Planned (routine and non-routine activities)						
Physical presence: light emissions	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area Intermittent flaring from the MODU
Physical presence: electromagnetic emissions				✓		Subsea infrastructure
Atmospheric emissions: offshore activities	✓	✓	✓	✓	✓	Power generation on project vessels and the MODU Intermittent flaring from the MODU Venting of gas from the MODU (during well kick)

Aspect	Proposal Phase ¹					Source (in State jurisdiction)
	Dr	I	C	O	De	
Atmospheric noise	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area Intermittent flaring from the MODU Helicopters movements Piling for MODU mooring installation (if required)
Underwater noise	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area VSP/DAS during well development Piling for MODU mooring installation (if required) Wellhead operation Seabed preparation Helicopter movements
Marine discharges: sewage and sullage	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area
Marine discharges: treated utility water, chemical and deck drainage	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area
Marine discharges: produced water	✓					MODU during well unloading activities
Marine discharges: cooling water	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area
Marine discharges: drilling and completions discharges	✓					MODU during drilling activities
Marine discharges: subsea control fluids	✓	✓		✓	✓	Subsea infrastructure during operations BOP during drilling ROVs
Marine discharges: hydrotest fluid	✓	✓	✓	✓		Temporary production system on MODU Integrity testing of subsea infrastructure
Production Activities: Seabed Subsidence				✓		Extraction of reservoir fluids
Unplanned events and incidents						
Marine discharges: hazardous and non-hazardous waste inorganic waste	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area
Physical Presence (unplanned): Vessel Interactions with Fauna	✓	✓	✓	✓	✓	Project vessels and installation vessels operating in the State Proposal Area
Physical Presences (unplanned): Invasive Marine Species	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating in the State Proposal Area
Unplanned hydrocarbon releases	✓	✓	✓	✓	✓	Project vessels, installation vessels and MODU operating the State Proposal Area Subsea infrastructure

¹ Dr = Drilling; I = Installation; C = Commissioning; O = Operation; De = Decommissioning

8.4.4.2 Physical presence: light

Modelling

A detailed description of the planned light emissions and an assessment of the potential impacts associated with these emissions is provided in [Section 6.3.3](#) of the draft EIS/ERD.

Light emissions within the State Proposal Area will occur as a result of operational and navigational lighting on project vessels, installation vessels and the MODU; as well as intermittent flaring on the MODU during well unloading. Light emissions in the State Proposal Area will occur only during the construction phase, contingency drilling and completion activities and during infrequent IMR activities. There will be no regular sources of light emissions in the State Proposal Area during routine operations.

To further understand the effects of light emissions on sensitive receptors (particularly green turtles), a line of sight assessment and a light density (luminous flux density) modelling study were conducted as part of the approved Browse FLNG Development EIS developed in 2014. Although the MODU for drilling is yet to be confirmed and different MODUs are likely to be used throughout the Browse field life, light levels associated with drill rig lighting are expected to be comparable to that studied. It is considered that these studies adequately define the potential impacts from artificial light emissions associated with the proposed Browse to NWS Project. Given the similar nature of the Proposal and the previously considered Torosa Subsea Development, the modelling undertaken previously is considered appropriate to inform the impact assessment of the Proposal. The results of these studies are summarised in [Section 6.3.3.3](#) of the draft EIS/ERD.

Due to the proximity of the TRE drill centre to Scott Reef, it was predicted direct light emitted from a drill rig at this location would be visible to some extent from all areas of Scott Reef, including Sandy Islet (approximately 7 km distant) ([Figure 6-5](#) of the draft EIS/ERD). However, based on the light density modelling, the maximum predicted light density levels from a drill rig at TRE reaching Sandy Islet are lower than 0.01 Lux, which is comparable to light levels between a moonless clear night sky and a quarter moon.

Light emissions from project vessels were not included in the line of sight assessment and light density modelling due to the temporary and transient nature of vessel movements.

Seabirds and migratory shorebirds

As described in [Section 6.3.3](#) of the draft EIS/ERD, seabirds and migratory shorebirds at Scott Reef may be affected by light emissions from project vessels and the MODU operating in the State Proposal Area. It should be noted, however, that the area does not represent a significant aggregation, nesting or roosting area.

The exact mechanism for navigation of migratory birds is not clear, however, it is widely thought that they use a mixture of natural cues, including the earth's magnetic field, solar and celestial orientation and polarised light patterns to determine their migratory pathway (Weindler and Liepa, 1999; Wiltschko and Wiltschko, 2001). Therefore, there is a risk that artificial light sources along migratory pathways may alter natural patterns, specifically in the absence of terrestrial landmarks (i.e. within offshore).

Studies have demonstrated that light from offshore facilities may attract migrating birds, with species that migrate during the night more likely to be affected (Marquenie et al., 2008; Verheijen, 1985). Birds may either be attracted by the light source itself or indirectly as lighted structures in marine environments tend to attract marine life at all trophic levels, creating food sources and shelter for seabirds. In some cases, sources of artificial light may provide enhanced capability for seabirds to forage at night (Verheijen, 1985). Studies in the North Sea indicated that migratory birds may be attracted to lights on offshore platforms when travelling within a radius of 3 to 5 km from the light source. Outside this area their migratory paths were not likely to be affected (Marquenie et al., 2008).

Additionally, artificial lighting may interfere with a bird's internal magnetic compass. It is thought that migratory birds require light from the blue-green part of the spectrum for magnetic compass orientation (Muheim et al., 2002; Wiltschko and Wiltschko, 2001, 1995) whereas red light, the long-wavelength component of light, is more likely to disrupt magnetic compass orientation.

Light from the MODU is unlikely to attract a significant number of such seabirds or shorebirds as activities are proposed to be located a considerable distance from known key aggregation areas such as Ashmore Reef (230 km), Roebuck Bay (370 km) and Eighty Mile Beach (500 km). Given a relatively small number of transiting birds are expected to pass in the vicinity of the Proposal Area, behavioural effects such as disorientation and/or attraction are expected to be minor. Similarly, birds roosting at night on Sandy Islet are unlikely to be disturbed given the low level of artificial light (less than 0.01 Lux) that would be received at Sandy Islet from the MODU.

Red light (the long-wavelength component of light) is more likely to disrupt the magnetic compass orientation of migratory birds. The expected spectral signature of light emissions from the MODU is between 530 to 620 nm (based on measurements of the drill rig during drilling of the TS-1 pilot appraisal well), with the red part of the spectrum outside of these ranges. Therefore, it is not expected that bird species magnetic compass orientation will be disrupted.

Fish

As described in [Section 6.3.3](#) of the draft EIS/ERD, the waters of the State Proposal Area host a rich diversity of fish species, including demersal and pelagic fish. The attraction of fish to artificial light is a well known phenomenon and is likely to be associated with the increased availability of planktonic prey on the surface at night (due to vertical migration of zooplankton) and the increased prey detection abilities provided by the light (Marchesan et al., 2005). The response of fish to artificial light has been shown to differ depending on species and changes in behaviour due to the light regime potentially pose an increased risk of predation through changes to natural night time distribution (Marchesan et al., 2005; Nightingale and Simenstad, 2001). Artificial light may also exclude nocturnal foragers/predators from an area, allowing diurnal species to benefit from increased access to resources. Credible impacts from light emissions from the MODU and project vessels associated with the Proposal are expected to be restricted to localised fish attraction.

The whale shark is the only threatened fish species that is likely to occur within the State Proposal Area, albeit infrequently and in low numbers (refer to [Section 5.3.2.8](#) of the draft EIS/ERD). Impacts from light emissions are not documented for this species, although this has been identified as an area for further research within the latest conservation advice for this species (Threatened Species Scientific Committee, 2015c). Given the low numbers and infrequent nature of whale shark presence in the State Proposal Area, it is considered highly unlikely that adverse impacts will occur to the small number of individual whale sharks that may encounter elevated, localised light emissions around the MODU and vessels. Occasional and temporary behavioural changes such as utilising attractant aggregations of food sources (such as zooplankton) for opportunistic feeding is known to occur around offshore facilities and may occur for the proposed Browse to NWS Project.

Marine turtles

Specific behavioural response to artificial light emissions by marine turtles relates to altered nocturnal behaviours (as described by Witherington and Martin (1996) and include:

- + disorientation: loss of orientation, being unable to maintain constant directional movement
- + misorientation: orientation in the wrong direction, for hatchling marine turtles on the beach, travel in any direction other than the general vicinity of the ocean.

There are many variables that influence the range and severity of potential impacts of light emissions on the behaviour of marine turtles including:

- + turtle vision
- + life stage (adult and hatchling).

Exposure of marine turtles to artificial light can result in changes to their natural behaviour, in particular with regards to nesting (Commonwealth of Australia, 2019). Sandy Islet (nesting habitat) and a 20 km interesting buffer of the surrounding waters are recognised as habitat critical to the survival of green turtles for the Scott Reef-Browse Island genetic stock in the Recovery Plan for Australian Marine Turtles 2017-2027 (Commonwealth of Australia, 2017a) ([Figure 5-29](#) of the draft EIS/ERD). In addition, a BIA exists for interesting green and hawksbill turtles around Sandy Islet (Commonwealth of Australia, 2017a). Green turtles predominately nest at Sandy Islet between November and February and interesting turtles have been observed to aggregate primarily in an area to the south west of Sandy Islet. Only one hawksbill turtle has been recorded nesting at Sandy Islet ([Section 5.3.2.5.2](#) of the draft EIS/ERD).

The Recovery Plan for Marine Turtles in Australia (2017-2027) identifies light pollution as a moderate risk to the Scott Reef-Browse Island green turtle genetic stock and a high risk to the WA hawksbill turtle population (Commonwealth of Australia, 2017a). The long-term recovery objective for marine turtles is to 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.

The National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (Commonwealth of Australia, 2019) further discuss impacts and management of artificial light in relation to marine turtles.

Female adult marine turtles spend most of their lives in open ocean environments, however, female turtles return to natal beaches to nest and lay eggs, predominantly at night. There is significant evidence that indicates artificial lighting on or near nesting beaches may disrupt adult female turtle nesting behaviour (Commonwealth of Australia, 2019; Salmon, 2005; Salmon et al., 1992). Artificial lighting may affect the location that turtles emerge on the beach, the success of nest construction, whether nesting is abandoned and even the seaward return of adults (Salmon, 2005 and Salmon et al., 1992). It was found that turtles deterred from typical nesting beaches due to artificial lighting re-emerged onto alternate beaches outside of their typical range at increasingly distant and inappropriate nesting locations (Witherington and Martin, 2000, 1996). The selection of suboptimal nesting habitat may contribute to a reduction in the success of egg deposition and hatchling production (Witherington and Martin, 2000). There is no indication whether, under natural conditions, the full moon affects rates of female adults landing on a beach to nest. Nor is there any information available in the published literature that suggests adult turtles are affected by light during foraging activity (Pendoley, 2000).

Hatchlings have a strong tendency to orient themselves to the brightest light source, which under natural conditions is the seaward horizon (in natural circumstances derived from the moon for most of the month) rather than the darker silhouetted landward horizon (Limpus, 2006). The light glow created by artificial lighting may, therefore, cause hatchlings to be attracted to this light source rather than to the water (Witherington and Martin, 2000, 1996). Hatchlings which are disoriented or mis-oriented by artificial lights often do not find the sea promptly, this may lead to predation or exhaustion. Once in the ocean, little is known of the extent to which hatchlings still use vision over wave direction and the earth's magnetic field for orientation (Lohmann, 1992). Hatchlings swimming out to sea from the beach, however, may be attracted to light emissions from offshore structures or vessels, making them more susceptible to predation or vessel strike after they enter the water (Thums et al., 2016). Wilson et al. (2018) found that light emissions disrupted the dispersal of hatchlings and hatchlings become disoriented in nearshore environments.

The wavelength at which adult and hatchling turtles can sense light is important in determining their corresponding attraction and sensitivity to light emissions. Studies suggest that marine turtles are most sensitive to short-wavelength light in the near-ultraviolet to yellow region of the visible spectrum, from approximately 340 to 700 nm (Witherington and Martin, 2000). Studies on hatchling orientation, relative to spectrally controlled light sources, indicate that although the wavelength at which hatchlings can sense light varies between species, all turtle species are more sensitive to light in the blue and ultraviolet (UV) end of the spectrum. The most disruptive wavelengths to hatchlings are in the 300 to 500 nm range (Witherington, 1997). Light spill effects are not known to vary for different turtle species, however, green turtles are known to be attracted to light of lower wavelengths (<600 nm), with a preference for blue light (400 – 450 nm). The light intensity measurements and modelling predictions accounted for the full wavelength spectrum detected by marine turtles (340 to 700 nm) (ERM and SKM, 2008).

Based on lighting data from the drill rig, approximately 60% of the total light wavelength transmission is within the sensitive wavelength range for turtle hatchlings (300 to 500 nm) (ERM, 2010), with most common artificial light sources, such as fluorescent, generating light within these wavelengths (Witherington and Martin, 2000; Witherington, 1997). Given light intensity attenuated to 0.1 Lux at distances of 1.2 km from the studied drilling rig, given the distance of the TRE drill centre location from Sandy Islet it is only in the nearfield light spill that may impact adult breeding turtles on the water.

Based on the measured attenuation of light density and wavelengths from a drill rig at Scott Reef (ERM and SKM, 2008) and the predicted light levels modelled (ERM and

SKM, 2008; Jacobs and SKM, 2014), light levels expected are below detection levels or so low (0.1 Lux) that no disturbance to nesting behaviour of adult female marine turtles is predicted at Sandy Islet. It should also be noted that drilling at TRE (the closest light source to Sandy Islet) is a temporary activity, with the MODU only likely to be in that location during the development drilling activities. Flaring from the MODU is not predicted to lead to impacts given its temporary nature (will only occur during well unloading activities and be of 1-2 days duration per well)

Impact of light spill around MODU on marine turtles

Historical studies have reported that due to turtle hatchlings' vision being limited in water, other more dominant navigational cues take over (Amos, 2014; Lohmann and Lohmann, 1992) such as surface currents (Frick, 1976; Liew and Heng Chan, 1992; Okuyama et al., 2009; Salmon and Wyneken, 1987; Witherington, 1995). However, more recent studies (Limpus et al., 2003; Thums et al., 2016) have demonstrated that offshore lights have the ability to attract in-water dispersing hatchlings, causing them to linger around the light source at sea. Additionally, Whelan and Wyneken (2007) and Harewood and Horrocks (2008) reported that artificial lights onshore, can slow down hatchlings' in-water dispersal. Harewood and Horrocks (2008) also demonstrated in this study, that hatchling turtles released from dark beaches, were attracted by artificial lights from neighbouring beaches that were only visible after the hatchlings were a substantial distance from shore. Perhaps more importantly, this study reported that a number of the unsuccessful hatchlings (unsuccessful, meaning hatchlings which did not correctly orientate themselves in a seaward position from the beach) stayed within 10 m of shore and travelled parallel to the shoreline, orientating towards the lighted headlands. Harewood and Horrocks (2008) concluded that artificial lights may override the effects of wave cues in low wave energy environments.

Similarly, Truscott et al. (2017) reported that artificial light sources can attract hatchlings back to shore. More recently, Wilson et al. (2018) confirmed that in the presence of artificial light, surface currents had little effect on the bearing of hatchling swimming, with 88% of individuals' trajectories tracked, orientated towards the experimental artificial lighting. Additionally, this study showed that under ambient conditions, ocean currents affected the bearing of hatchlings as they left the shore; however, when light was present, this effect was diminished, showing that the turtles actively swam against currents in their attempts to move towards light. Hatchling behaviour onshore is not expected to be impacted given the distance of Sandy Islet to TRE and the islet's height above sea level (maximum on west side of 5 m). Hatchling emergence and sea entry were assessed for potential impact from MODU lighting. It was concluded that hatchlings being drawn to MODU

lighting thereby increasing vulnerability to predation were considered unlikely, given the distance of Sandy Islet from all drill centre locations and short travel distance to water regardless of direction.

As surface currents within the Scott Reef channel are known to be strong (averaging approximately 0.5 knots with speeds up to and exceeding two knots), it is unlikely that hatchlings will have the ability to linger and come within the light spill area in the vicinity of a MODU operating in the channel as a result of the artificial light acting as an attractant.

Therefore, artificial lighting associated with the MODU and proposed facilities, may theoretically have the potential to override and disorientate natural hatchling cues, potentially attracting individuals towards the structure. However, the results from the line of sight assessment undertaken as part of the previously proposed FLNG Development concept (ERM, 2010; Jacobs and SKM, 2014), demonstrate that the maximum predicted direct light levels reaching Sandy Islet from a MODU at the TRE drill centre (approximately 7 km away, [Figure 6-5](#) of the draft EIS/ERD) are less than 0.1 Lux.

For context, the predicted light intensity at this level of light is comparable to the light level between a moonless clear night sky and a quarter moon. Therefore, this level of light is not expected to be of an intensity (and associated wavelength frequency) to alter hatchling behaviour (attraction or mis-orientation of hatchlings leaving nesting sites on Sandy Islet). In addition, spectral analysis of light emissions from a flare at Thevenard Island (Pendoley 2000) determined that this light source does not contain a high proportion of light wavelengths within the range that is most disruptive to turtle hatchlings (300 to 500 nm). Therefore, no adverse impacts to hatchlings from artificial light are anticipated, despite the fact that some studies have demonstrated the theoretical potential for misorientation to some individuals.

Adult turtles passing through the Project Area may temporarily alter their normal behaviour whilst attracted to the light spill from the offshore facilities. Light spill of at least 0.1 Lux (i.e. at least quarter moon light intensity levels) is likely to extend 1.2 km radially from the MODU. While the light spill area overlaps with the interesting habitat for green turtles, it is not anticipated that large number of individuals will be present within this area given the preference to internest to the southwest of Sandy Islet and, therefore, will not be subject to behavioural impacts.

In addition, given the wide migratory distribution of adult turtles outside of nesting season (i.e. several hundred kilometres) and their low-density presence within the Project Area, the zone of influence and subsequent attraction from direct lighting is expected to be relatively minor in comparison to their migratory area, resulting in only a temporary disruption to a small portion of the adult turtle population. In addition,

due to the limited range of any lighting impacts, it is not deemed that the predicted lighting impacts will adversely affect habitat critical to the survival of green turtles and is, therefore, not inconsistent with the recovery objectives outlined within the Recovery Plan for Marine Turtles in Australia (2017-2027) (Commonwealth of Australia, 2017a).

8.4.4.3 Physical presence: electromagnetic emissions

EMF will be generated within the State Proposal Area as a result of active heating of the subsea flowlines and power cables. The use of active heating technology in the design of the subsea system minimises the volume of Mono-ethylene Glycol (MEG) required to prevent hydrate formation. Active heating occurs using electricity and will be used in the infield flowlines and risers carrying the reservoir fluids from the subsea manifolds to the FPSOs. Active heating will prevent blockages in the flowlines which can occur when fluids cool causing hydrates and waxes to solidify. Active heating is not expected to be required continuously. While the flowlines are producing, active heating is not required, instead only being turned on for hydrate management when the flowline is not producing after a short period. Active heating remains on until the flowline recommences production and warms up. The other source of EMF will be the subsea power cables that distribute power generated at the FPSO to subsea infrastructure.

Further details of the potential electromagnetic emissions resulting from the proposed Browse to NWS Project is provided in [Section 6.3.4](#) of the draft EIS/ERD.

Fish

It is well established that many organisms including elasmobranchs and some bony fish, can detect both natural and anthropogenic EMFs, which many species use for directional movement, foraging and migration. However, the mechanism or mechanisms by which animals can exploit these fields is not fully understood. Some species may sense magnetic fields directly through biogenic magnetite crystals that reorient as the animal moves to maintain alignment with geomagnetic field lines (e.g., (Kirschvink et al., 2001)). Alternatively, the movement of seawater through magnetic fields (e.g. via current or tidal flow) induces localized electric fields that, although small (0.05-0.5 uV/cm), may be detectable by certain species (Kalmijn, 1982).

A wide range of studies have quantified the effects of EMFs on the behaviour and physiology of fish species (Gill et al., 2005; Normandeau et al., 2011; Walker, 2001). EMF produced from anthropogenic sources within the range of detection by electroreceptors have the potential to impact these species through alteration of their behaviour (attraction or repulsion) or disorientation, leading to interference in migration and movement patterns (Gill et al., 2005; Gill and Taylor, 2005). As electric fields diminish in strength with

increasing distance from the source, elasmobranchs are likely to be initially attracted to the electric field, but as the individual approaches and the electric field strength increases there will be a point where the animal will turn and swim away. Gill and Taylor (2005) observed the repulsion of elasmobranchs from electric fields $>10 \mu\text{V}/\text{cm}$ (Gill and Taylor, 2005). Therefore, when considering the result of the modelling presented in the draft EIS/ERD it is likely that fish may be repulsed by the electric field from the DEH system within a least 75m of the source. However, such impacts are predicted to be behavioural only with no physical impacts likely as a result of the likely avoidance of the source (Walker, 2001).

Marine turtles

Marine turtles are able to detect magnetic fields and note electric fields; however, they do not appear to be as sensitive to magnetic fields as elasmobranchs (Courty et al., 1997; Normandeau et al., 2011; Walker, 2001) and furthermore the potential for behavioural disturbance or displacement is considered low as they are unlikely to be in proximity to the sources of EMF given the depth of water ($>400 \text{ m}$) that the subsea infrastructure will be installed in.

Marine mammals

Marine mammals have been observed to be affected to varying degrees by magnetic fields but not electric fields (Fisher and Slater, 2010). Whales and dolphins appear to rely on geomagnetic contours for navigation, and magnetic fields generated by cables may result in disorientation and disruption to navigation and therefore negatively affect migratory behaviour (Meißner et al., 2006). However, the magnetic field strength emitted from the active heating of the flowlines will be indistinguishable from the earth's field beyond 1 m from the source (Table 6-28 of the draft EIS/ERD). In addition, given the depth of water ($>400 \text{ m}$) that the majority of the EMF will be in, the significance level is predicted to be slight as it is not anticipated that marine mammals will be in close enough proximity to the source to elicit any lasting effects.

Summary

In summary, EMF can be detected at various levels of sensitivity by a number of marine fauna, with some behaviour responses evident from studies outlined above. However, EMF associated with DEH of the flowlines and risers are predicted to attenuate rapidly from the source, with the magnetic field predicted to be below the earth's natural geomagnetic level within 1 m and the electric field predicted to dissipate to $46 \mu\text{V}/\text{cm}$ within 75 m (Table 6-28 of the draft EIS/ERD). Given the depth of water ($>400 \text{ m}$) that the majority of the EMF will be in and the predicted attenuation distances of the electric and magnetic fields, impacts on marine fauna are not predicted to be significant. If marine fauna are temporarily within the area of influence of EMF, effects are expected to be limited to short-term behavioural impacts.

8.4.4.4 Atmospheric emissions: offshore activities

Potential impacts relating the EPA Environmental Factor – Air Quality are addressed in Section 8.5. This assessment concluded that given the low emissions levels it is not anticipated emissions from the Proposal will result in lasting adverse impacts to air quality in the State Proposal Area.

Atmospheric emissions can cause direct impacts to fauna if they are present in the immediate vicinity of significant releases. Birds, for example, have been shown to suffer respiratory distress and illness when subjected to extended duration exposure to air pollutants (Sanderfoot and Holloway, 2017). Given that no lasting adverse impacts to air quality are predicted, it is highly unlikely that seabirds or migratory shorebirds will be exposed to air pollutants for an extended duration of time. As such, adverse impacts to seabirds or migratory shorebirds as a result of atmospheric emission are not predicted.

8.4.4.5 Atmospheric noise

Atmospheric noise emissions are expected to be generated in the State Proposal Area as a result of helicopter flyover during crew transfer, MODU flaring, pile driving and the operation of project vessels and the MODU. Predicted atmospheric noise levels and potential impacts relating to the proposed Browse to NWS Project are described in Section 6.3.7 of the draft EIS/ERD, which concluded that potential impacts to marine fauna from atmospheric noise emissions are expected to be limited to temporary behavioural responses.

Potential behavioural impacts for fauna that are present on the surface during a helicopter flyover (either in State waters near Broome during crew transfer, or in the State Proposal Area near the MODU during crew transfer) may include temporary 'startle' responses (e.g. diving). Such responses typically occur at relatively short ranges (tens of metres) (Hazel et al., 2007) and behavioural impacts during a typical helicopter flight are highly unlikely due to the altitude and distance between the helicopter and the potential receptor.

Atmospheric noise emissions from flaring on the MODU during well unloading will be intermittent and short in duration and are not expected to result in impacts to fauna beyond avoidance behaviour of individual fauna near the MODU at the time of flaring.

Some atmospheric noise emissions will occur during pile driving (if pile driving is required for the MODU mooring during the construction phase) and from project vessels and the MODU (particularly while on DP). The atmospheric noise emissions associated with these sources are expected to be relatively minor and are not expected to result in impacts to fauna beyond avoidance behaviour of individual fauna.

Seabirds and migratory shorebirds

Seabirds and migratory shorebirds may be affected by atmospheric noise emissions from helicopters

transiting between Broome Heliport and the Browse Development Area. In particular, bird species present around Roebuck Bay and Cable Beach (<1 km from the Broome Heliport) and roosting birds at Scott Reef may be affected. Anthropogenic disturbance is identified in the Wildlife Conservation Plan for Migratory Shorebirds as a threat to the conservation of migratory shorebirds (Commonwealth of Australia, 2015c).

Given the high visibility and noise levels associated with helicopter movements, bird species are expected to actively avoid interaction. Any disturbance from helicopters in transit will be of limited duration as they pass by.

Impacts to bird species in the area surrounding Broome are expected to be negligible as helicopters passing by bird aggregation areas will be at significant altitude.

Impacts to bird species at Scott Reef are also expected to be negligible given the area does not represent a significant aggregation, nesting or roosting area for seabirds and migratory shorebirds; and flight paths will actively avoid roosting areas (Sandy Islet).

Bird species along the remainder of the flight path are expected to occur in low numbers. Given the altitude the helicopters will be flying at, impacts are not considered credible.

Cetaceans, marine turtles and fish

Underwater noise monitoring by McCauley (2008) at Scott Reef during a drilling program in 2008 demonstrated that noise emissions from helicopters operating from the MODU were not detectable at a noise logger set 4.6 km away (McCauley, 2008). Given this, and the typical characteristics of helicopter flights from Broome Heliport to the Project Area (i.e. duration, frequency, altitude and air speed), the predicted environmental impact of helicopter generated atmospheric levels that may result in behavioural disturbance to cetaceans, marine turtles and fish is not expected to have any lasting effect.

8.4.4.6 Underwater noise

Key underwater noise emissions that may occur within the State Proposal Area may include pile driving for mooring of the MODU, the MODU on DP, VSP and DAS and the operation of the wellhead. Other noise sources such as vessel operation, helicopter movements and seabed preparation are expected to be minor in comparison and are not considered further here. A detailed assessment of the potential impacts to marine fauna resulting from underwater noise emissions relating to the proposed Browse to NWS Project is presented in [Section 6.3.8](#) of the draft EIS/ERD.

Modelling

Underwater noise emissions in the State Proposal Area are likely to be greatest during drilling, installation and decommissioning phases when activities such as pile

driving may be occurring and vessel activity within the State Proposal Area is at its highest. Nevertheless, given the overall scale of the Proposal and activity phasing, noise emissions during these phases are expected to be limited and of relatively short duration. The results of the underwater noise modelling undertaken for the proposed Browse to NWS Project, including simulated animal movement and exposure modelling, are presented in [Section 6.3.8.3](#) of the draft EIS/ERD. The representative modelling undertaken for activities represent the State Proposal Area include driven piling modelling, the MODU on DP, well VSP and wellhead noise modelling. Modelling for MODU piling noise was based on results for the larger FPSO anchor piles using the IHC S-600 hammer. These estimated ranges of potential impact are considered a representative analogue for potential pile driving for mooring of the MODU, due to the expected smaller diameter and reduced loading requirements of the MODU mooring piles.

Marine mammals

The assessment presented in [Section 6.3.8](#) of the draft EIS/ERD concluded that predicted underwater noise emissions associated with key activities within the State Proposal Area may result in localised avoidance and/or behavioural disturbance of marine mammals within the vicinity of the proposed activities. Humpback and pygmy blue whales are known to occur within the State Proposal Area during their annual migrations, however, studies indicate these species occur in relatively low numbers within the area.

Injury/Mortality

As discussed in [Section 6.3.8.3](#) of the draft EIS/ERD, acoustic modelling of piling activities at Torosa (which incorporates animal behaviour and exposure), indicates that with exclusion zones in place, exposures to sounds levels where permanent injury could occur for pygmy blue whales is reduced to zero. Modelling also indicates that for other activities including the MODU on DP, it is highly unlikely that marine mammals would be exposed to underwater noise levels where injury would occur and as such injury or mortality to marine fauna is not expected.

Behavioural impacts

Modelling of the FPSO anchor piling activities estimated that only 0.32 migrating individual pygmy blue whales and 0.43 foraging pygmy blue whale individuals would be exposed to behavioural response per pile. These estimates are based on the larger FPSO piles and does not include industry standard pre-start observations or soft starts and, as such, the actual number of individuals for MODU piling is likely to be less. Impacts are expected to be limited to temporary avoidance behaviour for the duration of the piling.

Modelling indicates that behavioural impacts may result from the MODU DP to a distance of 10.5 km. As with the piling noise, these impacts are expected to be limited to temporary avoidance behaviour and would only occur during MODU activities (in the order of 75 days per well).

Noise levels predicted from well evaluation using VSP demonstrate that potential behaviour impacts may occur within 1.6-1.7 km from the well; however, these would be limited to a very short duration as this type of activity will only occur for up to 10 hours per well.

Underwater noise levels from subsea wellheads will likely fall below the 120 dB re 1 μ Pa (SPL) cetacean behavioural response threshold within approximately 500 m of the wellheads at the TRD and TRE drill centres and are not predicted to reach the top 100 m of the water column, even directly above the wellheads. Potential impacts to whales and other cetaceans from increased noise levels in the vicinity of the wellheads are therefore expected to be minor and highly localised and are not expected to deter passage through Scott Reef Channel.

Potential impacts to whales and other cetaceans from increased noise levels in the vicinity of the wellheads are, therefore, expected to be localised and are not expected to cause significant impact at a population level.

Given the above, impacts to marine mammals resulting from underwater noise emissions are expected to be limited to occasional temporary behavioural/avoidance impacts to a relatively low numbers of transient marine mammals expected to seasonally occur within the State Proposal Area.

Marine turtles

A detailed assessment of the potential impacts to marine turtles resulting from underwater noise emissions relating to the proposed Browse to NWS Project is presented in [Section 6.3.8](#) of the draft EIS/ERD.

The underwater noise and animal exposure modelling ([Section 6.3.8.3](#) of the draft EIS/ERD) shows when representative animal movement and behaviour for both migratory and internesting turtles is incorporated into the impact piling propagation model for piling at the Torosa location in the State Proposal Area, no individual turtles would be exposed to injury levels. Additionally, when incorporating representative migratory green turtle animal movement and behaviour, the 95th percentile exposure ranges to the recoverable auditory fatigue (TTS) threshold are approximately 1.65 km for the IHC S-600 hammer. It should be noted these results do not incorporate incorporated potential shutdowns and soft starts.

Further, the modelling shows for other key activities the turtle injury PTS threshold is either not reached, or only extends a distance in the order of 130 m. Given these results do not incorporate animal movement and behaviour is based on the assumption the marine turtle is stationary within this distance for a 24 hour period

(which is highly unlikely to occur), it is considered highly unlikely marine turtles will be exposed to underwater noise levels above the PTS threshold as a result of activities associated with the Proposal.

Modelling also indicates that the recoverable TTS threshold for marine turtles extends in the order of 50 – 160 m for other modelled activities, including the MODU on DP and VSP. It should be noted again that these results do not incorporate animal movement and behaviour and based on the assumption the marine turtle is stationary within this distance for the duration of VSP or 24 hour period for continuous sources (which is highly unlikely to occur). Given this, the planned mitigation measures (including exclusion zones and shut downs), the small exposure area, the temporary nature of the piling activities and the likely avoidance behaviour of marine turtles, it is considered that these impacts will be limited to behavioural (avoidance) impacts and would not result in any lasting effect. Given the temporary nature of the piling and drilling activities, these behavioural impacts are not expected to result in any reduction in nesting success or long terms impacts to internesting or migrating marine turtles in the State Proposal Area.

Fish

The modelling indicates that for the most sensitive fish groups (fish with swim bladder involved in hearing) sounds levels from the piling activities could exceed mortality levels within 200-210 m of the noise source. For fish species, including sharks, sound levels exceeding the recoverable TTS threshold are predicted to within in the order of 9 km at Torosa, assuming fish are stationary and do not avoid the sound source. Given the mobility of fish species and the likely avoidance behaviour, it is considered unlikely that such an exposure would occur.

For the other modelled activities, including the MODU on DP and VSP activities, the modelling indicates that fish would not be exposed to sound levels that could cause permanent injury or mortality. Recoverable injury to some fish species could occur, but only if the animals were in very close proximity to the sound sources (within a planar distance of 60 m) for a 48-hour period. As discussed above, this is considered highly improbable. Temporary impairment due to TTS could occur at similar short distances if fish remain at the same point within the sound field for long periods of time (12 hours), which is also considered highly improbable.

As such, it is considered that any impacts to fish from underwater noise emissions will be limited to temporary avoidance behaviour.

Sea snakes

As discussed in [Section 6.3.8](#) of the draft EIS/ERD, there is limited information available on hearing in sea snakes, but they are known to be capable of detecting pressure changes (Mick Guinea pers. comm.). Due to this and the fact that quantifiable distances for assessing

impacts from continuous sounds only exist for fish, fish have been used as a surrogate for this assessment. As discussed, any impacts to fish from underwater noise emissions will be limited to temporary avoidance behaviour.

8.4.4.7 Marine discharges: sewage and sullage

An assessment of the potential impact on marine environmental quality from the discharge of sewage and sullage from project vessels, installation vessels and the MODU is presented in [Section 8.2.4](#). This assessment concluded that changes to the physical and chemical properties of the marine water will be temporary and highly localised (discharge diluted to 1% of its original concentration with 50 m). Given the relatively small volume of treated sewage and sullage to be discharged and the expected rapid dilution of the discharge, the temporary and highly localised changes to water quality are not expected to have any lasting impacts to marine fauna within the State Proposal Area.

8.4.4.8 Marine discharges: treated utility water, chemical and deck drainage

An assessment of the potential impact on marine environmental quality from the discharge of treated utility water, chemical and deck drainage from project vessels, installation vessels and the MODU is presented in [Section 8.2.4](#). This assessment concluded that treated utility water, chemical and deck discharges would result in temporary change water quality in the immediate vicinity of the discharge. Marine fauna such as fish, marine mammals and marine turtles may come into contact with these discharges. However, the discharges are expected to be rapidly diluted in the prevailing currents. Given this, the small volume of any discharge and the short, intermittent nature of these discharges, any contact with the discharge with marine fauna would be of extremely short duration. As such, it is not considered credible that toxic affects to marine fauna will occur as a result of the discharge of treated utility water, chemical and deck drainage within the State Proposal Area.

8.4.4.9 Marine discharges: produced water

As detailed in [Section 8.2.4](#), given the small percentage that the PW component makes of the overall discharge from the MODU during well unloading, this discharge is addressed as part of the assessment of discharges during drill cuttings and fluids.

8.4.4.10 Marine discharges: cooling water

An assessment of the potential impact on marine environmental quality from the discharge of cooling water from project vessels, installation vessels and the MODU is presented in [Section 8.2.4](#). This assessment concluded that cooling water discharges would result in temporary changes in water quality in the immediate vicinity of the discharge. While marine fauna such as fish, marine mammals and marine turtles may come into

contact with these discharges, given that the discharges will disperse rapidly close to the discharge point and that any contact with the discharge with marine fauna will be of extremely short duration, it is not considered credible that toxic affects to marine fauna will occur as a result of the discharge of cooling water within the State Proposal Area.

8.4.4.11 Marine discharges: drill cuttings and fluids

An assessment of the potential impact on marine environmental quality from the discharge of drill cuttings and fluids from the MODU during drilling activities is presented in [Section 8.2.4](#). This assessment concluded that change in to water quality (through elevated TSS and the introduction of contaminants) would be temporary and localised with no subsequent impacts to biota predicted.

This reduction in water quality would be temporary (limited to the duration of the activity) and subject to rapid dispersion and dilution by prevailing currents, due to the open oceanic waters of the State Proposal Area. There is a large body of knowledge indicating a discharge of cuttings with adhered fluids dilutes rapidly. These studies found that that within 100 m of the discharge point, a drilling cuttings and fluid plume released at the surface diluted by a factor of at least 10,000, while J.M. Neff (2005) stated that, in well-mixed oceans waters (as is likely to be the case within the drilling area), drilling fluid was diluted by more than 100-fold within 10 m of the discharge. While marine fauna such as fish, marine mammals and marine turtles may come into contact with these discharges, given that the discharges will disperse rapidly close to the discharge point and that any contact with the discharge with mobile marine fauna will be of extremely short duration, it is not considered credible that toxic affects to marine fauna will occur as a result of changes in water quality resulting from the discharge of drilling cuttings and fluids within the State Proposal Area.

The assessment presented in [Section 8.2.4](#) also found that impacts to benthic biota from sedimentation (discharged drill cuttings and fluids depositing on the seabed) are expected to be confined to sessile biota, such as sediment burrowing infauna and epifauna, where present in or on the seabed in immediate proximity to the well location (in the order of 200 m from each well). Away from this immediate area, sedimentation over the course of the drilling program would be low, equating to a thin veneer of settled drill cuttings which would likely be naturally reworked into surficial sediment through processes such as bioturbation (US EPA (2002). Ecological impacts are not expected for mobile benthic fauna such as crabs and shrimps or pelagic and demersal fish, given their mobility (IOGP, 2016).

As detailed in [Section 8.2.4.8](#), modelling indicated that the sea surface discharge of drill cuttings from the bottom-hole sections generated at the previously

proposed TRE and TRD drill centre locations would potentially result in incursions of sediment plumes and associated increased sedimentation to portions of North and South Scott Reef including within the lagoons.

Given the potential sensitivities of Scott Reef shallow water benthic communities and habitats (and associated marine fauna) to sedimentation from drilling discharges, Woodside has committed to managing the drilling discharges (in particular bottom hole discharges) at drill centre locations in the State Proposal Area (i.e. TRA, TRD, TRE and TRF) in such a manner to avoid impacts to Scott Reef shallow water benthic communities and habitats (<75 m water depth). This approach is outlined in [Section 8.2.6](#).

Given that impacts to marine fauna will be limited to highly localised smothering of biota associated the deepwater habitats that are well represented both in the State Proposal Area and regionally, is not predicted to result in any reduction of biological diversity and ecological integrity at local and regional scales will occur.

8.4.4.12 Marine discharges: subsea control fluids

An assessment of the potential impact on marine environmental quality from the discharge of subsea control fluids during operation of the subsea infrastructure is presented in [Section 8.2.4](#). This assessment concluded that the intermittent discharge of small volumes of subsea control fluid may result in a temporary reduction in water quality (limited to the duration of the activity), restricted to deep water and subject to rapid dispersion and dilution by prevailing currents, due to the open oceanic waters of the State Proposal Area.

Given the volume of the discharges and the location (at the seabed in water depths exceeding 300 m), it is not considered credible that impacts to marine fauna will occur as a result of the discharge of subsea control fluids within the State Proposal Area.

8.4.4.13 Marine discharges: hydrotest fluid

A description and assessment of the potential impact on marine environmental quality from the discharge of hydrotest fluid during integrity testing of the subsea infrastructure and the temporary production system on the MODU is presented in [Section 8.2.4](#). Modelling ([Section 6.3.17.3](#) of the draft EIS/ERD) indicates that the hydrotest plume would be expected to travel in close proximity to the seabed at depths greater than 300 m. As such, fauna exposed to the discharge plume would be limited to pelagic fish and benthic biota in the deep waters of the State Proposal Area. The assessment presented in [Section 8.2.4](#) concluded that given the low volume of hydrotest fluid to be discharged, the low toxicity of the fluid, and the water depth at which the discharge would occur, hydrotest discharges within the State Proposal Area are not expected to result in any lasting impacts to benthic biota.

Impacts to pelagic fish from the discharge of hydrotest fluid is expected to be highly localised. Highly motile fish and other marine fauna have the capacity to adapt their behaviour in response to changes in environmental conditions and can be expected to move away from the discharge if exposed. The depth of the plume will also limit the number of fish that may potentially be affected.

Given the above, it is not expected that hydrotest fluid discharge in the State Proposal Area will result in a reduction in biological diversity or ecological integrity.

8.4.4.14 Unplanned marine discharges: hazardous and non-hazardous waste inorganic waste

A description and assessment of the potential impact on marine environmental quality from unplanned discharge of hazardous and non-hazardous inorganic wastes is presented in [Section 8.2.4](#). This assessment concluded that in the unlikely event of an unplanned discharge, discharged materials in liquid or sludge form would be subject to rapid dispersion and dilution by prevailing currents, due to the open oceanic waters of the State Proposal Area. This would result in a temporary and highly localised change in water quality. Given this, it is not considered credible marine fauna will be exposed to sufficient concentrations or durations of the discharge constituents to elicit a toxic response.

Accidentally discharged non-buoyant waste has the potential to sink to the seabed and impact epifauna, however, given the sparse nature of deepwater habitats that are well represented both in the State Proposal Area and regionally, any impacts are highly unlikely to reduce biodiversity or ecological integrity within the State Proposal Area.

8.4.4.15 Physical presence (unplanned): vessel interactions with fauna

Vessel movements during all phases of the Proposal have the potential to cause injury or mortality to marine fauna as a result of accidental collisions ([Section 6.3.18](#) of the draft EIS/ERD). These movements include within the State Proposal Area, and within State coastal waters near the potential logistics supply bases (for example, FCTVs transiting between Broome and the FPSO facilities).

The type and number of vessels in the Project Area (and transiting to and from the Project Area) at any one time, and the duration of presence, will differ depending on the project phase. Vessel presence is expected to be greatest for short term project phases (e.g. drilling and completions, subsea installation including BTL, and commissioning), with the longer-term operational phase requiring fewer vessels.

In addition, in the instance flowlines are installed as towed bundles up to 10 km in length, the movement of these towed bundles have the potential to result in accidental collisions due to their length and limitations in

manoeuvrability. Although it is noted that there will be far fewer movements of towed bundles (when compared with traditional installation techniques such as pipelay vessels) which are only required during construction. Towed bundle movements will occur at a significantly slower speed than regular vessel movements.

Vessel speed has been demonstrated as a key factor in collisions with marine fauna (Commonwealth of Australia, 2017b; Laist et al., 2001). Large (>80 m), fast moving vessels pose the highest risk, collisions are difficult to avoid as the vessels are potentially not able to slow down or evade marine fauna upon sighting (Laist et al., 2001). All project vessels will not travel at speeds greater than 12 knots with the State Proposal Area, or 6 knots in the Scott Reef channel, which will reduce the risk of accidental collisions (Laist et al., 2001).

Fast Crew Transfer Vessel (FCTV)

Fast crew transfer vessels (FCTVs) may be used for crew transfer. These FCTVs are capable of travelling at 50 – 55 knots. It is anticipated that one transfer per day would occur during normal operations, with additional transfers during shut downs and major maintenance. FCTVs will not travel at speeds in excess of 12 knots in the State Proposal Area.

If a FCTV is utilised, Woodside would select a FCTV design which inherently minimises the risk of unplanned interaction with marine fauna. The vessel has no propeller, has a shallow draught (<1 m) and can rapidly slow down, for example reaching dead stop within approximately 150 m from a cruising speed of 30 knots.

Figure 6-46 of the draft EIS/ERD provides an indicative route from Broome to the Browse Development Area. Recognising that interactions are most likely to coincide with increased fauna presence particularly within BIAs, consideration has been given to control measures beyond standard practice to specifically manage the risk of vessel strike within sensitive areas at sensitive times. The Proposed Management Approach for the FCTV is outlined in detail in **Section 6.3.18.2** of the draft EIS/ERD.

Fauna that are highly unlikely to co-occur with project vessels

Fish

As described in **Section 6.3.18** of the draft EIS/ERD, in the context of unplanned vessel collisions with fauna, the type of fish most likely to be impacted are larger pelagic species, particularly large sharks. Whale sharks are at particular risk due to their slow swimming behaviour and propensity to spend significant portions of time at the surface. Studies have indicated that whale sharks spend approximately 25% of their time less than 2 m from the surface and greater than 40% in the upper 15 m of the water column (Gleiss et al., 2013; Wilson et al., 2006). Conservation advice for the whale shark (Threatened Species Scientific Committee, 2015f) identifies vessel

strike from large vessels as a key threat. However, based on the available information, it is expected that while whale sharks may occur within the Project Area, they are likely to occur in low numbers and as vagrant individuals (Meekan and Radford, 2010; Wilson et al., 2006). Whale sharks are not expected to occur in State waters near the potential logistic base locations. As such, it is considered highly unlikely that a vessel strike on a whale shark will occur in these areas. Given this, and the proposed vessel speed restrictions, it is considered highly unlikely that a vessel strike on a whale shark will occur.

Other fish are thought to be generally less vulnerable to vessel strike due to size, natural flee responses and preferred habitat use. Smaller fish may be at risk of mortality through being caught in vessel thrusters during station keeping operations. However, the noise emissions generated by the operation of dynamic positioning thrusters will generally deter fish from the vicinity of these operations.

Marine mammals – cetaceans (other than humpback whales)

As described in **Section 6.3.18** of the draft EIS/ERD, large whales are more vulnerable to vessel collisions, particularly those species whose behaviour includes extended surface ‘milling’ time (Laist et al., 2001) and which demonstrate a lack of avoidance behaviour to approaching vessels (Nowacek et al., 2004). Cetacean calves and juveniles also have a higher risk of impact (Stevick, 1999), possibly due to less frequent and shorter dives (Szabo and Duffus, 2008).

Pygmy blue whales demonstrate limited behavioural responses to avoiding vessel collisions, with some undertaking slow shallow dives; however, active flee responses from vessels have not been observed (McKenna et al., 2015). While it is acknowledged that pygmy blue whales are vulnerable to vessel collisions, they are not expected to occur in high densities within the State Proposal Area or within State waters along the route that vessels will traverse when transiting to and from the Project Area. It is noted that the Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015a) documents a possible foraging area within the vicinity of the Scott Reef. The plan also recognises vessel disturbance as a key threat to blue whales.

However, while studies indicate that pygmy blue whales pass through the Scott Reef area and that this area represents a potential foraging area for the species (as outlined in Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015c)), multiple surveys, have failed to observe significant numbers of individuals present or evidence of foraging.

Therefore, co-occurrence of project vessels with pygmy blue whales is considered to be highly unlikely.

With respect to the other large cetacean species that may occur in the State Proposal Area, neither the Bryde's whale, sei whale or fin whale are expected to occur in large numbers in the State Proposal Area or in the State waters along the route project vessels would take when transiting to and from the Project Area.

Although spinner dolphins are very agile in the water and often display positive behaviours to the presence of vessels (e.g. bow-riding), there are a significant numbers of recorded vessel collisions with dolphins across Australia (DoEE, 2017). However, it is likely that the majority of such occurrences occur within more confined coastal areas subject to high vessel-traffic, significantly increasing the chance of vessel collision. It is thought that the risk of collision within deeper offshore waters with less vessel traffic, is significantly reduced (DoEE, 2017).

Given the low likelihood of co-occurrence of vessels with these species and the proposed speed restrictions within sensitive areas at sensitive times ([Table 6-139](#) of the draft EIS/ERD), the likelihood of vessel interaction with these species resulting in injury or mortality to fauna is considered highly unlikely, with the subsequent risk rated as low.

Fauna that may co-occur with project vessels

Humpback whales

As described in [Section 6.3.18](#) of the draft EIS/ERD, considering the densities, distributions and migratory pathways of the key marine fauna within the Project Area, humpback whales are considered to be the main species at risk from vessel interactions related to the proposed project activities, and in particular the possible use of FCTVs to transfer personnel from Broome to the offshore facilities during operations. A comprehensive review of ship strikes on large whales by Jensen and Silber (2004) revealed that humpback whales were the second highest reported species struck (44 records).

During their annual migration, humpback whales occur in relatively high densities between the Project Area and the Western Australian coast, include State waters adjacent to the mainland, which represents a migratory BIA for the species (see [Section 5.3](#) of the draft EIS/ERD for a detailed discussion on humpback whale distribution). Project vessels including FCTVs will traverse this BIA during transit from logistic bases (in Broome and Dampier) and the Project Area ([Figure 6-46](#) of the draft EIS/ERD). The risk of collision is likely to be higher during the southern migration given the broader migratory corridor and the presence of cow and calf pairs travelling at slower speeds with a higher proportion of time spent at the surface (Bejder et al., 2019; Zoidis and Lomac-MacNair, 2017). Vessel disturbance and strike is identified as a threat to humpback whales within the Conservation advice

Megaptera novaeangliae, Humpback Whale (Threatened Species Scientific Committee, 2015e).

Given this risk to high value fauna, Woodside has developed a mitigation measures to reduce the likelihood and severity of potential vessel collision with humpback whales. These measures have been developed in consideration of the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (Commonwealth of Australia, 2017b).

While research into these potential methods to reduce the risk of vessel collisions is limited in the existing scientific literature, a key action of the National Strategy for Reducing Vessel Strike is to identify and adopt best-practice mitigation measures and emerging technologies and encourage the development of new mitigation measures. It is therefore considered emerging technologies may offer an equivalent reduction in risk to speed reductions and may in future eliminate the need for speed reductions in sensitive areas at sensitive times.

The proposed management approach (outlined in [Section 6.3.18](#) of the draft EIS/ERD) including engineering controls and speed restrictions, is considered sufficient to manage the risk of unplanned vessel interaction with humpback whales.

Dugongs

As described in [Section 5.3.2.5](#) of the draft EIS/ERD, dugongs are known to inhabit the coastal regions of the Dampier Peninsula, with high concentrations noted at Roebuck Bay adjacent to Broome (RPS, 2010). Dugongs typically spend the majority of their time submerged, surfacing on average every 1-4 minutes (Anderson and Birtles, 1978; De longh et al., 1997; and Cox, 2002) and typically spending less than 5% of the time resting on the surface (Hodgson, 2004). Because of their size, dugongs are susceptible to injury or mortality resulting from interaction with vessels, particularly when they rise to the surface to breathe, rest or forage in shallow waters. One of the primary responses of dugongs to approaching vessels is to move towards deeper water (Hodgson, 2004).

Similarly, dugongs are susceptible to injury or mortality resulting from interaction with vessels, particularly when they rise to the surface to breathe, rest or forage in shallow coastal waters as opposed to deeper offshore waters.

The proposed management approach (outlined in [Section 6.3.18.2](#) of the draft EIS/ERD) including engineering controls and speed restrictions, is considered sufficient to manage the risk of unplanned vessel interaction with dugongs, particularly given the likely lower densities of individuals within the proposed FCTV route and the minimal overlap between the proposed route and dugong foraging BIA.

Turtles

Turtles that are known to occur in the North West Marine Region are described in [Section 5.3.2.6](#) of the draft EIS/ERD). The Recovery Plan for Marine Turtles in Australia (2017-2027) (Commonwealth of Australia, 2017a) recognises vessel strikes as a moderate threat to the Scott Reef – Browse Island green turtle genetic stock. It also defines the area around Scott Reef as habitat critical to the survival of green turtles, and the area around the Lacepede Islands as an important nesting location for green turtles and flatback turtles.

Turtles may be particularly vulnerable to vessel strike while surfacing to rest or breathe. However, it has been reported that turtles spend a comparatively limited amount of time (3–6%) at the surface, with dives lasting between 15 and 60 minutes in general (Milton and Lutz, 2003). Turtles have been observed to avoid approaching vessels by moving away from the vessel's track (Hazel et al., 2007). Hazel et al. (2007) suggest that this avoidance behaviour is based primarily on visual cues (although the authors acknowledge vessel noise is within range of turtle hearing), and the success of this behaviour in avoiding a vessel strike largely depends on the speed of the approaching vessel and the prevailing water clarity. It's also likely that the propagation characteristics of underwater noise, particularly in high-use areas, would make it difficult for turtles to determine the direction of an oncoming vessel to elicit an appropriate flee response (Hazel et al., 2007). In the event of a collision, a turtle's carapace provides a level of protection from serious injury, although the type and severity of the injuries would depend on the force of the collision and structure and size of the vessel.

Turtles generally aggregate in shallow coastal areas adjacent to nesting beaches or in areas where sufficient food is available. Therefore, vessel interactions with turtles will be primarily restricted to coastal areas and in proximity to offshore nesting beaches (e.g. Scott Reef) where vessel movements would be limited, significantly reducing the likelihood of vessel collision.

The proposed management approach (outlined in [Section 6.3.18](#) of the draft EIS/ERD), including engineering controls and speed restrictions, is sufficient to manage the risk of unplanned vessel interaction with marine turtles.

8.4.4.16 Production activities: seabed subsidence

A detailed description of the subsea subsidence that may manifest as a result of production activities and as an assessment of the potential impacts that may result is provided in [Section 6.3.20](#) of the draft EIS/ERD. This includes peer reviewed modelling ([Section 6.3.20.3](#) of the draft EIS/ERD) which estimated that the average vertical seafloor movement is a total of approximately 5.4 cm (range 2.6 – 8.9 cm) over 40 years based on modelling; this is equivalent to 0.06–0.22 cm/year.

AIMS, (2012) assessed the impact of net sea level rise (from subsidence and climate change induced sea level rise) and its predicted impacts on reef flat habitat (0 to 5 m depth), shallow water coral habitats (5 to 30 m), deepwater coral habitat (30 to 70 m) and Sandy Islet, for three scenarios (worse case, intermediate case and best case).

Overall the study concluded that minor seabed subsidence over the life of the Torosa reservoir affecting a part of Scott Reef and Sandy Islet is not predicted to significantly contribute to sea level changes and predicted associated impacts.

Seabed subsidence has the potential to impact marine fauna by reducing the available land which comprises Sandy Islet. A reduction in the area of Sandy Islet could impact marine turtles, which use the landform for nesting, by reducing available or suitable nesting locations, which could impact nesting success rates. Scott Reef and Sandy Islet have experienced considerable natural variability in sea level over different time scales. For example, the tidal regime at Scott Reef is semi-diurnal with a maximum daily range of approximately 4 m. Similarly, sea levels can temporarily vary by tens of centimetres in response to large-scale oceanographic and atmospheric processes, such as the passage of mesoscale ocean eddies and inverse barometer effects with the passing of cyclonic and anticyclonic pressure systems. During El Nino years, up to 20 to 30 cm increases in sea levels occurred from the eastern Pacific Ocean to the eastern Indian ocean. Satellite data (ToPEX/Poseidon) from 1992 to 2009 showed intra and inter-annual sea level variability in the vicinity of Scott Reef to be from 30 cm below to 40 cm above MSL (Cooper et al., 2010). Given the natural variability in sea level at Scott Reef described above, nesting turtles (primarily green turtles) demonstrate the ability to cope with variability in the sea level at Sandy Islet.

The AIMS (2012) study concluded that with worst-case net sea level rises there is potential for wave action at high tide to reduce the height of the islet. This could affect the stability of Sandy Islet due to erosional processes associated with increased wave height, and thus impact on the availability of turtle nesting habitat. These impacts would still occur in the absence of subsidence, albeit over a slightly longer time period, with the most important factor influencing the persistence of the islet being the frequency of Category five cyclones. The study concluded for the worst-case scenario, given the highly variable nature of sea level rise, cyclone occurrence and sediment dynamics, that it is not possible to reliably predict the timing or just how much earlier any major changes to Sandy Islet might occur. The AIMS (2012) study concluded impact to Sandy Islet from the intermediate and bestcase scenarios would be negligible.

Given the above, no change is predicted in terms of available turtle nesting locations or nesting success as a result of seabed subsidence.

Likewise, no material reduction in the land available for seabirds that may roost on Sandy Islet is expected.

8.4.4.17 Physical presences (unplanned): invasive marine species (IMS)

A detailed assessment of the potential risks associated with unplanned introduction of IMS is provided in [Section 6.3.17](#) of the draft EIS/ERD.

While the primary receptors with respect to IMS within the State Proposal Area are the benthic communities and habitats of the Scott Reef system (refer to [Section 8.3.4.14](#)), once an IMS is established, it has the potential to impact on native species diversity and abundance in a variety of ways which may result in changes to ecosystem dynamics. This can occur via competition for or reduction of natural resources, predation, changes to nutrient cycling processes, habitat change and the spread of disease.

As described in [Section 6.3.17](#) of the draft EIS/ERD, given the existing legislative and management controls in place to prevent translocation and establishment of IMS within State waters, it is considered that the likelihood of IMS being introduced, establish a self-sustaining population and subsequently cause environmental impacts to the ecological communities within Scott Reef is remote and, as such, biological diversity and ecological integrity will be maintained.

8.4.4.18 Unplanned hydrocarbon releases

A detailed assessment of the potential risks associated with unplanned hydrocarbon releases is provided in [Section 6.3.19](#) of the draft EIS/ERD. Quantitative hydrocarbon spill modelling of various worst-case hydrocarbon release scenarios is presented in [Section 6.3.21.3](#) of the draft EIS/ERD. This included modelling of a loss of well integrity scenario at the TRA-C well (Scenario 1) which represents the worst case impacts to Scott Reef. The results of the modelling of Scenario 1 are summarised in [Table 6-158](#) and [Figure 6-51](#) of the draft EIS/ERD.

Based on the outcomes of quantitative spill modelling, hydrocarbon spills resulting from the proposed Browse to NWS Project have the potential to significantly impact marine fauna within the State Proposal Area and other State waters in the region such as at Rowley Shoals and the Kimberly coastline. Potential impacts to marine fauna exposed to hydrocarbons are described in [Section 6.3.21](#) of the draft EIS/ERD. Given the existing legislative and management controls, the occurrence of hydrocarbon spills is considered highly unlikely.

8.4.4.19 Cumulative impacts

Given the distance of the State Proposal Area from other operating developments in the region, it is not considered credible that cumulative impacts from the proposed Browse to NWS Project and other development will occur.

Cumulative impacts to marine fauna from exposure to multiple aspects resulting from the proposed Browse to NWS Project (both State and Commonwealth Waters components) are discussed in [Section 9.2.2](#) of the draft EIS/ERD. The following provides an assessment of the potential cumulative impacts to marine fauna located in the State Proposal Area.

Seabirds and migratory shorebirds

Atmospheric noise from helicopters and flaring from the MODU, and light emissions from vessels and the MODU, may have slight and temporary behavioural impacts on seabirds and migratory shorebirds. The low magnitude of these light impacts and the infrequent nature of the noise emissions means that exposure to multiple impact sources is unlikely, with cumulative impact to seabirds and migratory shorebirds expected to be limited to slight and temporary behavioural changes.

Fish

With respect to the Commonwealth waters component of the proposed Browse to NWS Project, it is not expected that planned marine discharges to Commonwealth waters will contribute to impacts on marine fauna within the State Proposal Area ([Chapter 6](#) of the draft EIS/ERD). Operational discharges (i.e. PW and cooling water) from the FPSO will be managed in Commonwealth waters to ensure the defined threshold values (e.g. 99% species protection or no effect concentrations) at the State waters 3 nm boundary are met 95% of the time based on dispersion modelling results.

Operational discharges within the State Proposal Area from project vessels and the MODU (such as cooling water and PW) are predicted to rapidly disperse and dilute within the receiving environment and therefore impacts to fish, if any, will be limited to a localised area within the associated mixing zone. In addition, the relatively low toxicity of these discharges, and short exposure time, means that a toxic response by fish is considered unlikely.

Likewise, modelling has indicated impacts to fish (including whale sharks) from underwater noise emissions are expected to be limited to behavioural impacts.

Given no lasting impacts to fish from marine discharges are predicted and impacts from underwater noise emissions are expected to be limited to behavioural impacts, cumulative impacts on fish as a result of the Proposal are not expected.

Marine mammals

The primary source of potential impacts to marine mammals such as pygmy blue whales in the State Proposal Area is from underwater noise emissions during construction (e.g. piling, VSP and DAS, and MODU on DP) and operations (e.g. subsea infrastructure operations). As described in [Section 6.3.8](#) of the draft EIS/ERD, modelling has indicated that although no injury or mortality to cetaceans is predicted to occur, there is potential for some degree of behavioural disturbance to cetaceans as a result of underwater noise emissions resulting from activities in the State Proposal Area. Potential impacts to whales and other cetaceans from increased noise levels in the vicinity of the wellheads are expected to be limited to behavioural/avoidance impacts to a relatively low numbers of transient marine mammals expected to seasonally occur within the State Proposal Area which is not recognised as habitat key to any life cycle stage (breeding, calving) or marked aggregations for marine mammals.

No other aspect is predicted to have any lasting effect on marine mammals and, as such, cumulative impact from multiple aspects is not expected.

Marine reptiles

The primary sources of potential impacts to marine turtles are artificial light emissions from the MODU and underwater noise emissions resulting from potential pile driving activities, drilling and the MODU DP.

As described above, it is considered that these impacts can be managed to an acceptable level through the implementation of mitigation measures. Cumulative impacts may occur as a result of simultaneous exposure to these sources. For example, nesting turtles or hatchlings attracted by light emissions from the MODU would subsequently be exposed to noise emissions from the MODU (e.g. DP noise). These cumulative impacts would be limited to behavioural responses for a small number of adult marine turtles.

Cumulative impacts to marine turtles may also occur as a result of attraction resulting from light emissions and concurrent exposure to other temporary, higher intensity noise emissions such as pile driving and VSP noise emissions. However, with the implementation of a proposed 500 m shut down zone during pile driving and VSP operations, as well as pre-start up visual observations, soft starts, operational, and shut-down procedures; cumulative impacts resulting from light and noise emission from piling and VSP operations are not expected to occur.

Cumulative impacts could also occur as a result of non-simultaneous exposure to light and noise emissions. For example, decreased nesting success as a result of behavioural impacts from noise emissions (i.e. females avoiding nesting habitat at Sandy Islet) combined with decreased hatchling survival rates due to disorientation from light emissions would have a combined impact on the overall population success of green turtles.

However, as described above, light and noise emissions are not expected to significantly impact the breeding cycle of marine turtles at Sandy Islet (predominately green turtles) and given the temporary nature of pile driving activities and the MODU's presence at a single location, no cumulative impacts on the nesting success or hatchling survival rates are expected as a result of the Proposal.

Potential impacts may also potentially occur to sea snakes as a result of marine discharges and underwater noise emissions resulting from the proposed Browse to NWS Project. As described in [Section 8.2.4](#), impacts to water quality will be temporary and localised and impacts to sea snakes from noise emissions are expected to be limited to slight behavioural/avoidance impacts. As such, no cumulative impacts to sea snakes from the Proposal are predicted.

8.4.5 Assessment of Impacts

With the implementation of management measures such as shut down zones during activities such as piling and VSP, impacts to marine fauna are predicted to be restricted to temporary and localised behavioural impacts to a small number of individual seabirds and migratory shorebird, cetaceans, fish and marine turtles, primarily resulting from underwater noise and light emissions. These emissions will potentially occur from piling activities, VSP, project vessels and the MODU operating in the State Proposal Area, primarily during the construction phase of the project. There is no proposed permanent vessel or facilities presence in the State Proposal Area.

These behavioural impacts are not expected to impact foraging or nesting success and are not expected to reduce biological diversity or ecological integrity.

There is a risk of injury or mortality to a small number of individual animals resulting from collision with project vessels, particularly FCTVs. As described above, however, an adaptive management strategy will be implemented to ensure the risk of vessel strike is not significantly increased above the risk presented by existing marine traffic.

8.4.6 Mitigation

[Chapter 8](#) of the draft EIS/ERD presents the overarching HSE management approach Woodside will implement for the proposed Browse to NWS Project.

Specific proposed measures to mitigate and manage unavoidable impacts from planned activities and reduce the environmental risk associated with unplanned events and incidents are presented in [Chapter 6](#) of the draft EIS/ERD.

Note that the measures presented in this draft EIS/ERD will be incorporated into activity-specific Environment Plans to be submitted for acceptance by DMIRS prior to the activity commencing within the State Proposal Area.

8.4.7 Predicted Outcome

Taking proposed mitigation and management measures into account; and considering the limited scope and scale of the Proposal (with no permanent facility or vessel presence) and the overall phasing of Proposal development, impacts to marine fauna within the State Proposal Area as a result of the proposed Browse to NWS Project are expected to be limited to temporary behavioural impacts to a small number of individual fauna.

Potential impacts to marine fauna that use the shallow water and emergent habitats of Scott Reef will be reduced by locating the FPSO facilities, BTL and inter-field spur line outside of the State Proposal Area and siting infrastructure within the State Proposal Area in deep waters off Scott Reef. As the State Proposal Area is not known to provide significant aggregation areas for birds or marine mammals, any impacts associated with Proposal activities on fauna are likely to be limited to transient individuals. Similarly, given the small scale of Proposal activities in the State Proposal Area, the temporary nature of the surface activities (restricted to the construction phase and intermittent IMR activities) and the distance from nesting and internesting sites for marine turtles, only a small portion of the turtle nesting population could be temporarily disturbed with no adverse impact on nesting success or hatchling survival rates predicted.

Impacts will be further reduced via the implementation of mitigation and management measures, the majority of which are standard maritime and offshore oil and gas industry practice. Implementation of these mitigation and management measures to ensure impacts are acceptable and ALARP will be assured through activity specific Environment Plans under other regulatory processes.

As such, the WA EPA environmental objective “*To protect marine fauna so that biological diversity and ecological integrity are maintained*” will be achieved for the proposed Browse to NWS Project; and the predicted impacts on marine fauna within the State Proposal Area are considered **Acceptable**.

8.5 Key Environmental Factor – Air Quality

8.5.1 EPA Objective

The EPA objective for air quality is “*To maintain air quality and minimise emissions so that environmental values are protected*” (EPA, 2016e).

8.5.2 Policy and Guidance

The following policy and guidance have been considered in relation to the EPA environmental factor - air quality.

EPA Policy and Guidance

- + Statement of Environmental Principles, Factors and Objectives (EPA, 2016b)
- + Environmental Factor Guideline – Air Quality (EPA, 2016e).

The Western Australia Government released a GHG Emissions Policy for Major Projects on 28 August 2019. The Policy includes an aspirational target of net zero GHG emissions by 2050. The Minister for Environment will consider how the Policy relates to major proposals assessed under Part IV of the EP Act (Government of Western Australia, 2019).

Public consultation on the WA EPA's draft Environmental Factor Guideline and Technical Guidance relating specifically to GHG emissions closed on 2 September 2019.

8.5.2.1 Receiving Environment

Air quality within the State Proposal Area is described in detail in [Chapter 5](#) of the draft EIS/ERD. The State Proposal Area is located approximately 260 km the WA coastline and is thus remote from urban and/or industrial air pollutants. Given this, air quality at the State Proposal Area is expected to be of high quality. Air quality of the receiving environment in relation to the atmospheric emissions resulting from the third party processing of Browse gas are described within the ERD associated with the North West Shelf Project Extension Proposal (EPA 2186, EPBC 2018/8335).

8.5.3 Potential Impacts

Summary of identified impacts and risks

[Table 8-9](#) summarises the sources of potential impact to air quality from the Proposal. [Table 8-9](#) is followed by a detailed description of the potential direct, indirect and cumulative impacts. An assessment of the significance of these impacts on air quality and a conclusion on the acceptability of the impacts in relation to the EPA environmental objective is presented in [Section 8.5.4](#).

Table 8-9 Sources of Potential Impact to Air Quality from the Proposal

Aspect	Proposal Phase ¹					Source (in State jurisdiction)
	Dr	I	C	O	De	
<i>Planned (routine and non-routine activities)</i>						
Atmospheric emissions: offshore activities	✓	✓	✓	✓	✓	Power generation on project vessels and the MODU. Intermittent flaring from the MODU Venting of gas from the MODU (during well kick)
Atmospheric emissions: third party processing of Browse gas			✓	✓		Emissions anticipated to result from third party processing of Browse gas

¹ Dr = Drilling; I = Installation; C = Commissioning; O = Operation; De = Decommissioning

Atmospheric emissions: offshore activities

Atmospheric emissions will occur from activities within the State Proposal Area. Sources will include the combustion of fuel for power generation, intermittent flaring from the MODU during drilling and completions and the venting of reservoir gas in the event of a well kick (where there is an influx of gas into the wellbore while drilling). These emissions will occur mainly during the construction phase, with emissions during operations limited to vessel emissions during infrequent IMR activities. Atmospheric emissions generated may include carbon monoxide (CO), oxides of nitrogen (NO_x), sulphur dioxide (SO₂), particulate matter less than 10 microns (PM₁₀), mercury and non-methane volatile organic compounds (VOCs), such as BTEX (benzene, toluene, ethylbenzene and xylenes).

A detailed description of the planned atmospheric emissions (non GHG) from the offshore activities associated with the proposed Browse to NWS Project is provided in [Section 6.3.5](#) of the draft EIS/ERD, which concluded that no material impact to local air quality or sensitive receptors would occur. Given the majority of emissions from the proposed Browse to NWS Project will occur during operations from the FPSO facilities in Commonwealth waters, the emissions planned within the State Proposal Area represent a small portion of the planned emissions. As such, it can be concluded impacts to air quality and sensitive receptors from these emissions are likely to negligible.

GHG emissions expected to occur within State jurisdiction are described in [Section 7.4.4](#) of the draft EIS/ERD. GHG emissions occurring within State jurisdiction associated with the proposed Browse to NWS Project relate to activities in the State Proposal Area associated with the Torosa field. Total installation emissions across the life of the proposed Browse to NWS Project occurring within the State Proposal Area

are estimated to be ~0.4 MT CO₂-e (total over field life).

Atmospheric emissions: third party processing of Browse gas

The assessment of any potential impacts on the national heritage values, including aboriginal heritage values, of the listed National Heritage Place on the Dampier Archipelago that may be associated with the onshore processing of the Browse gas by the NWS JV, is addressed within the ERD associated with the North West Shelf Project Extension Proposal (EPA 2186, EPBC 2018/8335).

As described in [Section 7.4.4](#) of the draft EIS/ERD, downstream GHG emissions have been apportioned based on the proportion of NWS processing plant capacity that Browse gas utilises, relative to the GHG footprint currently approved for the facility as per Ministerial Statement 536. [Table 7-5](#) in [Section 7.4.4](#) of the draft EIS/ERD details the reservoir emissions estimated to occur in each jurisdiction under the range of expected export gas specification outcomes. This is dependent on the outcome of final commercial arrangements between the Browse JV and NWS JV.

8.5.4 Assessment of Impacts

Air quality

While a slight reduction in air quality on a local scale will occur for the duration of the activities, given the low emissions levels and the very low background levels of contaminants, it is not anticipated emissions from the Proposal will have a lasting impact on air quality within the State Proposal Area.

8.5.5 Mitigation

[Chapter 8](#) of the draft EIS/ERD presents the overarching HSE management approach Woodside will implement for the proposed Browse to NWS Project. Specific proposed measures to mitigate and manage air

quality impacts from planned activities and reduce the environmental risk associated with unplanned events and incidents are presented in [Chapter 6](#) of the draft EIS/ERD. Note the measures presented in this draft EIS/ERD will be incorporated into activity-specific Environment Plans to be submitted for acceptance by DMIRS prior to the activity commencing within the State Proposal Area.

Specific measures to manage and mitigate GHG emissions are presented in [Section 7.7](#) of the draft EIS/ERD. The proposed Browse to NWS Project has proposed a GHG Abatement Plan to continuously review mechanisms to mitigate and manage GHG emissions and compliance with NGER/SGM baseline requirements through use of offsets, at this stage anticipated to be in the form of Australian Carbon Credit Units (ACCUs).

8.5.6 Predicted Outcome

Given the low emissions levels and distance of the emissions sources from the nearest sensitive environmental receptors, it is not anticipated emissions from the Proposal will have an impact on any sensitive receptors. The Proposal is expected to result in a localised, temporary and negligible reduction in air quality in the immediate vicinity of the release point with overall contributions to the atmosphere not expected to be significant. No impact to the environmental values of the State Proposal Area are expected.

As such, the WA EPA environmental objective “*To maintain air quality and minimise emissions so that environmental values are protected*” will be achieved for the Proposal; and the predicted impacts on air quality within the State Proposal Area around Scott Reef are considered **Acceptable**.

9. OTHER ENVIRONMENTAL FACTORS OR MATTERS

No other environmental factors or matters against the environmental objectives/s have been identified in the ESD and/or during stakeholder engagement.

10. MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

As detailed in [Section 2.9](#) of the draft EIS/ERD (and [Section 5.1](#)), the proposed Browse to NWS Project was referred to the DoEE under the EPBC Act in October 2018 and subsequently determined to be a controlled action. The following Matters of National Environmental Significance (MNES) were identified as controlled action provisions for the proposed Browse to NWS Project:

- + National heritage values of a National Heritage Place
- + Listed threatened species and communities
- + Listed migratory species
- + the Commonwealth marine area, the protected matter being the environment generally.

[Chapter 5](#) of the draft EIS/ERD summarises the specific MNES/existing environmental values identified as relevant to the proposed Browse to NWS Project. Potential impacts to these MNES (e.g. atmospheric emissions, marine discharges), and an assessment of the level of significance of these impacts to MNES are detailed in [Chapter 6](#) and [Chapter 9](#) of the draft EIS/ERD respectively. Proposed mitigation and management of these impacts are outlined within the respective impact and risk assessment for each aspect in [Chapter 6](#) of the draft EIS/ERD.

WA State Legislation and policy relevant to the MNES listed above are detailed in [Section 2.11.4](#) and [Section 2.11.5](#) of the draft EIS/ERD, including the EP Act and BC Act.

In the event impacts to MNES cannot be avoided or mitigated to an acceptable level, an environmental offset plan will be developed, as described in [Chapter 8](#) of the draft EIS/ERD. This excludes GHG emissions offsets, which have been considered separately in [Chapter 7](#) of the draft EIS/ERD.

11. HOLISTIC IMPACT ASSESSMENT

An assessment of the Proposal against the relevant WA EPA's Environmental Objectives (as determined by the WA EPA) is provided in [Section 9.5](#) of the draft EIS/ERD.

This section assesses holistically the potential impacts of the Proposal on the whole environment. In accordance with 'Instructions on how to prepare an environmental review document' (EPA, 2018a) this section describes the connections and interactions between the environmental factors relevant to the Proposal and discusses the predicted outcomes of the Proposal in relation to the environmental principles and the EPA's environmental objectives.

The receiving environment relevant to the Proposal is characterised by relatively pristine offshore environment, largely unaffected by anthropogenic sources and of high marine and air quality. The Proposal's activities have the potential to affect various elements of the environment (as defined by the EPA's environmental factors). Where the receiving environment of environmental factors overlaps, the draft EIS/ERD has considered the receiving environment from the perspective of each relevant environmental factor.

The air quality and marine fauna environmental factors overlap in relation to potential impacts to seabirds and migratory shorebirds. However, as described in [Section 8.4.4](#), no lasting effect on seabirds and migratory shorebirds from air emissions is predicted.

Significant overlaps exist between the other relevant factors (marine environmental quality, benthic communities and habits; and marine fauna), where impacts to components of one or more of these factors would potentially impact the other factors. For example, changes to marine environmental quality (e.g. water quality reduction) would potentially impact benthic communities and habitats (e.g. Scott Reef corals) and marine fauna (e.g. green turtles). This is one of the primary drivers in the setting of a level of ecological protection (no detectable change from natural background) for all of Scott Reef (<75 m water depth) and a high level of ecological protection (99% species protection) for the majority of the remainder of the State Proposal Area during steady state operations.

As described in [Section 8.2.6](#), it is expected a maximum LEP will be achieved in the majority of the State Proposal Area during construction and operations. A high LEP will be achieved for the deep waters of the State Proposal Area where subsea infrastructure will be located, except where a moderate LEP is proposed within a 1000 m radius of each drill centre during construction and operations; and 500 m around subsea infrastructure during construction. Further, an area of moderate LEP is proposed during construction where the potential discharge of hydrotest fluid from the BTL (in Commonwealth waters), may incur into the State Proposal Area. An EQMP will be prepared and implemented to achieve this outcome.

No disturbance to Scott Reef shallow water benthic communities and habitats (<75 m water depth) will occur, with impacts to benthic habitats limited to the disturbance of approximately 4.15 km² (0.31 km² permanent and 3.84 km² reversible loss) of deepwater habitats that are well represented both in the State Proposal Area and regionally. Feasible mitigation measures (e.g. discharge at depth and/or skip and ship) exist to achieve the stated objective of avoiding impact on Scott Reef coral habitat. Impacts to other fauna such as seabirds and migratory shorebird, fish, marine mammals and marine turtles from marine discharges, light emissions and noise emissions are expected to be restricted to temporary behavioral impacts such as avoidance or attraction.

As such, in consideration of the interconnection between these environmental factors, and the detailed environmental assessment undertaken in the draft EIS/ERD, it is expected the environmental values of the State Proposal Area including marine environmental quality, biological diversity and ecological integrity, and air quality will be maintained, and the Proposal is **Acceptable**.

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CHAPTER 10, APPENDIX C

PROTECTED MATTER SEARCH TOOL REPORT



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Chapter 10 C.7 Species identified in PMST not considered likely to occur within Project Area	1062

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Australian Government
Department of the Environment and Energy

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: 18/03/19 19:20:20

[Summary](#)

[Details](#)

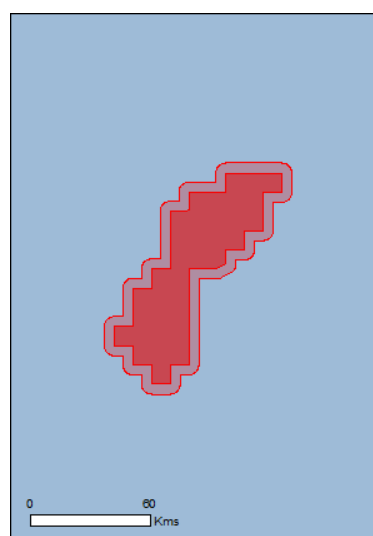
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

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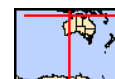
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 5.0Km



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:	19
Listed Migratory Species:	37

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:	1
Listed Marine Species:	67
Whales and Other Cetaceans:	25
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	2

Details

Matters of National Environmental Significance

Commonwealth Marine Area

[\[Resource Information \]](#)

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name

EEZ and Territorial Sea

Marine Regions

[\[Resource Information \]](#)

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name

[North-west](#)

Listed Threatened Species

[\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti		
Abbott's Booby [59297]	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	Migration route known to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely 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	Foraging, feeding or related behaviour likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour 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
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
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 likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Sternula albifrons Little Tern [82849]		Congregation or aggregation known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within

Name	Threatened	Type of Presence 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
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 likely 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	Foraging, feeding or related behaviour likely 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 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 likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Orcaella heinssohni 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

Name	Threatened	Type of Presence
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		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 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 may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Heritage Places		[Resource Information]
Name	State	Status
Natural		
Scott Reef and Surrounds - Commonwealth Area	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

Name	Threatened	Type of Presence
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
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 known to 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
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
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 may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		Congregation or aggregation known to occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribbioned Pipehorse, Ribbioned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area

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
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
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 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
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour 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
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
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	Foraging, feeding or related behaviour likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	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
Feresa attenuata Pygmy Killer Whale [61]		Species or species

Name	Status	Type of Presence
Globicephala macrorhynchus Short-finned Pilot Whale [62]		habitat may occur within area Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		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	Species or species habitat likely to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		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
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 (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within

Name	Status	Type of Presence
Ziphius cavirostris		area
Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

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
Continental Slope Demersal Fish Communities	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

-14.581948 121.50126,-14.581949 121.41793,-14.498615 121.41793,-14.498615 121.50126,-14.331948 121.50126,-14.331947 121.58459,-14.248613 121.58459,-14.248613 121.66793,-13.998612 121.66793,-13.998612 121.73711,-13.99273 121.75126,-13.915278 121.75126,-13.915277 121.91792,-13.831943 121.91792,-13.831942 122.16792,-13.915275 122.16792,-13.915276 122.08459,-14.081943 122.08459,-14.081943 122.00126,-14.165277 122.00126,-14.165277 121.91793,-14.227459 121.91793,-14.248612 121.87802,-14.248612 121.75126,-14.66528 121.75126,-14.66528 121.66793,-14.748614 121.66793,-14.748615 121.5846,-14.665281 121.5846,-14.665281 121.50126,-14.581948 121.50126

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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](#)
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- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

Chapter 10 C.2 PMST Browse Trunkline Route



Australian Government
Department of the Environment and Energy

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: 18/03/19 18:57:07

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

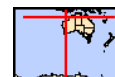
[Caveat](#)

[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)
Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	20
Listed Migratory Species:	38

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:	73
Whales and Other Cetaceans:	25
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	3

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)	4

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name

EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name

[North-west](#)

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti		
Abbott's Booby [59297]	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	Migration route known to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur

Name	Status	Type of Presence within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely 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	Foraging, feeding or related behaviour likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour 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
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis 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 known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Sternula albifrons Little Tern [82849]		Congregation or aggregation known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera 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
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 likely 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	Foraging, feeding or related behaviour likely 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 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 likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
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 zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
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 may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat 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	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 known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area
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
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within

Name	Threatened	Type of Presence area
Phaethon lepturus White-tailed Tropicbird [1014]		Foraging, feeding or related behaviour likely to occur within area
Sterna albifrons Little Tern [813]		Congregation or aggregation known to occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
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

Name	Threatened	Type of Presence area
Halicampus spirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribbioned Pipehorse, Ribbioned 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 spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
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

Name	Threatened	Type of Presence area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may 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
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely 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	Foraging, feeding or related behaviour 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 coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis czéblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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	Foraging, feeding or related behaviour likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	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
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
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	Species or species habitat known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		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

Name	Status	Type of Presence
Physeter macrocephalus Sperm Whale [59]		habitat may occur within area Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
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 may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks		[Resource Information]
Name	Label	
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)	
Kimberley	Multiple Use Zone (IUCN VI)	
Mermaid Reef	National Park Zone (IUCN II)	

Extra Information

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
Continental Slope Demersal Fish Communities	North-west

Name	Region
Mermaid Reef and Commonwealth waters	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

-19.583 116.133,-19.539 116.129,-19.502 116.137,-19.472 116.159,-19.462 116.173,-19.247 116.609,-19.036 117.039,-18.15 118.437,-17.757 119.058,-17.706 119.128,-17.309 119.664,-17.146 119.879,-16.987 120.026,-15.576 120.93,-15.369 121.079,-14.865 121.439,-14.483 121.66,-14.158 122.026,-13.98 122.026

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](#)
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- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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 Department of the Environment
 GPO Box 787
 Canberra ACT 2601 Australia
 +61 2 6274 1111

Chapter 10 C.3 PMST EMBA



Australian Government

Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 19/11/19 14:03:59

[Summary](#)

[Details](#)

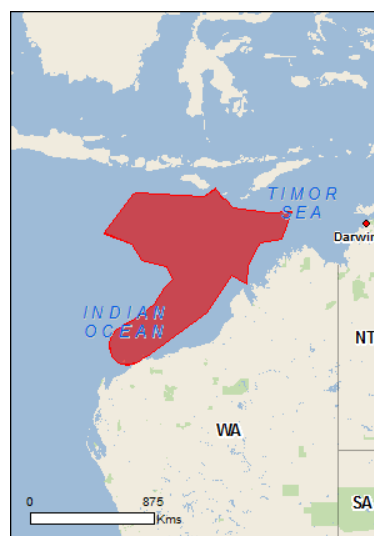
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

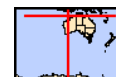
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 1.0Km



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:	2
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	44
Listed Migratory Species:	64

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:	1
Commonwealth Heritage Places:	3
Listed Marine Species:	118
Whales and Other Cetaceans:	32
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	14

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	15
Regional Forest Agreements:	None
Invasive Species:	13
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	8

Details

Matters of National Environmental Significance

National Heritage Properties [\[Resource Information \]](#)

Name	State	Status
Natural		
The West Kimberley	WA	Listed place
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place

Wetlands of International Importance (Ramsar) [\[Resource Information \]](#)

Name	Proximity
Ashmore reef national nature reserve	Within Ramsar site

Commonwealth Marine Area [\[Resource Information \]](#)

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name

EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [\[Resource Information \]](#)

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name

[North-west](#)

Listed Threatened Species [\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	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
Limosa lapponica baueri		
Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	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 may 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

Name	Status	Type of Presence
		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
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
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	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	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia lesueur Barrow and Boodie Islands subspecies Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Species or species habitat known to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Isodon auratus barrowensis Golden Bandicoot (Barrow Island) [66666]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes conspicillatus conspicillatus Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus Central Australian subspecies Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Osphranter robustus isabellinus Barrow Island Wallaroo, Barrow Island Euro [89262]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Rhinionictis aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	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 zasticus Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely 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	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
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 may 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]		Breeding known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
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
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat 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

Name	Threatened	Type of Presence
<u>Balaenoptera edeni</u> Bryde's Whale [35]		Species or species habitat likely to occur within area
<u>Balaenoptera musculus</u> Blue Whale [36]	Endangered	Migration route known to occur within area
<u>Balaenoptera physalus</u> Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<u>Carcharodon carcharias</u> White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
<u>Caretta caretta</u> Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
<u>Chelonia mydas</u> Green Turtle [1765]	Vulnerable	Breeding known to occur within area
<u>Crocodylus porosus</u> Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
<u>Dermochelys coriacea</u> Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
<u>Dugong dugon</u> Dugong [28]		Breeding known to occur within area
<u>Eretmochelys imbricata</u> Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
<u>Isurus oxyrinchus</u> Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
<u>Isurus paucus</u> Longfin Mako [82947]		Species or species habitat likely to occur within area
<u>Lepidochelys olivacea</u> Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat known to occur within area
<u>Manta alfredi</u> 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
<u>Manta birostris</u> 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
<u>Megaptera novaeangliae</u> Humpback Whale [38]	Vulnerable	Breeding known to occur within area
<u>Natator depressus</u> Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
<u>Orcaella heinsohni</u> Australian Snubfin Dolphin [81322]		Species or species habitat may occur within area
<u>Orcinus orca</u> Killer Whale, Orca [46]		Species or species habitat may occur within area
<u>Physeter macrocephalus</u> Sperm Whale [59]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may 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
Calidris acuminata Sharp-tailed Sandpiper [874]		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 known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		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
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 known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Commonwealth Heritage Places [\[Resource Information \]](#)

Name	State	Status
Natural		
Ashmore Reef National Nature Reserve	EXT	Listed place
Mermaid Reef - Rowley Shoals	WA	Listed place
Scott Reef and Surrounds - Commonwealth Area	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
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species

Name	Threatened	Type of Presence
Calidris acuminata Sharp-tailed Sandpiper [874]		habitat may occur within area 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 known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		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 likely 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
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat 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
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
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

Name	Threatened	Type of Presence
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	habitat known to occur within area 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
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may 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
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
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within

Name	Threatened	Type of Presence area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
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

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 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 Ribbioned Pipehorse, Ribbioned 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 spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
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	Breeding likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within

Name	Threatened	Type of Presence
Emydocephalus annulatus Turtle-headed Seasnake [1125]		area 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 habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat 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

Name	Status	Type of Presence
<i>Balaenoptera borealis</i> Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<i>Balaenoptera edeni</i> Bryde's Whale [35]		Species or species habitat likely to occur within area
<i>Balaenoptera musculus</i> Blue Whale [36]	Endangered	Migration route known to occur within area
<i>Balaenoptera physalus</i> Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
<i>Delphinus delphis</i> Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
<i>Eubalaena australis</i> Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
<i>Feresa attenuata</i> Pygmy Killer Whale [61]		Species or species habitat may occur within area
<i>Globicephala macrorhynchus</i> Short-finned Pilot Whale [62]		Species or species habitat may occur within area
<i>Grampus griseus</i> Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
<i>Indopacetus pacificus</i> Longman's Beaked Whale [72]		Species or species habitat may occur within area
<i>Kogia breviceps</i> Pygmy Sperm Whale [57]		Species or species habitat may occur within area
<i>Kogia simus</i> Dwarf Sperm Whale [58]		Species or species habitat may occur within area
<i>Lagenodelphis hosei</i> Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
<i>Megaptera novaeangliae</i> Humpback Whale [38]	Vulnerable	Breeding known to occur within area
<i>Mesoplodon densirostris</i> Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
<i>Mesoplodon ginkgodens</i> Ginkgo-toothed Beaked Whale, Ginkgo-toothed Whale, Ginkgo Beaked Whale [59564]		Species or species habitat may occur within area
<i>Orcaella brevirostris</i> Irrawaddy Dolphin [45]		Species or species habitat may occur within area
<i>Orcinus orca</i> Killer Whale, Orca [46]		Species or species habitat may occur within area
<i>Peponocephala electra</i> Melon-headed Whale [47]		Species or species habitat may occur within

Name	Status	Type of Presence
Physeter macrocephalus Sperm Whale [59]		area Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks		[Resource Information]
Name	Label	
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)	
Argo-Rowley Terrace	National Park Zone (IUCN II)	
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)	
Ashmore Reef	Recreational Use Zone (IUCN IV)	
Ashmore Reef	Sanctuary Zone (IUCN Ia)	
Cartier Island	Sanctuary Zone (IUCN Ia)	
Dampier	Habitat Protection Zone (IUCN IV)	
Dampier	Multiple Use Zone (IUCN VI)	
Dampier	National Park Zone (IUCN II)	
Kimberley	Habitat Protection Zone (IUCN IV)	
Kimberley	Multiple Use Zone (IUCN VI)	
Kimberley	National Park Zone (IUCN II)	
Mermaid Reef	National Park Zone (IUCN II)	
Montebello	Multiple Use Zone (IUCN VI)	

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Adele Island	WA
Barrow Island	WA
Boodie, Double Middle Islands	WA
Browse Island	WA
Lowendal Islands	WA
Montebello Islands	WA
Unnamed WA36909	WA
Unnamed WA36910	WA
Unnamed WA36913	WA
Unnamed WA36915	WA
Unnamed WA40828	WA
Unnamed WA40877	WA
Unnamed WA41080	WA
Unnamed WA41775	WA
Unnamed WA44673	WA

Invasive Species	[Resource Information]
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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 Resources Audit, 2001.

Name	Status	Type of Presence
Mammals		
Canis lupus familiaris Domestic Dog [82654]		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
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
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Prosopis spp.		
Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area

Reptiles

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
Ashmore Reef	EXT
Mermaid Reef	EXT

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
Carbonate bank and terrace system of the Sahul	North-west
Continental Slope Demersal Fish Communities	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west
Serangapatam 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

-10.72757 120.4293,-10.19343 121.1663,-10.43254 121.3932,-10.56299 121.4444,-10.62183 121.4776,-10.65196 121.4951,-10.68166 121.5132,-10.69622 121.5227,-10.7105 121.5325,-10.72402 121.5425,-10.73724 121.5529,-10.76298 121.5746,-10.78787 121.5973,-10.79995 121.6089,-10.81169 121.6209,-10.823 121.6332,-10.83376 121.6459,-10.8367 121.6498,-10.88058 121.717,-10.88768 121.7764,-10.96269 121.8961,-11.38865 122.3002,-11.6862 124.5754,-11.61034 126.0347,-13.33985 125.3824,-13.54459 124.0767,-14.19068 123.6584,-15.07674 123.2374,-16.13121 123.1809,-15.61734 122.2045,-17.9044 120.633,-20.51458 116.7925,-20.51815 116.7381,-20.86655 116.1585,-20.93041 116.0111,-20.97548 115.8509,-20.99884 115.6827,-20.9996 115.5206,-20.97892 115.3579,-20.93689 115.1992,-20.87753 115.055,-20.79457 114.9117,-20.72521 114.8195,-20.64997 114.7377,-20.5629 114.6606,-20.46445 114.5906,-20.3682 114.5367,-20.25978 114.4904,-20.1523 114.4578,-20.04637 114.4376,-19.87308 114.422,-19.77535 114.42,-19.65889 114.4296,-19.54368 114.4522,-19.42472 114.4903,-19.31508 114.5398,-19.20626 114.6048,-19.10676 114.6808,-18.9789 114.8097,-18.87113 114.96,-18.51927 115.5542,-18.50949 115.5708,-18.48534 115.6207,-18.40199 115.7518,-18.33682 115.8941,-17.34141 117.3,-16.3512 117.8932,-15.85248 118.4494,-15.02616 118.0597,-14.67767 116.4879,-13.66786 115.8281,-12.99872 114.0832,-10.52483 115.9443,-10.47602 116.2651,-10.73517 120.4073,-10.72757 120.4293

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](#)
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- [Australian Government, Department of Defence](#)
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- [CSIRO](#)
- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

Chapter 10 C.4 PMST Exmouth Gulf



Australian Government
Department of the Environment and Energy

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: 16/07/19 09:55:21

[Summary](#)

[Details](#)

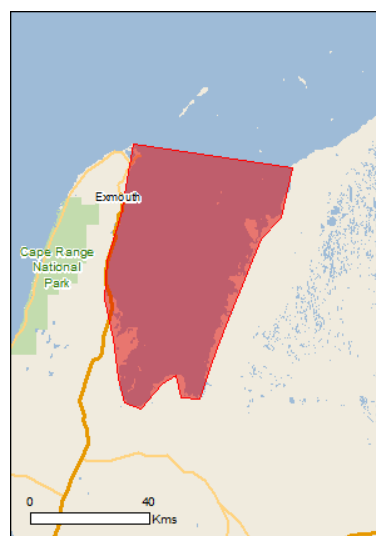
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

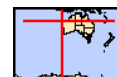
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	29
Listed Migratory Species:	42

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:	5
Commonwealth Heritage Places:	None
Listed Marine Species:	79
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	9
Regional Forest Agreements:	None
Invasive Species:	15
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
The Ningaloo Coast	WA	Listed place

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
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	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 known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Mammals		
Balaenoptera musculus Blue Whale [36]	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 likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation 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
Rhinonictes aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	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
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	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	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 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
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
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
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 likely to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to 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
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	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
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	Congregation or aggregation 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
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 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 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 known to 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

Name	Threatened	Type of Presence
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
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 known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Defence - EXMOUTH ADMIN & HF TRANSMITTING Defence - EXMOUTH VLF TRANSMITTER STATION Defence - LEARMONTH - RAAF BASE Defence - LEARMONTH TRANSMITTING STATION

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
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within

Name	Threatened	Type of Presence 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
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may 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
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]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleishy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur

Name	Threatened	Type of Presence within area
Sterna nereis Fairy Tern [796]		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 nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
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

Name	Threatened	Type of Presence
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribbioned Pipehorse, Ribbioned 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 Günther'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

Name	Threatened	Type of Presence
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 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	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	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
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	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

Name	Status	Type of Presence
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation 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 known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat 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

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Bundegi Coastal Park	WA
Burnside And Simpson Island	WA
Giralia	WA
Gnandaroo Island	WA
Rocky Island	WA
Tent Island	WA
Victor Island	WA
Whitmore, Roberts, Doole Islands And Sandalwood Landing	WA
Y Island	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 Resources 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
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 asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
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
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 may occur within area
Nationally Important Wetlands		[Resource Information]
Name	State	
Cape Range Subterranean Waterways	WA	
Exmouth Gulf East	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

-21.78629 114.16425,-21.85037 114.64648,-21.99407 114.61211,-22.052083 114.550381,-22.26055 114.45991,-22.35743 114.4182,-22.50269 114.36582,-22.49732 114.30945,-22.43685 114.29314,-22.46177 114.25,-22.52883 114.18754,-22.51184 114.1379,-22.44411 114.11747,-22.33451 114.10353,-22.22184 114.07659,-22.11393 114.0827,-21.98585 114.12735,-21.78629 114.16425

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](#)
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- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence Forestry Corporation, NSW](#)
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- [CSIRO](#)
- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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 Department of the Environment
 GPO Box 787
 Canberra ACT 2601 Australia
 +61 2 6274 1111

Chapter 10 C.5 PSMT Port of Broome



Australian Government
Department of the Environment and Energy

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: 02/05/19 18:52:55

[Summary](#)

[Details](#)

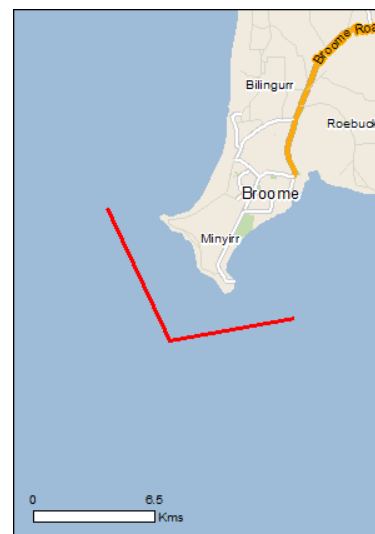
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

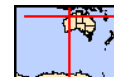
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 10.0Km



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:	1
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	31
Listed Migratory Species:	65

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:	2
Commonwealth Heritage Places:	None
Listed Marine Species:	104
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:	3
Regional Forest Agreements:	None
Invasive Species:	12
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

National Heritage Properties [\[Resource Information \]](#)

Name	State	Status
Natural		
The West Kimberley	WA	Listed place

Wetlands of International Importance (Ramsar) [\[Resource Information \]](#)

Name	Proximity
Roebuck bay	Within Ramsar site

Commonwealth Marine Area [\[Resource Information \]](#)

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

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 Ecological Communities [\[Resource Information \]](#)

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Endangered	Community likely to occur within area

Listed Threatened Species [\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris		
Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius leschenaultii		
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus		
Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Erythrura gouldiae		
Gouldian Finch [413]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
<u>Limosa lapponica baueri</u> Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
<u>Limosa lapponica menzbieri</u> Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat known to occur within area
<u>Numenius madagascariensis</u> Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
<u>Papasula abbotti</u> Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
<u>Polytelis alexandrae</u> Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat likely to occur within area
<u>Rostratula australis</u> Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
<u>Tyto novaehollandiae kimberli</u> Masked Owl (northern) [26048]	Vulnerable	Species or species habitat may occur within area
Mammals		
<u>Balaenoptera musculus</u> Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
<u>Macrotis lagotis</u> Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area
<u>Megaptera novaeangliae</u> Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
<u>Saccolaimus saccolaimus nudiclunatus</u> Bare-rumped Sheath-tailed Bat, Bare-rumped Sheath-tail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area
<u>Xeromys myoides</u> Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat may occur within area
Plants		
<u>Keraudrenia exastia</u> Fringed Keraudrenia [66301]	Critically Endangered	Species or species habitat known to occur within area
Reptiles		
<u>Aipysurus apraefrontalis</u> Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
<u>Caretta caretta</u> Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
<u>Chelonia mydas</u> Green Turtle [1765]	Vulnerable	Breeding known to occur within area
<u>Ctenotus angusticeps</u> Northwestern Coastal Ctenotus, Airlie Island Ctenotus [25937]	Vulnerable	Species or species habitat likely to occur within area
<u>Dermochelys coriacea</u> Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area

Name	Status	Type of Presence
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
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 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	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 likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Sternula albifrons Little Tern [82849]		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 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
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Dugong dugon Dugong [28]		Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat 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
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	Breeding 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]		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

Name	Threatened	Type of Presence
Hirundo rustica Barn Swallow [662]		habitat known to occur within area 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 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	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

Name	Threatened	Type of Presence
Limosa lapponica Bar-tailed Godwit [844]		within area 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
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Defence - BROOME TRAINING DEPOT

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

Name	Threatened	Type of Presence
Anseranas semipalmata Magpie Goose [978]		within area 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]		Species or species habitat 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 within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	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 ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat 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
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
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
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Breeding known to occur within area
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		
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		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
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

Name	Threatened	Type of Presence
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 Ribbioned Pipehorse, Ribbioned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
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
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]		Foraging, feeding or related behaviour known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within

Name	Threatened	Type of Presence area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, 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	Breeding 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	Breeding likely to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		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

Name	Threatened	Type of Presence area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to 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
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
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

Australian Marine Parks		[Resource Information]
Name	Label	
Roebuck	Multiple Use Zone (IUCN VI)	

Extra Information

State and Territory Reserves		[Resource Information]
Name	State	
Unnamed WA51105	WA	
Unnamed WA51497	WA	
Unnamed WA51617	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 Resources 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
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		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
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw		Species or species

Name	Status	Type of Presence
Creeper, Funnel Creeper [85119]		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
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Reptiles

Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
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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
Roebuck Bay		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

-17.97 122.15,-18.03 122.18,-18.02 122.24

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Office of Environment and Heritage, New South Wales](#)
- [Department of Environment and Primary Industries, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment, Water and Natural Resources, South Australia](#)
- [Department of Land and Resource Management, Northern Territory](#)
- [Department of Environmental and Heritage Protection, Queensland](#)
- [Department of Parks and Wildlife, Western Australia](#)
- [Environment and Planning Directorate, ACT](#)
- [Birdlife Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [South Australian Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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 Department of the Environment
 GPO Box 787
 Canberra ACT 2601 Australia
 +61 2 6274 1111

Chapter 10 C.6 PSMT Port of Dampier



Australian Government
Department of the Environment and Energy

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: 02/05/19 18:39:40

[Summary](#)

[Details](#)

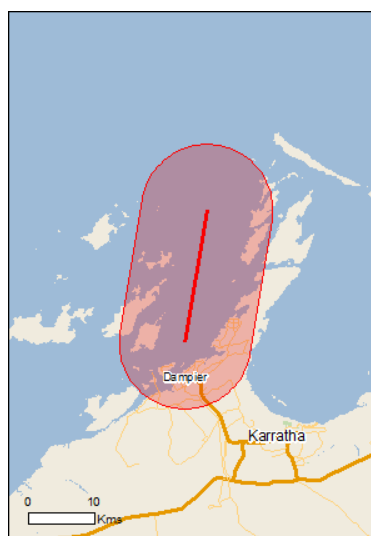
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

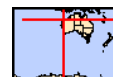
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 10.0Km



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:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	31
Listed Migratory Species:	60

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:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	103
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	5
Regional Forest Agreements:	None
Invasive Species:	17
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
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
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	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 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 known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted-snipe, 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

Name	Status	Type of Presence
Mammals		
<i>Balaenoptera musculus</i> Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
<i>Dasyurus hallucatus</i> Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
<i>Macroderma gigas</i> Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
<i>Macrotis lagotis</i> Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
<i>Megaptera novaeangliae</i> Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
<i>Rhinonicteris aurantia (Pilbara form)</i> Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat may occur within area
Reptiles		
<i>Aipysurus apraefrontalis</i> Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
<i>Caretta caretta</i> Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
<i>Chelonia mydas</i> Green Turtle [1765]	Vulnerable	Breeding known to occur within area
<i>Ctenotus angusticeps</i> Northwestern Coastal Ctenotus, Airlie Island Ctenotus [25937]	Vulnerable	Species or species habitat likely to occur within area
<i>Dermochelys coriacea</i> Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
<i>Eretmochelys imbricata</i> Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
<i>Liasis olivaceus barroni</i> Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat known to occur within area
<i>Natator depressus</i> Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
<i>Carcharias taurus (west coast population)</i> Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area
<i>Carcharodon carcharias</i> White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
<i>Pristis clavata</i> Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
<i>Pristis zijsron</i> Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
<i>Rhincodon typus</i> Whale Shark [66680]	Vulnerable	Species or species

Name	Status	Type of Presence
		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
Apus pacificus		
Fork-tailed Swift [678]		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
Fregata ariel		
Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat 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
Sterna dougallii		
Roseate Tern [817]		Breeding likely to occur within area
Migratory Marine Species		
Anoxypristis cuspidata		
Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat likely to 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
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	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	Breeding likely to occur within area
Dugong dugon		
Dugong [28]		Species or species habitat known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area

Name	Threatened	Type of Presence
<u>Manta alfredi</u> 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
<u>Manta birostris</u> 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
<u>Megaptera novaeangliae</u> Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
<u>Natator depressus</u> Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
<u>Orcinus orca</u> Killer Whale, Orca [46]		Species or species habitat may occur within area
<u>Pristis clavata</u> Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
<u>Pristis zijsron</u> Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
<u>Rhincodon typus</u> Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
<u>Sousa chinensis</u> Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
<u>Tursiops aduncus (Arafura/Timor Sea populations)</u> Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
<u>Hirundo rustica</u> Barn Swallow [662]		Species or species habitat may occur within area
<u>Motacilla cinerea</u> Grey Wagtail [642]		Species or species habitat may occur within area
<u>Motacilla flava</u> Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
<u>Actitis hypoleucos</u> Common Sandpiper [59309]		Species or species habitat known to occur within area
<u>Arenaria interpres</u> Ruddy Turnstone [872]		Species or species habitat known to occur within area
<u>Calidris acuminata</u> Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
<u>Calidris alba</u> Sanderling [875]		Species or species habitat known to occur within area
<u>Calidris canutus</u> 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 may occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat 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	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known 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
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
Phalaropus lobatus Red-necked Phalarope [838]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur

Name	Threatened	Type of Presence within area
Tringa brevipes Grey-tailed Tattler [851]		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]		Species or species habitat known to occur within area
Tringa totanus Common Redshank, Redshank [835]		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 -

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 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]		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
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

Name	Threatened	Type of Presence
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 subminuta Long-toed Stint [861]		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
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat 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 known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known 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
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

Name	Threatened	Type of Presence within area
Limicola falcinellus Broad-billed Sandpiper [842]		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
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
Phalaropus lobatus Red-necked Phalarope [838]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known 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 may occur within area
Sterna anaethetus Bridled Tern [814]		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

Name	Threatened	Type of Presence
Sterna dougallii Roseate Tern [817]		Breeding likely 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
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area
Fish		
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 suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		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

Name	Threatened	Type of Presence area
Halicampus spirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribbioned Pipehorse, Ribbioned 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
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

Name	Threatened	Type of Presence
Aipysurus duboisii Dubois' Seasnake [1116]		habitat likely to occur within area Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	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	Breeding 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	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

Name	Threatened	Type of Presence
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
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	Species or species habitat 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 known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat 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

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Murujuga	WA
Unnamed WA36907	WA
Unnamed WA36909	WA
Unnamed WA36910	WA
Unnamed WA36915	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 Resources Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		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
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
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
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

Name	Status	Type of Presence
Ramphotyphlops braminus		habitat likely to occur within area
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

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

-20.62 116.71,-20.45 116.74

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Office of Environment and Heritage, New South Wales](#)
- [Department of Environment and Primary Industries, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment, Water and Natural Resources, South Australia](#)
- [Department of Land and Resource Management, Northern Territory](#)
- [Department of Environmental and Heritage Protection, Queensland](#)
- [Department of Parks and Wildlife, Western Australia](#)
- [Environment and Planning Directorate, ACT](#)
- [Birdlife Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- [Natural history museums of Australia](#)
- [Museum Victoria](#)
- [Australian Museum](#)
- [South Australian Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence Forestry Corporation, NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

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 Department of the Environment
 GPO Box 787
 Canberra ACT 2601 Australia
 +61 2 6274 1111

Chapter 10 C.7 Species identified in PMST not considered likely to occur within Project Area

Species identified by the PMST as potentially occurring within the Project Area, but which are not considered likely to occur within the Project Area and/or be impacted by Project Activities and were, therefore, excluded from discussion. Justification of this decision is provided here.

Species	EPBC Act Listing	Status under BC Act	Justification
Birds			
Assessment: The following migratory shorebird species utilise sites along the WA coastline (e.g. 80 Mile Beach, Roebuck Bay and Ashmore Reef). They do not have key sites within the Project Area and are not expected to occur within the Project Area, other than as migratory vagrants.			
Red knot (<i>Calidris canutus</i>)	Endangered, Migratory (Wetland), Marine	Endangered	SPRAT Distribution Map: Species or species habitat may occur within Project Area.
Curlew sandpiper (<i>Calidris ferruginea</i>)	Critically Endangered, Migratory (Wetland), Marine	Critically Endangered	SPRAT Distribution Map: Species or species habitat may occur within Project Area.
Eastern curlew (<i>Numenius madagascariensis</i>)	Critically Endangered, Migratory (Wetland), Marine	Critically Endangered	SPRAT Distribution Map: Species or species habitat may occur within Project Area.
Sharp-tailed sandpiper (<i>Calidris acuminata</i>)	Migratory (Wetland), Marine	Migratory	SPRAT Distribution Map: Species or species habitat may occur within Project Area.
Assessment: The following species do not have key sites within the Project Area, however, as these species are migratory, they may be present as vagrants within the Project Area.			
Greater frigatebird (<i>Fregata minor</i>)	Migratory (Marine), Marine	Migratory	SPRAT Distribution Map: Species or species habitat may occur within Project Area.
Pectoral sandpiper (<i>Calidris melanotos</i>)	Migratory (Wetland), Marine	Migratory	SPRAT Distribution Map: Species or species habitat may occur within Project Area.
Grey wagtail (<i>Motacilla cinerea</i>)	Migratory (Terrestrial), Marine	Migratory	SPRAT Distribution Map: Species or species habitat may occur within Project Area.
Yellow wagtail (<i>Motacilla flava</i>)	Migratory (Terrestrial), Marine	Migratory	SPRAT Distribution Map: Species or species habitat may occur within Project Area.
Red-rumped swallow (<i>Cecropis daurica</i>)	Migratory (Terrestrial), Marine	Migratory	SPRAT Distribution Map: Species or species habitat may occur within Project Area.

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Species	EPBC Act Listing	Status under BC Act	Justification
Marine Mammals			
Killer whale (<i>Orcinus orca</i>)	Migratory (Marine)	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: The killer whale is the largest member of the dolphin family and is widespread from polar to equatorial regions of all oceans. This species has been recorded for waters all states of Australia (Bannister et al., 1996), with concentrations reported around Tasmania and frequent sightings in South Australia and Victoria. Killer whales appear to be more common in cold, deep waters; however, they have been observed along the continental slope and shelf (Bannister et al., 1996), as well as in shallow coastal areas of WA (RPS, 2011). Killer whales are not well surveyed in Australian waters, with the exception of the Antarctic where whale surveys have been conducted and off Macquarie Island in the southwest Pacific Ocean. There are no documented areas of aggregation or important habitat for killer whales within the Browse Development Area (including Scott Reef) or along the proposed BTL route. Given the wide distribution of killer whales, it is possible that they may occur in the Project Area while travelling within the wider NWMR. .
Pygmy killer whale (<i>Feresa attenuata</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: There are a limited number of recordings for this species within Australia; a number of records are in relation to strandings with three mass stranding events in and around Augusta (WA) since 1986. Records indicate this species is distributed widely throughout Australia, typically in deep offshore waters. There is no known key habitat within the Project Area for this cetacean species and it is not expected to be present in large numbers within the Project Area.
False killer whale (<i>Pseudorca crassidens</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>likely</i> to occur within Project Area. Assessment: The false killer whale is considered to be widespread globally in tropical and warm temperate waters,
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Species	EPBC Act Listing	Status under BC Act	Justification
			including throughout Australian oceanic waters. Though sometimes sighted closer to the coast in areas with cooler water, this species is typically oceanic in distribution and sighted away from land (Australian Museum, 2019; DEC, 2011). The false killer whale is known to form groups in excess of 100 individuals with strong social cohesion (DEC, 2011). Two mass stranding events for this species have occurred in southern WA in Augusta (1986 and 1988; DEC, 2011). The false killer whale's distribution has largely been surmised from stranding events and incidental sightings. A NT study found by satellite tracking of four individuals indicated, regular use of both coastal and pelagic waters of the Arafura and Timor Seas. Globally, however, the species is listed as Data Deficient by the IUCN and no population estimates or categorised habitat preferences are available for this species. There are no known key habitats for this species within the Project Area and survey efforts to date encompassing the Project Area have recorded this species. This species is not expected to occur in large numbers within the Project Area.
Short-finned pilot whale (<i>Globicephala macrorhynchus</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: The short-finned pilot whale has a widespread distribution throughout Australia in tropical and warm-temperate waters. There is a paucity of records for this species within Australian waters, with limited incidental sightings and only a few stranding events around Australia to provide records of possible distribution. This species is still hunted in Japan. No key habitats have been identified within the Project Area. This species is not expected to occur in large numbers within the Project Area.
Sperm whale (<i>Physeter macrocephalus</i>)	Migratory (Marine)	Vulnerable	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: The sperm whale is the largest of the toothed whales. The species is distributed globally in deep waters off continental shelves and sometimes near

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Species	EPBC Act Listing	Status under BC Act	Justification
			shelf edges (Bannister et al., 1996). Sperm whales have been recorded in all Australian state waters and are known to migrate northward in winter and southwards in summer (Bannister et al., 1996). They tend to inhabit offshore areas with a water depth greater than 600 m and are uncommon in waters less than 300 m deep (National Marine Fisheries Service, 2006). Sperm whales, like other toothed whales, live in groups of up to 50 individuals, although male sperm whales are sometimes solitary in high latitudes (above 40°). In WA sperm whales have two BIAs recognised for foraging activities; these are located west of Rottnest Island and along the southern WA coastline between Cape Leeuwin and Esperance (more than 1,000 km from the Project Area). In deep water off the North West Cape sperm whales have been sighted in pod sizes of up to six animals between February and April from two separate surveys, in 2010 and 2017 (EPI Group, 2017; RPS, 2011). Based on the available information, it is considered unlikely that the sperm whale will be present in large numbers within the project area; however, transient individuals may occur especially in the areas of greatest water depth which occur off the west side of Scott Reef in the Browse Development Area.
Pygmy sperm whale (<i>Kogia breviceps</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: This species typically occurs in warmer oceanic waters and has been recorded in all Australian States. There are no known key habitats within the Project Area. This species is, therefore, not expected to occur in large numbers within the Project Area.
Dwarf sperm whale (<i>Kogia simus</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: This species typically occurs in warmer oceanic waters. There are no known key habitats within the Project Area. This species is, therefore, not

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Species	EPBC Act Listing	Status under BC Act	Justification
			expected to occur in large numbers within the Project Area.
Blainville's beaked whale (<i>Mesoplodon densirostris</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: Blainville's beaked whales are considered to have an oceanic and global distribution, occurring in low to mid latitudes in all oceans and both hemispheres, and preferring tropical and warm temperate waters (Mead, 1989). There are no estimates of population size either globally or in Australia but the species appears to be one of the more widespread and common beaked whales (Pitman, 2002). Their preferred habitat appears to be in tropical oceanic regions, in waters ranging from 700 m to 100 m deep, but are often recorded adjacent to much deeper waters of 5000 m (Bannister et al., 1996). Historically it was thought that Blainville's beaked whales avoided coasts, however, a study suggested that this species are the most commonly seen beaked whales in the shallower waters around tropical oceanic islands (Culik, 2011). It is likely that such habitats are utilised by beaked whales along much of Australia's extensive coastline (Ross, 2006). There are no key habitat known within the Project Area. Given this species wide distribution it is not expected to occur in large numbers within the Project Area.
Cuvier's beaked whale (<i>Ziphius cavirostris</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: Cuvier's beaked whales may have the most extensive range and be one of the most abundant of any beaked whale species (Culik, 2011). The species has a worldwide distribution in all temperate and tropical waters and is only absent from the polar waters in each hemisphere. In Australian waters, Cuviers beaked whale is known from 31 strandings, mostly from January to July, suggesting some seasonality to occurrence (Ross, 2006). Records of this species are from all States and Territories. Whaling records from Japan indicate that Cuvier's beaked

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Species	EPBC Act Listing	Status under BC Act	Justification
			whales are most commonly found in waters deeper than 1,000 m. They are considered an oceanic species and are rarely found close to mainland shores, except in submarine canyons or in areas where the continental shelf is narrow and coastal waters are deep. Similar to the Blainville's beaked whale this species may utilise shelf-edge habitats along much of Australia's extensive coastline. There are no known key habitat within Australian waters and the species is not expected to occur in large numbers within the Project Area.
Melon-headed whale (<i>Peponocephala electra</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: Records for this species are largely from mass stranding events in the NT, NSW and QLD. There are no known key habitat within the Project Area for this species and it is not expected to occur within the Project Area.
Australian snubfin dolphin (<i>Orcaella heinsohni</i>)	Migratory (Marine)	Priority 4	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: This species occurs along the Australian coastline, typically in shallow waters, including north of Broome within WA. No key habitat have been identified within or in proximity to the Project Area and this species is not expected to occur within the Project Area.
Irrawaddy dolphin (<i>Orcaella brevirostris</i>)	Cetacean, Migratory (Marine)	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: This species is known to occur north of Broome within WA, typically in shallow coastal waters. There are no known key habitat within the Project Area. The species, is therefore, not expected to occur in large numbers within the Project Area.
Striped dolphin (<i>Stenella coeruleoalba</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: There is a sparsity of records within Australia and the species is not thought to be common in Australian waters. There are no known key habitat within the Project Area and the species is

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Species	EPBC Act Listing	Status under BC Act	Justification
			not expected to occur within the Project Area.
Rough-toothed dolphin (<i>Steno bredanensis</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: Within WA this species was recorded at Barrow Island, south of the Project Area, when three individuals were stranded in 1971. There are no known key habitat within the Project Area or in WA waters. The species is not expected to occur in large numbers within the Project Area.
Bottlenose dolphin (<i>Tursiops truncatus</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>likely</i> to occur within Project Area. Assessment: This species is distributed widely throughout offshore, coastal and estuarine waters in Australia. There are no known key habitat within the Project Area, however, due to its wide distribution it may occur within the Project Area.
Spotted bottlenose dolphin (Arafura/Timor Sea populations) (<i>Tursiops aduncus</i> - Arafura/Timor Sea populations)	Cetacean, Migratory (Marine)	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: This species distribution extends south from the Timor and Arafura Seas to approximately Coral Bay (WA). It inhabits both inshore and offshore habitats and may occur within the Project Area.
Spotted Bottlenose Dolphin (<i>Tursiops aduncus</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: This species is widely distributed throughout Australian waters, with a preference for nearshore habitats. Due to its widespread distribution it may occur within the Project Area.

Oceanic Dolphin Species

Assessment: There is a paucity of records for these oceanic dolphin species, largely due to their offshore existence, meaning that population numbers, seasonal behaviours/movements (if any) and key habitat of aggregation/importance are unknown. Distribution within Australia is largely ascertained from incidental sightings and/or stranding events.

As these species do not have key habitats identified within WA waters, and as they are described as having widespread distributions, large numbers of these species are not expected to occur within the Project Area; rather, only low numbers of individuals may transit the area. Additional species specific information is provided below.

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Species	EPBC Act Listing	Status under BC Act	Justification
Common dolphin (<i>Delphinus delphis</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: This species typically occurs in the offshore waters of all Australian States and Territories. There are two primary groupings of this species; in the southern south-eastern Indian Ocean and the Tasman Sea. These locations are a significant distance from the Project Area. There are no known key habitats within the Project Area and this species is not expected to occur within the Project Area.
Risso's dolphin (<i>Grampus griseus</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: Typically considered to occur in oceanic waters, although in shore sightings recorded. The species has a widespread distribution throughout Australia, although there is a paucity of records meaning that estimates of population numbers is not possible. Records of incidental sightings vary in water depths from 180 to 1,500 m. The only residential population thought to be at Fraser Island (Qld). No key habitat have been identified within the Project Area. Therefore, not expected to occur in large numbers within the Project Area.
Fraser's dolphin (<i>Lagenodelphis hosei</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: Within Australia, this species is known to occur north of 30°S and in waters deeper than 1,000 m. Globally the species is considered pantropical and to occur between 30°N and 30°S, with sightings outside of these latitudes considered to be vagrants. There are no known key habitat within the Project Area. This species is not expected to occur in large numbers within the Project Area.
Spotted dolphin (<i>Stenella attenuate</i>)	Cetacean	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: Within Australian waters, this species has been recorded off the NT,

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Species	EPBC Act Listing	Status under BC Act	Justification
			WA, Qld and NSW. The species typically inhabits waters of depths greater than 200 m, although it is known to occur on the continental shelf. The species is considered to be common, although there are no reliable estimates of population numbers within Australia. Globally, this species has been killed for food, bait and by tuna fishers between the 1950s and 1980s. There are no known key habitat within the Project Area. This species is, therefore, not expected to occur in large numbers within the Project Area.

Marine Reptiles

Assessment: The following sea snake species were recorded at Scott Reef by (URS Australia Pty Ltd, 2006b, 2007). Whilst these species were recorded within the Project Area, their preference for and reliance on shallow reef habitats makes it unlikely that they will be impacted by Project infrastructure or activities. Notably, these species are thought to be resident at Scott Reef and to not undertake migrations to/from the reef; it is subsequently unlikely that they will interact with Project vessels in deeper waters near to the reef.

Horned seasnake (<i>Acalyptophis peronii</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Dubois' seasnake (<i>Aipysurus duboisii</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Olive seasnake (<i>Aipysurus laevis</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Turtle-headed seasnake (<i>Emydocephalus annulatus</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Slender-necked seasnake (<i>Hydrophis coggeri</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Dusky seasnake (<i>Aipysurus fuscus</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>likely</i> to occur within Project Area.

Assessment: The following sea snakes were not recorded at Scott Reef despite comprehensive survey effort by URS Australia Pty Ltd (2006b, 2007). As Scott Reef is the only shallow reef habitat within the Project Area these species are only expected to occur with the Project Area as vagrants, if at all.

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Species	EPBC Act Listing	Status under BC Act	Justification
Short-nosed seasnake (<i>Aipysurus apraefrontalis</i>)	Critically Endangered, Marine	Critically Endangered	SPRAT Distribution Map: Species or species habitat <i>likely</i> to occur within Project Area.
Stokes' seasnake (<i>Astrotia stokesii</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Spectacled seasnake (<i>Disteira kingii</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Olive-headed seasnake (<i>Disteira major</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Elegant seasnake (<i>Hydrophis elegans</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Spotted seasnake (<i>Hydrophis ornatus</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Spine-bellied seasnake (<i>Lapemis curtus</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
North-western mangrove seasnake (<i>Ephalophis greyi</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Fine-spined seasnake (<i>Leioselasma czeblukovi</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Small-headed seasnake (<i>Hydrophis macdowellii</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area.
Yellow-bellied seasnake (<i>Pelamis platurus</i>)	Marine	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: This species is distributed widely throughout Australian waters, typically exhibiting a preference for warmer waters. This species is known to frequent waters some kilometres from coastlines. There are no known key sites for this species within the Project Area; however given its broad distribution it may occur within the Project Area.

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Species	EPBC Act Listing	Status under BC Act	Justification
Fish			
White shark (<i>Carcharodon carcharias</i>)	Vulnerable, Migratory (Marine)	Vulnerable	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: This species is widely distributed in Australian waters and, therefore, may occur within the Project Area. There are no known key sites for this species within the Project Area and the species is not expected to interact with the Project infrastructure or activities.
Northern river shark (<i>Glyphis garricki</i>)	Endangered	Priority 1	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: Distributed across the northern WA and NT coastal areas, this species lives between both freshwater and seawater habitats, particularly rivers, intertidal and inshore habitats and estuarine systems. The species has also been recorded in waters further offshore, however, the extent to which this occurs is uncertain. Therefore, this species is not expected to occur within the Project Area.
Reef manta ray (<i>Mobula alfredi</i>)	Migratory (Marine)	N/A	SPRAT Distribution Map: Species or species habitat <i>likely</i> to occur within Project Area. Assessment: This species may occur in low numbers within the Project Area and is not expected to interact with Project vessels or infrastructure. There are no known key sites for this species within the Project Area.
Giant manta ray (<i>Mobula birostris</i>)	Migratory (Marine)	N/A	SPRAT Distribution Map: Species or species habitat <i>likely</i> to occur within Project Area. Assessment: This species may occur in low numbers within the Project Area and is not expected to interact with Project vessels or infrastructure. There are no known key sites for this species within the Project Area.
Narrow sawfish (<i>Anoxypristis cuspidate</i>)	Migratory (Marine)	N/A	SPRAT Distribution Map: Species or species habitat <i>may</i> occur within Project Area. Assessment: This species is not expected to occur within the Project Area due to the species' preference for shallow coastal habitats.

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