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

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.

- 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

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 (CO_2 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

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.

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* (OPGGS 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**.

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.

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.

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.

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,

- 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.

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).

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.

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

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

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.

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*)

        - 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.

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

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			✓																									

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.

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.woodside.com.au/our-business/burrup-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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f19---gilmour-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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-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-or-south-reef_-scott-reef_.pdf?sfvrsn=51b32958_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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f22---gilmour-et-al_2010---long-term-monitoring-of-coral-and-fish-communities-at-scott-reef_.pdf?sfvrsn=e480e4fd_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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f20---gilmour-et-al_-2009a---long-term-monitoring-of-shallow-water-coral-and-fish-communities-at-scott-reef_.pdf?sfvrsn=d29af749_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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f21---gilmour-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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f22---gilmour-et-al_2010---long-term-monitoring-of-coral-and-fish-communities-at-scott-reef_.pdf?sfvrsn=e480e4fd_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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-	Scott Reef and surrounds (Fish and

Organisation	Study Name	Link to Report	Receptor
		files/browse---documents-and-files/index-of-previous-browse-studies/f23---gilmour-et-al_-2011---long-term-monitoring-of-shallow-water-coral-and-fish-communities-at-scott-reef_.pdf?sfvrsn=4fbd8630_2	Benthic Habitat)
	Long-term Monitoring of Shallow Water Coral and Fish Communities at Scott Reef 2012	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f24---gilmour-et-al_-2013a---long-term-monitoring-of-shallow-water-coral-and-fish-communities-at-scott-reef-2012_.pdf?sfvrsn=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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f30---meekan-amp-radford-2010---migration-patterns-of-whale-sharks-a-summary-of-15-satellite-tag-tracks-from-2005-to-2008_.pdf?sfvrsn=f996a7e4_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 (*Megaptera novaeangliae*) 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)	Woodside Kimberley Sea Noise Logger Program, September 2006 to June 2009 - 2011	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f29---mccauley-2011---woodside-kimberley-sea-noise-logger-program_-sept-2006-to-june-2009-whales_-fish-and-man-made-noise_.pdf?sfvrsn=ba55f587_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 (*Balaenoptera musculus brevicauda*) 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.woodside/docs/default-source/our-business---documents-and-files/burrup-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?sfvrsn=2339899b_2	Marine turtles
	Long Term Monitoring of the Marine Turtles of Scott Reef, February 2010 Field Survey Report	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-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?sfvrsn=2339899b_2	Marine turtles

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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f38---williams-et-al_-2010---characterising-the-seabed-biodiversity-amp-habitats-of-the-deep-continental-shelf-amp-upper-slope-off-the-kimberley-coast_.pdf?sfvrsn=16f5d1c_2	Satellite data study of oceanography and plankton
DHI	Hydrodynamic Model Validation at Scott Reef and Surrounds – 2009	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---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=7deb2a9b_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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---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=e9cc49c6_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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f32---rps-2010b---humpback-whale-survey-report_.pdf?sfvrsn=bcb9973e_2	Humpback Whales
	Ecology of Marine Turtles of the Dampier Peninsula and the Lacepede Island Group - 2010	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---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=ece0e3ba_2	Marine turtles
	Marine Megafauna Study - 2010	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f34---rps-2011a---marine-megafauna-study-2010_.pdf?sfvrsn=1d25716d_2	Marine Megafuna
	Marine Megafauna Survey Report 2011	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f36---rps-2012---marine-megafauna-survey-report-2011_.pdf?sfvrsn=f970949f_2	Marine Megafuna
	Humpback Whale Survey Report - 2010	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f32---rps-2010b---humpback-whale-survey-report_.pdf?sfvrsn=bcb9973e_2	Humpback Whales

Organisation	Study Name	Link to Report	Receptor
	Turtle Supplementary Report - 2010	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f35---rps-2011c---turtle-supplementary-report-2010_.pdf?sfvrsn=b37eac02_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	Metocean conditions
	Detailed Metocean Conditions for the Browse Development - 2008	Relevant information is intended to be made publicly available for the EIS/ERD review	
Sinclair Knight Merz Ltd (SKM) ERM	Scott Reef Invasive Marine Species - 2008	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f37---skm-ltd-2009---scott-reef-invasive-marine-species-survey_.pdf?sfvrsn=7588df36_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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---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?sfvrsn=6fd7a6bf_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 Mermaid Reef (Rowley Shoals), Scott and Seringapatam Reef - 2006	Relevant information is intended to be made publicly available for the EIS/ERD review	Ecology of Mermaid, Scott and Seringapatam Reefs

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.

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 particularly 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	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.

Receptor Group	Receptor	Key Areas of Consideration	Assessment of Current Level of Understanding and information gaps	Environmental Studies Workplan
			route from Browse to James Price Point.	
Physical	Air quality	Browse Development Area	Woodside has sufficient information on air quality in the Browse Development Area on the basis that the area is offshore and remote from urban or industrial areas; and as such is not likely to be significantly influenced by anthropogenic sources.	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**. 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.	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	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).

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 would 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, Seringapatam 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 (Jenner 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 predominately 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 (Jenner 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.
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 (Jenner & Jenner 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., 2015; 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.

Receptor Group	Receptor	Key Areas of Consideration	Assessment of Current Level of Understanding and information gaps	Environmental Studies Workplan
			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.	
Ecological	Marine reptiles (turtles)	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, internesting 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 internesting habitat, the studies demonstrated that two areas of sandy substrate located to the south of Sandy Islet were identified as a preferred internesting 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 internesting interval of 10 days. Internesting 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 internesting 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 internesting 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.	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	Udyawer et al. (2016) has recently analysed data collected from 2290 Baited Remote Underwater Video Stations (BRUVS) between 1999 and 2016 to better define the range and distribution of sea snake families in the NWMR 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 Aipysurus (63%) followed by Hydrophis (12%) and Emydocephalus (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://vinayudyawer.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.

Receptor Group	Receptor	Key Areas of Consideration	Assessment of Current Level of Understanding and information gaps	Environmental Studies Workplan
			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 km^2). 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 Cartier 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 seasnakes, 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.	
Ecological	Key Ecological Features (KEFs)	Relevant KEFS: • Continental slope demersal fish communities • Seringapatam Reef and Commonwealth waters in the Scott Reef complex • Ancient coastline at 125 m depth contour • Mermaid Reef and Commonwealth waters surrounding Rowley Shoals.	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.

Receptor Group	Receptor	Key Areas of Consideration	Assessment of Current Level of Understanding and information gaps	Environmental Studies Workplan
		Marine Park (not intersected) • Scott Reef Nature Reserve		
Socio-Economic	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.
Socio-Economic	State managed fisheries	Relevant State managed fisheries including: • Northern Demersal Scalefish Managed Fishery (NDSF) • Mackerel Managed Fishery • Western Australia North Coast Shark Fishery (WANCSF) • 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.

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 2018/8335) 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.

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.

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)

- 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, magroalgae), 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.

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)

- 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

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.

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 receivers)	Slight reduction in air quality on a local scale for the duration of the activities.	F - Negligible

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 sullage (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	• Oily 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 biocides 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

Ref.	Aspect	Source/Activity	Receptor Sensitivity Level	Predicted Impact	Impact Significance Level
		putrescible wastes from offshore facilities.		the duration of the activity.	
IMP-10	Inorganic waste	• 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 waster, contaminated amine, waste, produced sand, mercury waste)	Low (licensed disposal facility)	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 SURF • Discharge of hydrotest and preservation fluid from the BTL and inter-field spur line.	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

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

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								✓	✓	✓			✓	✓			✓	✓										✓	✓

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
subsidence																													
Hydrocarbon spill	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	

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 (CO_2) 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.

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.woodside.com.au/our-business/burrup-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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f01---apasa-2014---browse-flng-development-quantitative-spill-risk-assessment_.pdf?sfvrsn=b722b339_2	Hydrocarbon spills
CGSS	Review of Reports on possible Subsidence at Scott Reef: Torosa Field – 2012	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-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?sfvrsn=fd8e45af_2	Seabed subsidence
	Follow-up Review of Reports on Possible Subsidence at Scott Reef: Torosa Field – 2013	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-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?sfvrsn=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.woodside/docs/default-source/our-business---documents-and-files/burrup-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?sfvrsn=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.woodside/docs/default-source/our-business---documents-and-files/burrup-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_-browse-basin_.pdf?sfvrsn=c309fb66_2	Seabed subsidence
DHI Water & Environment	Browse Environmental Modelling – Upstream EIS Wastewater Modelling - 2011	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f11---dhi-2011a---browse-environmental-modelling-upstream-eis-wastewater-modelling_.pdf?sfvrsn=6311c9a8_2	Produced water discharge Cooling water discharge
	Browse Environmental Modelling - Upstream EIS Sediment Transport Modelling of Drill Cuttings - 2010	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-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?sfvrsn=fbc999c4_2	Drill cuttings discharge
	Browse FLNG Development - Wastewater Dispersion Modelling - 2014	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-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?sfvrsn=2339899b_2	Produced water discharge Cooling water discharge
ERM	Browse Upstream LNG Development: Light Impact Assessment – 2010	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f16---erm-2010---browse-upstream-lng-development-light-impact-assessment_.pdf?sfvrsn=ce2e5f40_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.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f30---meekan-amp-radford-2010---migration-patterns-of-whale-sharks-a-summary-of-15-satellite-tag-tracks-from-2005-to-2008_.pdf?sfvrsn=f996a7e4_2	Underwater noise Emissions
	Prediction of Received Underwater Sound Levels from Torosa D and Torosa E Subsea Manifolds (Revised)	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-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?sfvrsn=eb4c19e9_2	Underwater noise Emissions
JacobsSKM	Light Modelling Study - 2014	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f28---jacobs-skm-2014---light-modelling-study_.pdf?sfvrsn=7a5395f6_2	Light emissions
SKM / ERM	Torosa South-1 (TS-1) Pilot Appraisal Well, Environmental Monitoring Programme – Development of Methodologies (Part 1)	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-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?sfvrsn=58af2a1a_2	Seabed disturbance Drill cuttings Wastewater discharge Underwater noise

Organisation	Study Name	Link to Report	Aspect / Impact / Risk
			Light emissions
AIMS	AIMS Expert Opinion on Recovery Trajectories of Coral Communities at Scott Reef – 2014	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-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?sfvrsn=fb882111_2	Hydrocarbon Spill
	AIMS Expert Opinion: Subsidence of Scott Reef - 2012	https://files.woodside/docs/default-source/our-business---documents-and-files/burrup-hub---documents-and-files/browse---documents-and-files/index-of-previous-browse-studies/f03---aims-2012b---expert-opinion-on-subsidence-of-scott-reef_.pdf?sfvrsn=7a0d2e36_2	Seabed subsidence

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**.

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 ensonified 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 ensonified 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. 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.	Literature review of Woodside owned and publicly available information including a review of applicable State and Commonwealth guidance and conservation plans. Use of previous modelling to inform impact assessment.
IMP-2b	Light emissions – vessels			
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). This information is considered sufficient to define the impacts associated with the physical presence of the infrastructure.	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			

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 In relation to GHG assessment refer to Section 3.9.	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 emissions. As such no further studies are considered required. In relation to GHG assessment refer to Section 3.9. 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.	Literature review of Woodside owned and publicly available information to inform impact assessment In relation to GHG assessment refer to Section 3.9. 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-4b	Gaseous emissions - GHG			
IMP-5	Treated sewage	Understand and assess impact of the discharged of treated sewage.	Sewage generated during the Proposed Action will be treated and disposed of in accordance with MARPOL 73/78Annex 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.	Literature review of Woodside owned and publicly available information to inform impact assessment.
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.	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 I, 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 (0.2ppm) 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			

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 scenario 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.

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.

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 invoice 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

- 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

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.

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)

- 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.

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.

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.

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.

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, 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 *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; *Pollution of Waters by Oil and Noxious Substance Act 1986.*
Drill cuttings and fluid discharges.	Disposal of drill cuttings and drilling fluids.	Approximately 800 - 900m^3 of cuttings are anticipated to be

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, *Environment Protection and Biodiversity Conservation Act 1999* (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.

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

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.

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)

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

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 *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

Marine Fauna	
	2017) • Conservation advice Rhincodon typus whale shark (Threatened Species Scientific Committee, 2015c) • Whale shark (*Rhyncodon typus*) 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

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	*Petroleum (Submerged Lands) Act 1982*
Chief Executive Officer, Department of Water and Environmental Regulation	*Environmental Protection Act 1986*
Chief Dangerous Goods Officer, Department of Mines, Industry Regulation and Safety	*Dangerous Goods Safety Act 2004*

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6. FIGURES

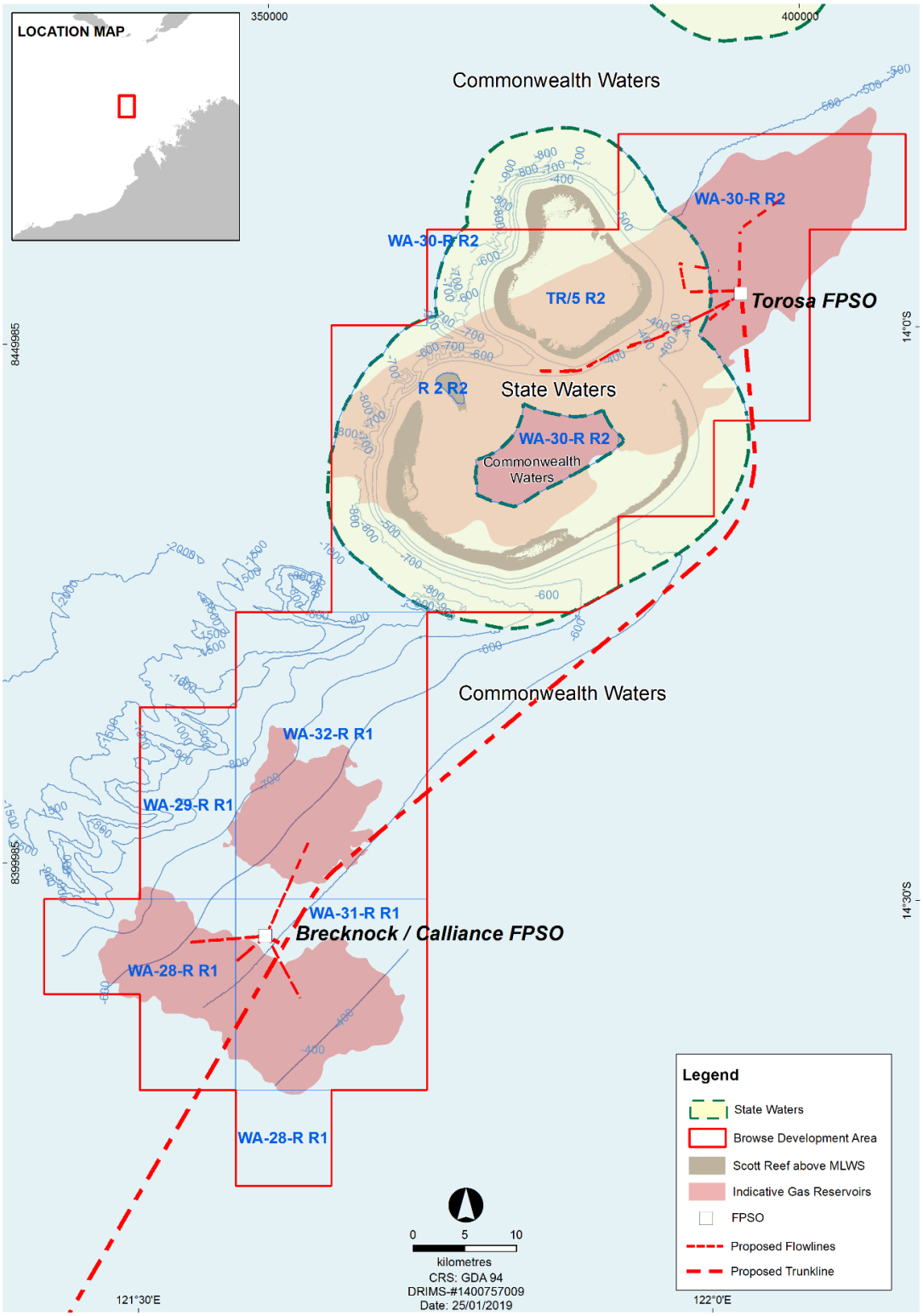

Figure 1 Proposed Browse Development Area

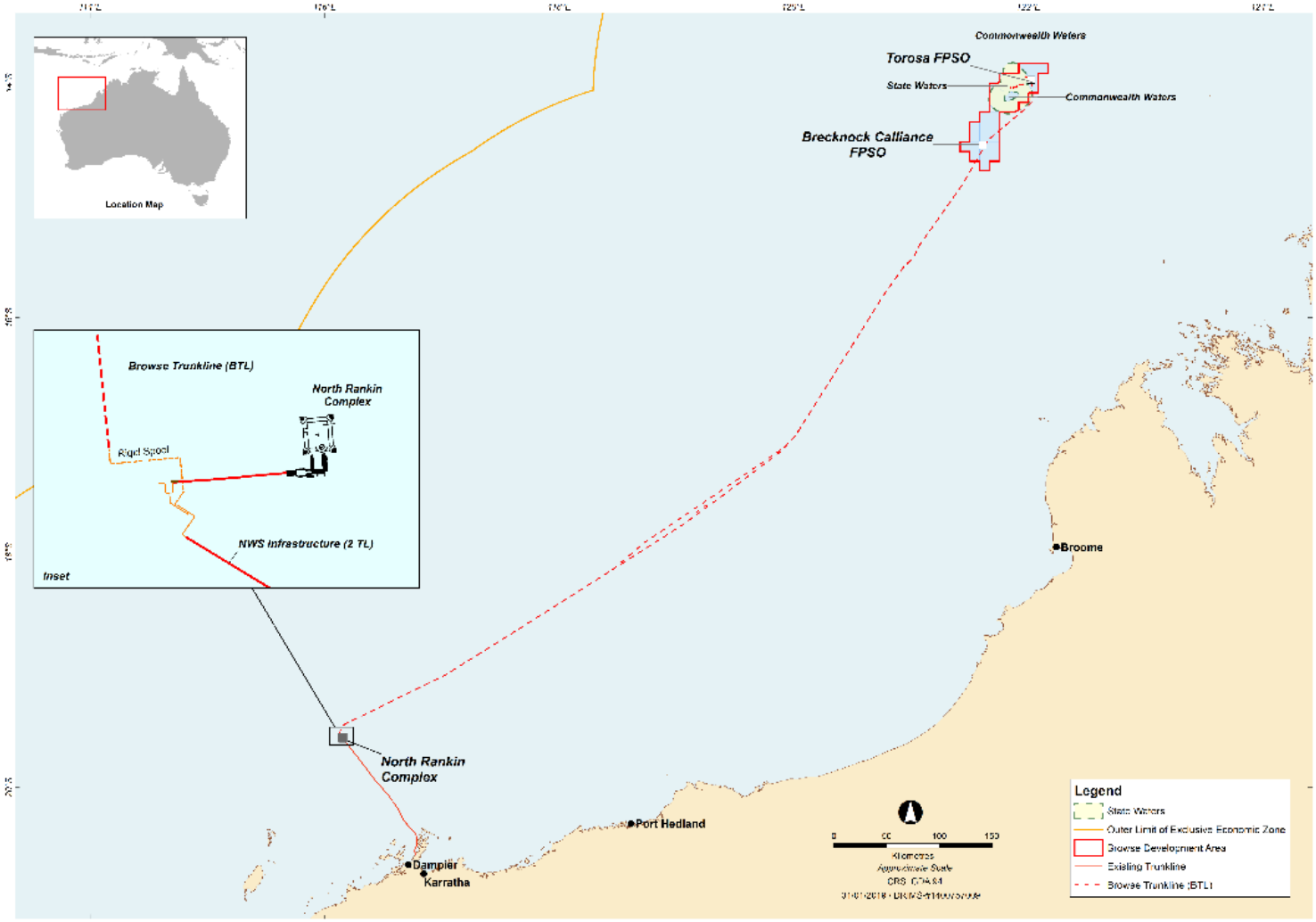

Figure 2 Indicative Browse Trunkline (BTL) route. Note alternative routes mid BTL are being assessed.

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.