Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation Environment Plan

Revision 2
(November 2020)

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

1.1 Overview

Woodside Energy Limited (Woodside), as Titleholder under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (referred to as the Environment Regulations),on behalf of the Joint Venture detailed in Section 1.7, proposes to undertake development drilling and subsea installation activities. The following activities are proposed to occur within Permit Area WA-5-L for the Greater Western Flank-3 (GWF-3) Development and within WA-16-L and WA-3-L for the Lambert Deep (LD) Development:

- drilling and development of three GWF-3 production wells
- drilling and development of one LD production well
- installation and pre-commissioning of flowlines, production manifold, umbilicals complete with umbilical termination assemblies (UTAs), hydraulic flying leads (HFLs) and electrical flying leads (EFLs)
- tie-in to existing subsea infrastructure
- pull-in of the LD flowline and LD umbilical to the Angel Platform via existing, unused J-tubes
- pre-commissioning of the new subsea infrastructure.

These activities will hereafter be referred to as the Petroleum Activities Program and form the scope of this Environment Plan (EP). A more detailed description of these activities is provided in **Section 3**.

This EP has been prepared as part of the requirements under the Environment Regulations, as administered by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

Hydrocarbons from the GWF-3 wells and the LD well will be produced via the existing Goodwyn Alpha (GWA) and Angel Platforms, respectively. The production of those hydrocarbons will be included in the Goodwyn Alpha (GWA) Facility and Angel Facility Operations Environment Plans, and is outside the scope of this EP.

1.2 Defining the Petroleum Activity

The Petroleum Activities Program to be undertaken in Permit Areas WA-3-L, WA-5-L and WA-16-L comprises development drilling and installation of related subsea infrastructure, which are petroleum activities as defined in Regulation 4 of the Environment Regulations. As such an EP is required.

1.3 Purpose of the Environment Plan

In accordance with the objectives of the Environment Regulations, the purpose of this EP is to demonstrate that:

- the potential environmental impacts and risks (planned (routine and non-routine) and unplanned) that may result from the Petroleum Activities Program are identified
- appropriate management controls are implemented to reduce impacts and risks to a level that is 'as low as reasonably practicable' (ALARP) and acceptable
- the Petroleum Activities Program is carried out in a manner consistent with the principles of ecologically sustainable development (ESD) (as defined in Section 3A of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)).

This EP describes the process and resulting outputs of the risk assessment, whereby impacts and risks are managed accordingly.

The EP defines activity-specific environmental performance outcomes, standards, and measurement criteria. These form the basis for monitoring, auditing, and managing the Petroleum Activities Program to be undertaken by Woodside and its contractors. The implementation strategy (derived from the decision support framework tools) specified in this EP provides Woodside and NOPSEMA with the required level of assurance that impacts and risks associated with the activity are reduced to ALARP and are acceptable.

1.4 Scope of the Environment Plan

The scope of this EP covers the activities that define the Petroleum Activities Program, as described in **Section 3**. The spatial boundary of the Petroleum Activities Program has been described and assessed using two 'areas' as further described in **Section 3.3.1**, collectively referred to as a single Operational Area.

This EP addresses potential environmental impacts from planned activities and any potential unplanned risks that originate from within the Operational Area. Transit to and from the Operational Area by the Mobile Offshore Drilling Unit (MODU) and project vessels, as well as port activities associated with these vessels, are not within the scope of this EP. Vessels supporting the Petroleum Activities Program operating outside the Operational Area (e.g. transiting to and from port) are subject to all applicable maritime regulations and other requirements and are not managed by this EP.

1.5 Environment Plan Summary

An EP summary will be prepared based on the material provided in this EP. **Table 1-1** summarises the content that will be provided within the EP summary, as required by Regulation 11(4).

Table 1-1: EP summary

EP Summary material requirement	Relevant section of this EP containing EP Summary material
The location of the activity	**Section 3.3**, pages 44 – 46
A description of the receiving environment	**Section 4**, pages 68 – 174
A description of the activity	**Section 3**, pages 41 – 67
Details of the environmental impacts and risks	**Section 6**, pages 190 – 352
The control measures for the activity	**Section 6**, pages 190 – 352
The arrangements for ongoing monitoring of the titleholder's environmental performance	**Section 7.4**, pages 366 – 371
Response arrangements in the oil pollution emergency plan	**Section 7.8**, pages 376 – 383, and **Appendix D**
Consultation already undertaken and plans for ongoing consultation	**Section 5**, pages 175 – 189
Details of the titleholder's nominated liaison person for the activity	**Section 1.8**, page 19

1.6 Structure of the Environment Plan

The EP has been structured to reflect the process and requirements of the Environment Regulations, as outlined in **Table 1-2**.

Table 1-2: EP process phases, applicable Environment Regulations and corresponding section of this EP

Criteria for acceptance	Content Requirements/Relevant Regulations	Elements	Section of EP
Regulation 10A(a): is appropriate for the nature and scale of the activity	Regulation 13: Environmental Assessment Regulation 14: Implementation strategy for the environment plan Regulation 16: Other information in the environment plan	The principle of 'nature and scale' applies throughout the EP	**Section 2** **Section 3** **Section 4** **Section 5** **Section 6** **Section 7**
Regulation 10A(b): demonstrates that the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable Regulation 10A(c): demonstrates that the environmental impacts and risks of the activity will be of an acceptable level	Regulation 13(1)–13(7): 13(1) Description of the activity 13(2)(3) Description of the environment 13(4) Requirements 13(5)(6) Evaluation of environmental impacts and risks 13(7) Environmental performance outcomes and standards Regulation 16(a)–16(c): A statement of the titleholder's corporate environmental policy A report on all consultations between the titleholder and any relevant person	Set the context (activity and existing environment) Define 'acceptable' (the requirements, the corporate policy, relevant persons) Detail the impacts and risks Evaluate the nature and scale Detail the control measures – ALARP and acceptable	**Section 1** **Section 2** **Section 3** **Section 4** **Section 5** **Section 6** **Section 7**
Regulation 10A(d): provides for appropriate environmental performance outcomes, environmental performance standards and measurement criteria	Regulation 13(7): Environmental performance outcomes and standards	Environmental Performance Outcomes (EPOs) Environmental Performance Standards (EPSs) Measurement criteria (MC)	**Section 6**
Regulation 10A(e): includes an appropriate implementation strategy and monitoring, recording and reporting arrangements	Regulation 14: Implementation strategy for the environment plan	Implementation strategy, including: • systems, practices and procedures • performance monitoring • Oil Pollution Emergency Plan (OPEP) and scientific monitoring • ongoing consultation.	**Section 7** **Appendix D**
Regulation 10A(f): does not involve the activity or part of the activity, other than arrangements for environmental monitoring or for responding to an emergency, being undertaken in any	Regulation 13 (1)–13(3): 13(1) Description of the activity 13(2) Description of the environment 13(3) Without limiting (Regulation 13(2)(b)), particular relevant values and sensitivities may include any of the following:	No activity, or part of the activity, undertaken in any part of a declared World Heritage property	**Section 3** **Section 4** **Section 6**

Criteria for acceptance	Content Requirements/Relevant Regulations	Elements	Section of EP
part of a declared World Heritage property within the meaning of the EPBC Act	(a) the world heritage values of a declared World Heritage property within the meaning of the EPBC Act; (b) the national heritage values of a National Heritage place within the meaning of that Act; (c) the ecological character of a declared Ramsar wetland within the meaning of that Act; (d) the presence of a listed threatened species or listed threatened ecological community within the meaning of that Act; (e) the presence of a listed migratory species within the meaning of that Act; (f) any values and sensitivities that exist in, or in relation to, part or all of: (i) a Commonwealth marine area within the meaning of that Act; or (ii) Commonwealth land within the meaning of that Act.		
Regulation 10A(g): (i) the titleholder has carried out the consultations required by Division 2.2A (ii) the measures (if any) that the titleholder has adopted, or proposes to adopt, because of the consultations are appropriate	Regulation 11A: Consultation with relevant authorities, persons and organisations, etc. Regulation 16(b): A report on all consultations between the titleholder and any relevant person	Consultation in preparation of the EP	**Section 5**
Regulation 10A(h): complies with the Act and the regulations	Regulation 15: Details of the Titleholder and liaison person Regulation 16(c): Details of all reportable incidents in relation to the proposed activity.	All contents of the EP must comply with the Act and the regulations	**Section 1.6** **Section 7.7**

1.7 Description of the Titleholder

Woodside Energy Limited is the Titleholder for this activity, on behalf of a Joint Venture including Woodside Energy Ltd, BP Developments Australia Pty Ltd, BHP Billiton Petroleum (North West Shelf) Pty Ltd, Chevron Australia Pty Ltd, Japan Australia LNG (MIMI) Pty Ltd, CNOOC NWS Private Ltd and Shell Developments (Australia) Pty Ltd.

Woodside's mission is to deliver superior shareholder returns through realising its vision of becoming a global leader in upstream oil and gas. Wherever Woodside works, it is committed to living its values of integrity, respect, working sustainably, discipline, excellence, and working together.

Woodside's operations are characterised by strong safety and environmental performance in remote and challenging locations.

Through collaboration, Woodside leverages its capabilities to progress its growth strategy. Since 1984, the company has been operating the landmark Australian project, the North West Shelf, which is one of the world's premier liquefied natural gas (LNG) facilities. In 2012, Woodside added the Pluto LNG Plant to its onshore operating facilities.

Woodside has an excellent track record of efficient and safe production. Woodside strives for excellence in safety and environmental performance and continues to strengthen relationships with customers, partners, co-venturers, governments, and communities to ensure they are a partner of choice. Further information about Woodside can be found at http://www.woodside.com.au.

1.8 Details of Titleholder, Liaison Person and Public Affairs Contact

In accordance with Regulation 15 of the Environment Regulations, details of the titleholder, liaison person and arrangements for the notification of changes are described below.

1.8.1 Titleholder

Woodside Energy Limited

11 Mount Street

Perth, Western Australia

T: 08 9348 4000

ACN: 63 005 482 986

1.8.2 Activity Contact

Neil McKay

Project Manager, GWF-3 and Lambert Deep

11 Mount Street

Perth, Western Australia, 6000

T: 08 9348 4000

E: feedback@woodside.com.au

1.8.3 Nominated Liaison Person

Daniel Clery

Corporate Affairs Manager

11 Mount Street

Perth, Western Australia

T: 08 9348 4000

E: feedback@woodside.com.au

1.8.4 Arrangements for Notifying Change

If the titleholder, titleholder's nominated liaison person, or the contact details for the titleholder or the liaison person change, then NOPSEMA will be notified of the change in writing within two weeks or as soon as practicable.

1.9 Woodside Management System

The Woodside Management System (WMS) provides a structured framework of documentation to set common expectations governing how all employees and contractors at Woodside will work. Many of the standards presented in **Section 6** are drawn from the WMS documentation, which comprises four elements: Compass and Policies; Expectations; Processes and Procedures; and Guidelines, as outlined below (and illustrated in **Figure 1-1**).

- **Compass and Policies**: Set the enterprise-wide direction for Woodside by governing our behaviours, actions, and business decisions and ensuring we meet our legal and other external obligations.
- **Expectations**: Set essential activities or deliverables required to achieve the objectives of the Key Business Activities and provide the basis for developing processes and procedures.
- **Processes and Procedures**: Processes identify the set of interrelated or interacting activities that transforms inputs into outputs, to systematically achieve a purpose or specific objective. Procedures specify what steps, by whom, and when required to carry out an activity or a process.
- **Guidelines**: Provide recommended practice and advice on how to perform the steps defined in Procedures, together with supporting information and associated tools. Guidelines provide advice on: how activities or tasks may be performed; information that may be taken into consideration; or, how to use tools and systems.

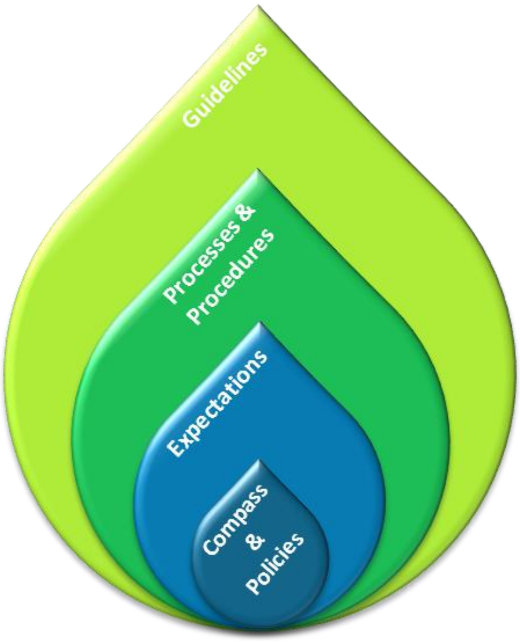


Figure 1-1: The four major elements of the Woodside Management System (WMS) Seed

The WMS is organised within a Business Process Hierarchy based upon Key Business Activities to ensure the system remains independent of organisation structure, is globally applicable and scalable wherever required. These Key Business Activities are grouped into Management, Support, and Value Stream activities as shown in **Figure 1-2**. The Value Stream activities capture, generate and deliver value through the exploration and production lifecycle. The Management activities influence all areas of the business, while Support activities may influence one or more value stream activities.

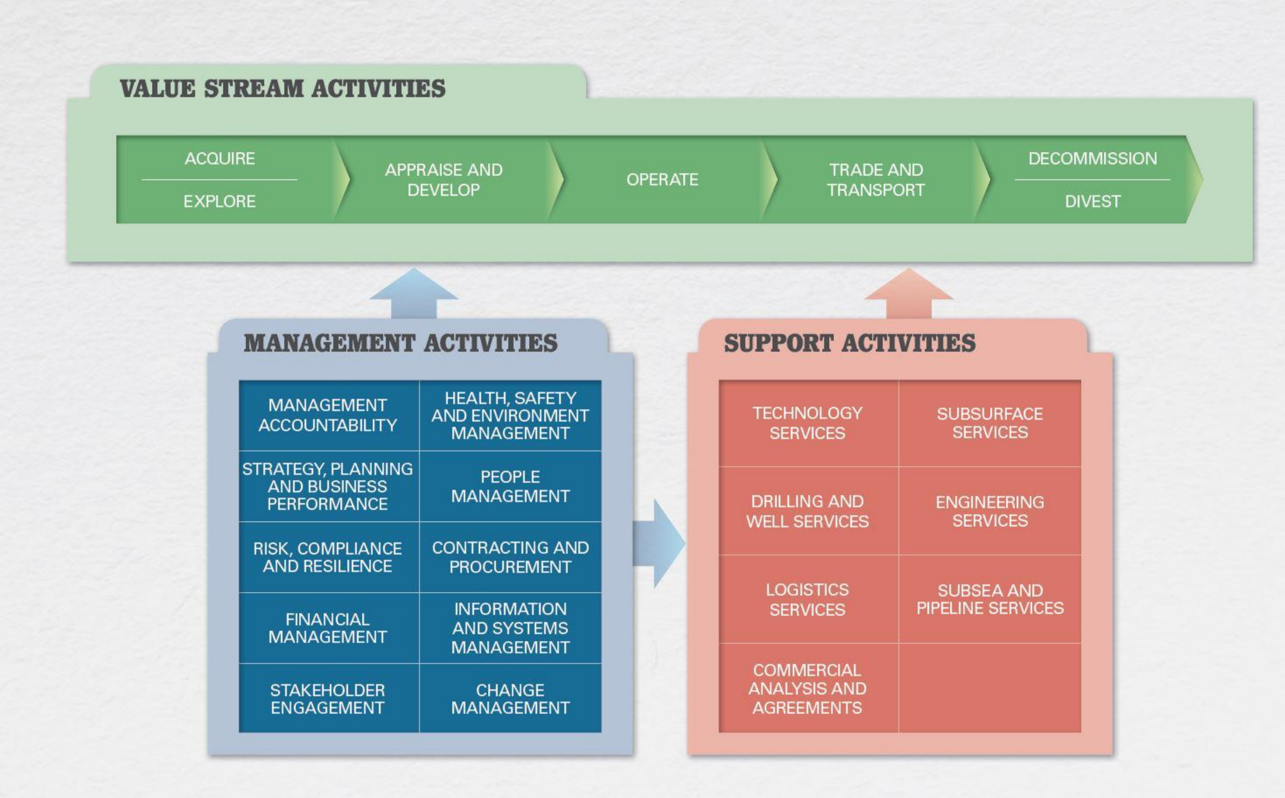


Figure 1-2: The Woodside Management System (WMS) business process hierarchy

1.9.1 Health, Safety, Environment and Quality Policy

In accordance with Regulation 16(a) of the Environment Regulations, Woodside's Corporate Health, Safety, Environment and Quality Policy is provided in **Appendix A** of this EP.

1.10 Description of Relevant Requirements

In accordance with Regulation 13(4) of the Environment Regulations, a description of requirements, including legislative requirements, that apply to the activity and are relevant to the management of risks and impacts of the Petroleum Activities Program are detailed in **Appendix B**. This EP will not be assessed under the WA *Environment Protection Act 1986* as the activity does not occur on State land or within State Waters.

1.10.1 Applicable Environmental Legislation

1.10.1.1 Offshore Petroleum and Greenhouse Gas Storage Act 2006

The Commonwealth *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) controls exploration and production activities beyond three nautical miles (nm) of the mainland (and islands) to the outer extent of the Australian Exclusive Economic Zone (EEZ) at 200 nm.

One of the final petroleum activities managed under the Environment Regulations for a petroleum title is decommissioning. Under subsection 270(3) of the OPGGS Act, before a title can be relinquished, all property brought into a title area must be removed or arrangements that are satisfactory to NOPSEMA must be made in relation to the property. The requirement for complete removal as a base case under the Act is also provided for in subsection 572(3). While there are no immediate plans for decommissioning (the scope of this EP is for drilling and installation activities for production operations) all equipment being installed has been designed for full removal. Subsection 572(2) provides that while structures, equipment and other property remain in the title area, they must be maintained in good condition and repair. Inspection, maintenance and repair of the infrastructure installed for future production, under this Environment Plan, will be managed under the Goodwyn Operations Environment Plan (GWF3) and the Angel Operations Environment Plan (Lambert Deep).

Alternative arrangements that may be satisfactory are ones that deliver equal or better environmental, safety and well integrity outcomes compared to complete removal, and that the approach chosen complies with all other legislative and regulatory requirements. This is outlined in the Offshore Petroleum Decommissioning Guideline (Department of Industry, Innovation and Science [DIIS], 2018).

Under the OPGGS Act, the Environment Regulations apply to petroleum activities in Commonwealth Waters and are administered by NOPSEMA.

The objective of the Environment Regulations is to ensure petroleum activities are:

- carried out in a manner consistent with the principles of ESD
- carried out in a manner by which the environmental impacts and risks of the activity will be reduced to ALARP
- carried out in a manner by which the environmental impacts and risks of the activity will be of an acceptable level.

1.10.1.2 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is administered by the Commonwealth Department of the Agriculture, Water and the Environment (DAWE). The EPBC Act protects matters of national environmental significance (MNES) across Australia and protects the environment in relation to actions on (or impacting upon) Commonwealth land or waters. When a person proposes to take an action that they believe may need approval under the EPBC Act, they must refer the proposal to the Commonwealth Minister for Environment.

The Petroleum Activities Program described for the LD Project is governed by the primary approval for the Angel Gas and Condensate Field.

Consolidated Approval Notice – Angel Gas and Condensate Field (EPBC 2004/1805) dated 14 June 2015 was issued to consolidate the approval conditions, and the approval conditions were subject to variation on the date of the notice. A key element to the variation relates to conditions requiring a plan for managing impacts of the action. The previous conditions required the Minister's approval of such plans, with the variation now automatically deeming the plan to have been approved by the Minister if the measures are included in an EP related to the action that was submitted to NOPSEMA after 27 February 2014 and is in force under the Environment Regulations.

The period of effect of the approval was extended in April 2018. Conditions in relation to the EPBC Act approval that are considered relevant to the scope of this EP are provided in **Table 1-3**.

Table 1-3: Conditions from the Angel Gas and Condensate Field (EPBC 2004/1805) relevant to the Petroleum Activities Program

Condition Number	Condition	Relevant Section of the EP
1[1]	The person taking the action must submit, for the Minister's approval, a plan (or plans) for managing the offshore impacts of the action. The plan (or plans) must include measures for the following individual activities:	**This EP**

[1] Condition 1c) (not shown) has been met through previous plans

Condition Number	Condition	Relevant Section of the EP
	a) Drilling operations i. Timetable for activities ii. Drilling fluid type and disposal method iii. Drill cuttings disposal method iv. Fuel and chemical handling procedures v. Cetacean interaction procedures for supply vessels and aircraft that are consistent with Part 8 of the *Environment Protection and Biodiversity Conservation Regulations 2000* and cetacean reporting	**i. Section 3.4** **ii. Section 3.8** **iii. Section 3.8** **iv. Section 3.7.4** and **6.7.6** **v. Section 6.6.3**
	b) Construction and installation i. Design and construction that allow for the decommissioning and removal of all structures and components above the seafloor ii. Hydrotest fluid type, handling and disposal iii. Cetacean interaction procedures for supply vessels and aircraft that are consistent with Part 8 of the *Environment Protection and Biodiversity Conservation Regulations 2000* and cetacean reporting	i. This EP (design and installation) including **Section 3.11.7** and a future decommissioning EP'. **ii. Section 3.9.7** and **6.6.7** **iii. Section 6.6.3** and **6.7.8**
2	The person taking the action must submit a decommissioning plan (or plans) for approval by the Minister prior to decommissioning of the development. The plan (or plans) must consider the complete removal of all structures and components above the sea floor. The approved plan (or plans) must be implemented.	Decommissioning beyond the scope of this EP, refer **Section 1.10.1**.
6	If the person taking the action wishes to carry out any activity otherwise than in accordance with the plans referred to in conditions 1 or 2, the person taking the action may submit for the Minister's approval a revised version of any such plan. If the Minister approves a revised plan so submitted, the person taking the action must implement that plan instead of the plan as originally accepted.	The implementation of this EP is considered to meet the requirements of this condition
8	A plan required by condition 1, 2 or 6 is automatically deemed to have been submitted to, and approved by, the Minister if the measures (as specified in the relevant condition) are included in an environment plan (or environment plans) relating to the taking of the action that: a) Was submitted to NOPSEMA after 27 February 2014; and b) Either: i. Is in force under the OPGGS Environment Regulations; or ii. Has ended in accordance with regulation 25A of the OPGGS Environment Regulations.	The implementation of this EP is considered to meet the requirements of this condition
8A	Where a plan required by condition 1 or 6 has been approved by the Minister and the measures (as specified in the relevant	The implementation of this EP is considered to meet this Condition

Condition Number	Condition	Relevant Section of the EP
	condition) are included in an environment plan (or environment plans) that: a) Was submitted to NOPSEMA after 27 February 2014; and b) Either: i. Is in force under the OPGGS Environment Regulations; or ii. Has ended in accordance with regulations 25A of the OPGGS Environment Regulations. iii. The plan approved by the Minister no longer needs to be implemented.	
8B	Where an environment plan, which includes measures specified in the conditions referred to in conditions 8 and 8A above, is in force under the OPGGS Environment Regulations that relates to the taking of the action, the person taking the action must comply with those measures as specified in that environment plan.	The implementation of this EP is considered to meet the requirements of this condition

1.10.2 Australian Marine Parks

Under the EPBC Act, Australian Marine Parks (AMPs), are recognised for conserving marine habitats and the species that live and rely on these habitats. The Director of National Parks (DNP) is responsible for managing AMPs (supported by Parks Australia). The North-west Marine Parks Network Management Plan (2018) describes the management requirements for the relevant AMPs, which are detailed in Section 4.7. Other parts of the Commonwealth Government must not perform functions or exercise powers in relation to these parks that are inconsistent with management plans (s.362 of the EPBC Act).

Specific zones within the AMPs have been allocated conservation objectives as stated below (International Union for Conservation of Nature (IUCN) Protected Area Category) based on the Australian IUCN reserve management principles outlined in Schedule 8 of the EPBC Regulations 2000:

- Special Purpose Zone (IUCN category VI): managed to allow specific activities through special purpose management arrangements while conserving ecosystems, habitats and native species. The zone allows or prohibits specific activities.
- Sanctuary Zone (IUCN category Ia): managed to conserve ecosystems, habitats and native species in as natural and undisturbed a state as possible. The zone allows only authorised scientific research and monitoring.
- National Park Zone (IUCN category II): managed to protect and conserve ecosystems, habitats and native species in as natural a state as possible. The zone only allows non-extractive activities unless authorised for research and monitoring.
- Recreational Use Zone (IUCN category IV): managed to allow recreational use, while conserving ecosystems, habitats and native species in as natural a state as possible. The zone allows for recreational fishing, but not commercial fishing.
- Habitat Protection Zone (IUCN category IV): managed to allow activities that do not harm or cause destruction to seafloor habitats, while conserving ecosystems, habitats and native species in as natural a state as possible.
- Multiple Use Zone (IUCN category VI): managed to allow ecologically sustainable use while conserving ecosystems, habitats and native species. The zone allows for a range of sustainable uses, including commercial fishing and mining where they are consistent with park values.

1.10.3 World Heritage Properties

Australian World Heritage management principles are prescribed in Schedule 5 of the EPBC Regulations 2000. Management principles that are considered relevant to the scope of this EP are provided in **Table 1-4.**

Table 1-4: Relevant Management Principles under Schedule 5—Australian World Heritage management principles of the EPBC Act.

Number	Principle	Relevant Section of the EP
3	Environmental impact assessment and approval 3.01 This principle applies to the assessment of an action that is likely to have a significant impact on the World Heritage values of a property (whether the action is to occur inside the property or not). 3.02 Before the action is taken, the likely impact of the action on the World Heritage values of the property should be assessed under a statutory environmental impact assessment and approval process. 3.03 The assessment process should: (a) identify the World Heritage values of the property that are likely to be affected by the action; and (b) examine how the World Heritage values of the property might be affected; and (c) provide for adequate opportunity for public consultation. 3.04 An action should not be approved if it would be inconsistent with the protection, conservation, presentation or transmission to future generations of the World Heritage values of the property. 3.05 Approval of the action should be subject to conditions that are necessary to ensure protection, conservation, presentation or transmission to future generations of the World Heritage values of the property. 3.06 The action should be monitored by the authority responsible for giving the approval (or another appropriate authority) and, if necessary, enforcement action should be taken to ensure compliance with the conditions of the approval.	3.01 and 3.02: Assessment of significant impact on World Heritage values is included in **Section 6**. Principles are met by the submitted EP. 3.03 (a) and (b): World Heritage values are identified in Section 4 and considered in the assessment of impacts and risks for the Petroleum Activity in **Section 6**. 3.03 (c): Relevant stakeholder consultation and feedback received in relation to impacts and risks to the Ningaloo World Heritage Property are outlined in **Section 5**. 3.04, 3.05 and 3.06: Principles are considered to be met by the acceptance of this EP.

Note that Section 1 – General Principles and 2 – Management Planning of Schedule 5 are not considered relevant to the scope of this EP and, therefore, have not been included.

2. ENVIRONMENT PLAN PROCESS

2.1 Overview

This section outlines the process taken by Woodside to prepare this EP once the activity was defined as a petroleum activity. The process describes the activity, the existing environment, followed by the environmental risk management methodology used to identify, analyse and evaluate risks to meet ALARP levels and acceptability requirements, and develop environmental performance outcomes (EPOs) and environmental performance standards (EPSs). This section also describes Woodside's risk management methodologies as applied to implementation strategies for the activity.

Regulation 13(5) of the Environment Regulations requires the detailing of environmental impacts and risks, and evaluation appropriate to the nature and scale of each impact and risk associated with the Petroleum Activities Program. The objective of the risk and impact assessment process described in this section is to identify environmental aspects and hazards and associated impacts and risk of an activity. The impacts and risks can then be assessed and appropriate control measures applied to eliminate, control or mitigate the impact/risk to ALARP, and to determine if the impact or risk level is acceptable.

Environmental impacts and risks include those directly and indirectly associated with the Petroleum Activities Program, and include potential emergency and accidental events:

- **Planned activities** have the potential for inherent environmental impacts.
- **Environmental risks** are unplanned events with the potential for environmental impact (termed risk 'consequence').

In this EP:

- Potential impacts from planned activities are termed 'impacts'.
- 'Risks' are associated with unplanned events with the potential for environmental impact should the risk be realised; and such impacts are termed potential 'consequences'.

2.2 Environmental Risk Management Methodology

2.2.1 Woodside Risk Management Process

Woodside recognises that risk is inherent to its business and that effective management of risk is vital to delivering on company objectives, success and continued growth. Woodside is committed to managing all risk proactively and effectively. The objective of Woodside's risk management system is to provide a consistent process for recognising and managing risks across Woodside's business. Achieving this objective includes ensuring risks consider impacts across these key areas of exposure: health and safety, environment, finance, reputation and brand, legal and compliance, and social and cultural. A copy of Woodside's Risk Management Policy is provided in **Appendix A**.

The environmental risk management methodology used in this EP is based on Woodside's Risk Management Procedure. This procedure aligns to industry standards, such as international standard ISO 31000. Woodside's WMS risk management procedures, guidelines and tools provide guidance of specific techniques for managing risk, tailored for particular areas of risk within certain business processes. Procedures applied for environmental risk management include:

- Health, Safety and Environment Management Procedure
- Impact Assessment Procedure
- Process Safety Management Procedure.

The risk management methodology provides a framework to demonstrate that risks and impacts are continually identified, reduced to ALARP and assessed to be at an acceptable level, as required by the Environment Regulations. The key steps of Woodside's Risk Management Process are shown in **Figure 2-1**. A description of each step and how it is applied to the scopes of this activity is provided in **Sections 2.2** to **2.10.**

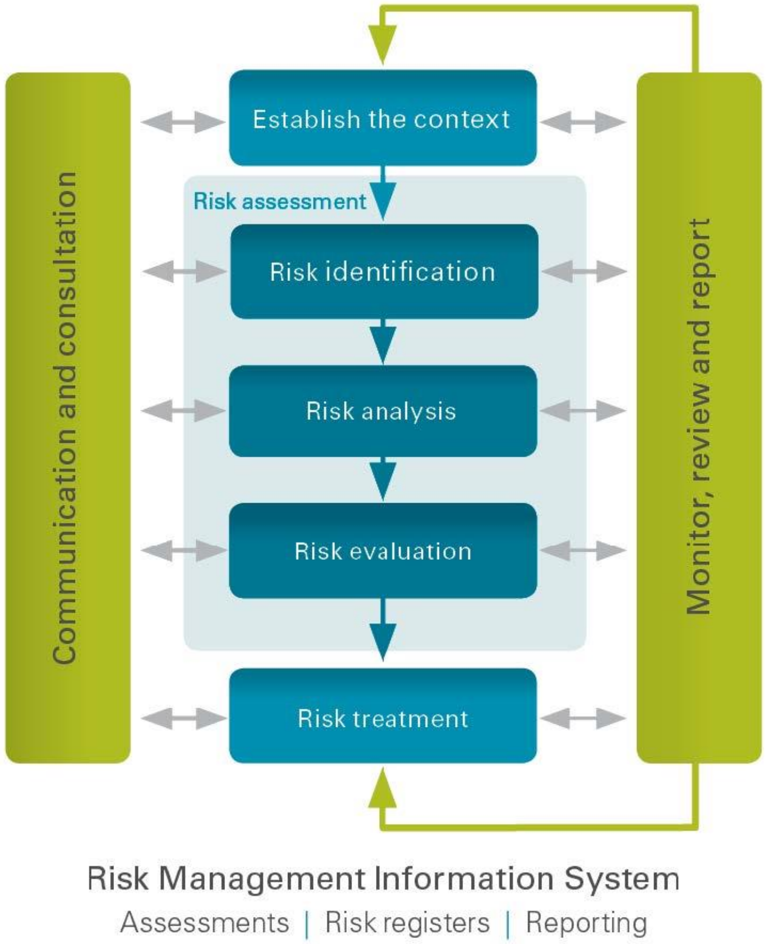


Figure 2-1: Woodside's risk management process

2.2.2 Health, Safety and Environment Management Procedure

The Health, Safety and Environment Management Procedure provides the structure for managing health, safety and environment (HSE) risks and impacts across Woodside, defines the decision authorities for company-wide HSE management activities and deliverables, and supports continuous improvement in HSE management.

2.2.3 Impact Assessment Procedure

To support effective environmental risk assessment, Woodside's Impact Assessment Procedure (**Figure 2-2**) provides the steps to meet the required environment, health and social standards by ensuring impact assessments are undertaken appropriate to the nature and scale of the activity, the regulatory context, the receiving environment, interests, concerns and rights of stakeholders, and the applicable framework of standards and practices.

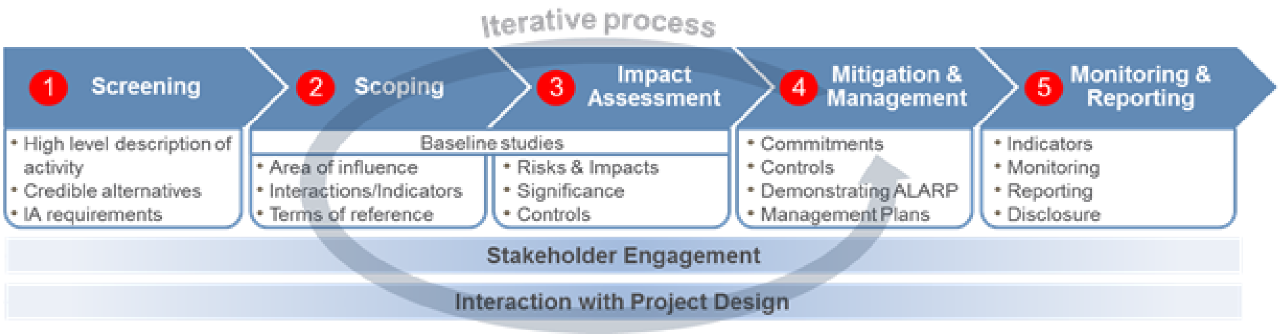


Figure 2-2: Woodside's impact assessment process

2.3 Environment Plan Process

Figure 2-3 illustrates the EP development process. Each element of this process is discussed further in **Sections 2.5** to **2.9**.

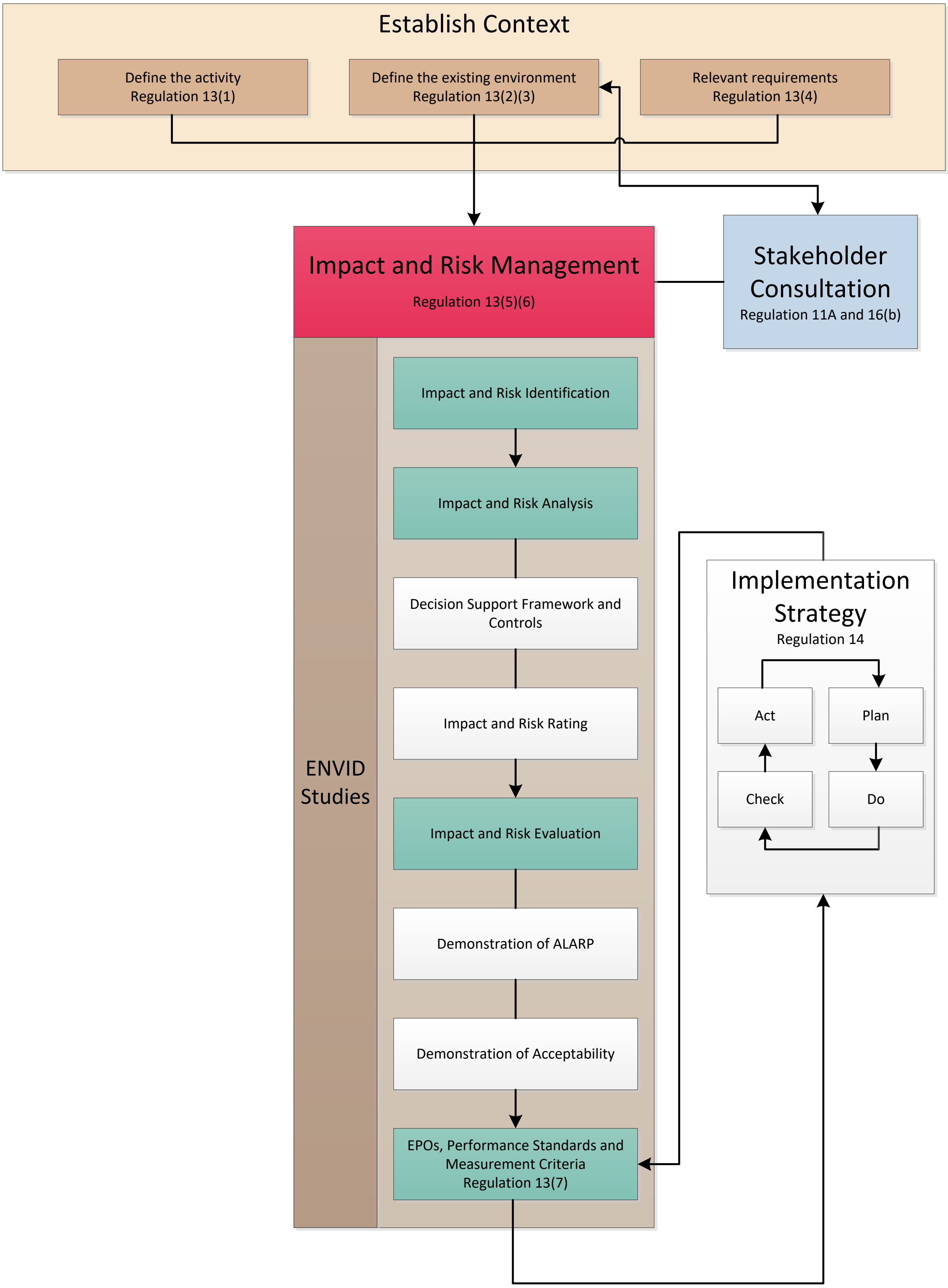


Figure 2-3: Environment Plan development process

2.4 Establish the Context

2.4.1 Define the Activity

This first stage involves evaluating whether the activity meets the definition of a 'petroleum activity' as defined in the Environment Regulations. The activity is described in relation to:

- the location
- what is to be undertaken
- how it is planned to be undertaken, including outlining operational details of the activity and proposed timeframes.

The 'what' and 'how' are described in the context of 'environmental aspects'[2] to inform the risk and impact assessment for planned (routine and non-routine) and unplanned (accidents/incidents/emergency conditions) activities.

The activity is described in **Section 3** and is referred to as the Petroleum Activities Program.

2.4.2 Define the Existing Environment

The context of the existing environment is described and determined by considering the nature and scale of the activity (size, type, timing, duration, complexity, and intensity of the activity), as described in **Section 3**. The purpose is to describe the existing environment that may be impacted by the activity, directly or indirectly, by planned or unplanned[3] events.

The Existing Environment (**Section 4**) is structured into subsections defining the physical, biological, socioeconomic and cultural attributes of the area of interest, in accordance with the definition of environment in Regulation 4(a) of the Environment Regulations. These subsections make particular reference to:

- The environmental, and social and cultural consequences as defined by Woodside (refer to **Table 2-1**), which address key physical and biological attributes, as well as social and cultural values of the existing environment. These consequence definitions are applied to the impact and risk analysis (refer **Section 2.2**) and rated for all planned and unplanned activities. Additional detail is provided for unplanned hydrocarbon spill risk evaluation.
- EPBC Act MNES including listed threatened species and ecological communities and listed migratory species. Defining the spatial extent of the existing environment is guided by the nature and scale of the Petroleum Activities Program (and associated sources of environmental risk). This considers the Operational Area and wider environment that may be affected (EMBA), as determined by the hydrocarbon spill risk assessments presented in **Section 6.7**. MNES, as defined within the EPBC Act, are addressed through Woodside's impact and risk assessment (**Section 6**).
- Relevant values and sensitivities, which may include world or national heritage listed areas, listed threatened species or ecological communities, listed migratory species, or sensitive values.

By grouping potentially impacted environmental values by aspect (as presented in **Table 2-1**), the presentation of information about the receiving environment is standardised. This information is then consistently applied to the risk evaluation section to provide a robust approach to the overall environmental risk evaluation and its documentation in the EP.

[2] An environmental aspect is an element of the activity that can interact with the environment.

[3] For each source of risk, the credible worst-case scenario in conjunction with impact thresholds is used to determine the spatial extent of the EMBA. The worst-case unplanned event is considered to be an unplanned hydrocarbon release, further defined for each activity through the risk assessment process. Interpretation of stochastic oil spill modelling determines the EMBA for the release, which defines the spatial scale of the environment that may be potentially impacted by the Petroleum Activities Program, which provides context to the 'nature and scale' of the existing environment.

Table 2-1: Example of the environment values potentially impacted which are assessed within the Environment Plan

Environmental Value Potentially Impacted Regulations 13(2)(3)						
Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl. Odour)	Ecosystems/ Habitats	Species	Socioeconomic

2.4.3 Relevant Requirements

The relevant requirements in the context of legislation, other environmental approval requirements, conditions and standards that apply to the Petroleum Activities Program are identified, reviewed and are presented in **Appendix B**.

The Corporate Health, Safety, Environment and Quality Policy is presented in **Appendix A**.

2.5 Impact and Risk Identification

Relevant environmental aspects and hazards were identified that support the process to define environmental impacts and risks associated with an activity.

The environmental impact and risk assessment presented in this EP has been informed by recent and historic hazard and environment identification studies (e.g. HAZID/ENVID), PSRA processes, reviews, and desktop studies associated with the Petroleum Activities Program. Impacts, risks and potential consequences were identified based on planned and potential interaction with the activity (based on the description in **Section 3**), the existing environment (**Section 4**) and the outcomes of Woodside's stakeholder engagement process (**Section 5**). The environmental outputs of applicable risk and impact workshops and associated studies are referred to as ENVID in this EP.

The ENVID was undertaken by multidisciplinary teams comprising relevant drilling, project, operational and environmental personnel with sufficient breadth of knowledge, training and experience to reasonably assure that risks and impacts were identified, and their potential environmental consequences assessed. Impacts and risks were identified during the ENVID for both planned (routine and non-routine) activities and unplanned (accidents/incidents/emergency conditions) events. During this process, risks identified as not applicable (not credible) were removed from the assessment.

The impact and risk information were classified, evaluated and tabulated for each planned activity and unplanned event. Environmental impacts and risk were recorded in an environmental impacts and risk register. The output of the ENVID is used to present the risk assessment and form the basis of performance outcomes, standards, and measurement criteria. This information is presented in **Section 6**, following the format presented in **Table 2-2**.

Table 2-2: Example of layout of identification of risks and impacts in relation to risk sources

Impacts and Risks Evaluation Summary													
Source of Risk	Environmental Value Potentially Impacted							Evaluation					
	Soil and groundwater	Marine sediment	Water quality	Air quality (incl odour)	Ecosystems/habitat	Species	Socioeconomic	Decision type	Consequence/impact	Likelihood	Risk rating	ALARP tools	Acceptability
Summary of source of impact/risk													

2.6 Impact and Risk Analysis

Risk analysis further develops the understanding of a risk by defining the impacts and assessing appropriate controls, as well as considering previous risk assessments for similar activities, relevant studies, past performance, external stakeholder consultation feedback, and the existing environment.

These key steps were undertaken for each identified risk during the risk assessment:

- identify the decision type in accordance with the decision support framework
- identify appropriate control measures (preventive and mitigation) aligned with the decision type
- assess the risk rating.

2.6.1 Decision Support Framework

To support the risk assessment process and Woodside's determination of acceptability (**Section 2.7.2**), Woodside's HSE risk management procedures include the use of a decision support framework based on principles set out in the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This concept was applied during the ENVID, or equivalent processes during historical design decisions, to determine the level of supporting evidence that may be required to draw sound conclusions regarding risk level and whether the risk is acceptable and ALARP (**Figure 2-4**). Application of the decision support framework confirms:

- activities do not pose an unacceptable environmental risk
- appropriate focus is placed on activities where the impact or risk is anticipated to be acceptable and demonstrated to be ALARP
- appropriate effort is applied to manage risks and impacts based on the uncertainty of the risk, the complexity and risk rating (i.e. potential higher order environmental impacts are subject to further evaluation/assessment).

The framework provides appropriate tools, commensurate to the level of uncertainty or novelty associated with the risk/impact (referred to as the Decision Type A, B, or C). The decision type is selected based on an informed discussion around the uncertainty of the risk/impact and is documented in ENVID worksheets.

This framework enables Woodside to appropriately understand a risk and determine if the risk or impact is acceptable and can be demonstrated to be ALARP.

2.6.1.1 Decision Type A

Decision Type A risks and impacts are well understood and established practice; they are generally recognised as good industry practice and are often embodied in legislation, codes and standards, and use professional judgment.

2.6.1.2 Decision Type B

Decision Type B risks and impacts typically involve greater uncertainty and complexity (and can include potential higher-order impacts/risks). These risks may deviate from established practice or have some lifecycle implications and therefore require further engineering risk assessment to support the decision and ensure that the risk is ALARP. Engineering risk assessment tools may include:

- risk-based tools such as cost-based analysis or modelling
- consequence modelling
- reliability analysis
- company values.

2.6.1.3 Decision Type C

Decision Type C risks and impacts typically have significant risks related to environmental performance. Such risks typically involve greater complexity and uncertainty, therefore requiring the adoption of the precautionary approach. The risks may result in significant environmental impact, significant project risk/exposure, or may elicit negative stakeholder concerns. For these risks or impacts, in addition to Decision Type A and B tools, company and societal values need to be considered by undertaking broader internal and external stakeholder consultation as part of the risk assessment process.

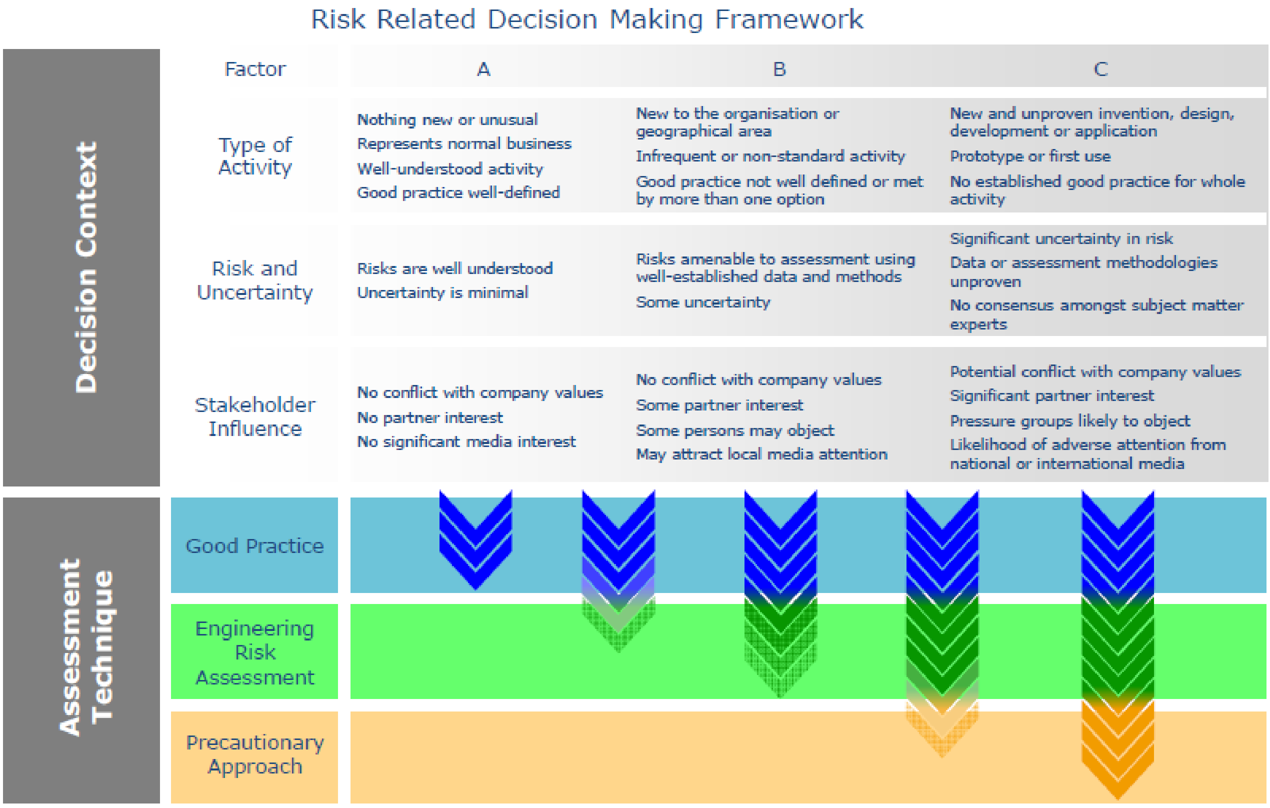


Figure 2-4: Risk-related decision-making framework

Source: Oil and Gas UK (2014)

2.6.1.4 Decision Support Framework Tools

These framework tools are applied, as appropriate, to help identify control measures based on the decision type described above:

- **Legislation, Codes and Standards (LCS)** – identifies the requirements of legislation, codes and standards that are to be complied with for the activity.
- **Good Industry Practice (GP)** – identifies further engineering control standards and guidelines that may be applied by Woodside above that required to meet the LCS.
- **Professional Judgement (PJ)** – uses relevant personnel with the knowledge and experience to identify alternative controls. Woodside applies the hierarchy of control as part of the risk assessment to identify any alternative measures to control the risk.
- **Risk-based Analysis (RBA)** – assesses the results of probabilistic analyses such as modelling, quantitative risk assessment and/or cost–benefit analysis to support the selection of control measures identified during the risk assessment process.
- **Company Values (CV)** – identifies values identified in Woodside's code of conduct, policies and the Woodside Compass. Views, concerns and perceptions are to be considered from internal Woodside stakeholders directly affected by the planned impact or potential risk.
- **Societal Values (SV)** – identifies the views, concerns and perceptions of relevant stakeholders and addresses relevant stakeholder views, concerns and perceptions.

Decision Calibration

To determine that the alternatives selected and the control measures applied are suitable, these tools may be used for calibration (i.e. checking) where required:

- **LCS/Verification of Predictions –** Verification of compliance with applicable LCS and/or good industry practice.
- **Peer Review** – Independent peer review of PJs, supported by RBA, where appropriate.
- **Benchmarking –** Where appropriate, benchmarking against a similar facility or activity type or situation that has been deemed to represent acceptable risk.
- **Internal Stakeholder Consultation** – Consultation undertaken within Woodside to inform the decision and verify company values are met.
- **External Stakeholder Consultation –** Consultation undertaken to inform the decision and verify societal values are considered.

Where appropriate, additional calibration tools may be selected specific to the decision type and the activity.

2.6.2 Control Measures (Hierarchy of Controls)

Risk reduction measures are prioritised and categorised in accordance with the hierarchy of controls, where risk reduction measures at the top of the hierarchy take precedence over risk reduction measures further down:

- **Elimination** of the risk by removing the hazard.
- **Substitution** of a hazard with a less hazardous one.
- **Engineering Controls** include design measures to prevent or reduce the frequency of the risk event, or detect or control the risk event (limiting the magnitude, intensity and duration) such as:
  - Prevention: design measures that reduce the likelihood of a hazardous event occurring
  - Detection: design measures that facilitate early detection of a hazardous event
  - Control: design measures that limit the extent/escalation potential of a hazardous event
  - Mitigation: design measures that protect the environment if a hazardous event occurs
  - Response Equipment: design measures or safeguards that enable clean-up/response after a hazardous event occurs.
- **Procedures and Administration** includes management systems and work instructions used to prevent or mitigate environmental exposure to hazards.
- **Emergency Response and Contingency Planning** includes methods to enable recovery from the impact of an event (e.g. protection barriers deployed near the sensitive receptor).

2.6.3 Impact and Risk Classification

Environmental impacts and risks are assessed to determine the potential impact significance/consequence. The impact significance/consequence considers the magnitude of the impact or risk and the sensitivity of the potentially impacted receptor (represented by **Figure 2-5**).

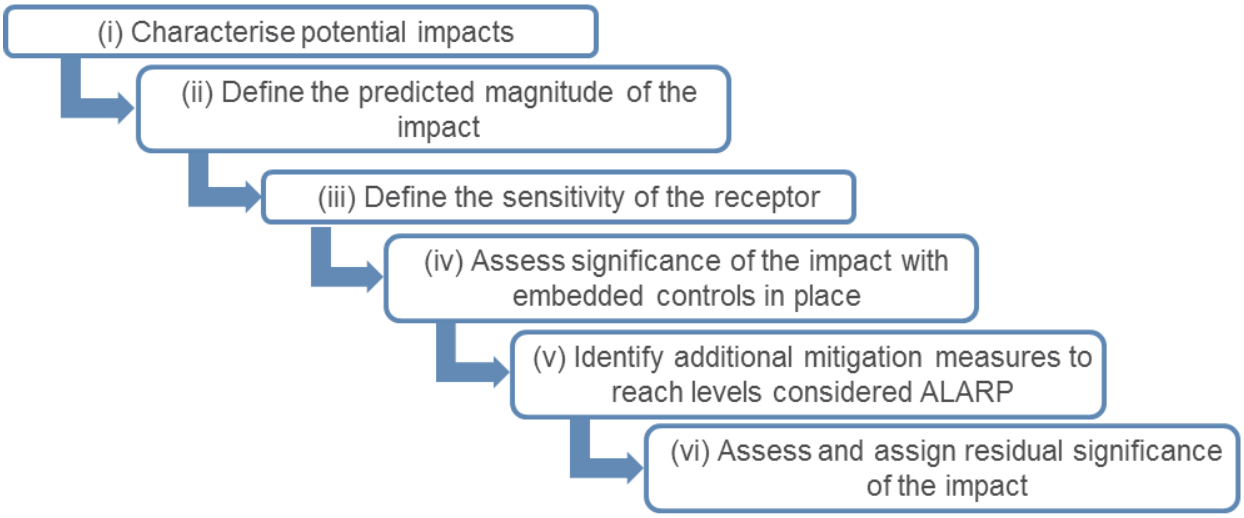


Figure 2-5: Environmental risk and impact analysis

Impacts are classified in accordance with the consequence (**Table 2-3**) outlined in Woodside's Risk Management Procedure and Risk Matrix (**Figure 2-6**). Risks are assessed qualitatively and/or quantitatively in terms of both likelihood and consequence in accordance with this matrix.

The impact and risk information, including classification and evaluation information as shown in the example (**Table 2-2**), are tabulated for each planned activity and unplanned event.

Table 2-3: Woodside risk matrix (Environment and Social and Cultural) consequence descriptions

Environment	Social and Cultural	Consequence Level
Catastrophic, long-term impact (>50 years) on highly valued ecosystem, species, habitat or physical or biological attribute.	Catastrophic, long-term impact (>20 years) to a community, social infrastructure or highly valued area/item of international cultural significance.	**A**
Major, long term impact (10–50 years) on highly valued ecosystem, species, habitat or physical or biological attribute.	Major, long-term impact (5–20 years) to a community, social infrastructure or highly valued area/item of national cultural significance.	**B**
Moderate, medium-term impact (2–10 years) on ecosystem, species, habitat or physical or biological attribute.	Moderate, medium term impact (2–5 years) to a community, social infrastructure or highly valued area/item of national cultural significance.	**C**
Minor, short-term impact (1–2 years) on species, habitat (but not affecting ecosystem function), physical or biological attribute.	Minor, short-term impact (1–2 years) to a community or highly valued area/item of cultural significance.	**D**
Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystem function), physical or biological attribute.	Slight, short-term impact (<1 year) to a community or area/item of cultural significance.	**E**
No lasting effect (<1 month). Localised impact not significant to environmental receptor.	No lasting effect (<1 month). Localised impact not significant to area/item of cultural significance.	**F**

2.6.3.1 Risk Rating Process

The risk rating process assigns a level of risk to each risk event, measured in terms of consequence and likelihood. The assigned risk rating is determined with controls in place; therefore, the risk rating is determined after identifying the decision type and appropriate control measures.

The risk rating process considers the potential environmental consequences and, where applicable, the social and cultural consequences of the risk. The risk ratings are assigned using the Woodside Risk Matrix (refer to **Figure 2-6**).

The risk rating process is done using the steps described in the subsections below.

Select the Consequence Level

Determine the worst-case credible consequence (**Table 2-3**) associated with the selected event, assuming all controls (preventive and mitigative) are absent or have failed. If more than one potential consequence applies, select the highest severity consequence level.

Select the Likelihood Level

Determine the description that best fits the chance of the selected consequence occurring, assuming reasonable effectiveness of the prevention and mitigation controls (**Table 2-4**).

Table 2-4: Woodside risk matrix likelihood levels

Likelihood Description						
Frequency	1 in 100,000–1,000,000 years	1 in 10,000–100,000 years	1 in 1000–10,000 years	1 in 100–1000 years	1 in 10–100 years	>1 in 10 years
Experience	Remote: Unheard of in the industry	Highly Unlikely: Has occurred once or twice in the industry	Unlikely: Has occurred many times in the industry but not at Woodside	Possible: Has occurred once or twice in Woodside or may possibly occur	Likely: Has occurred frequently at Woodside or is likely to occur	Highly Likely: Has occurred frequently at the location or is expected to occur
Likelihood Level	**0**	**1**	**2**	**3**	**4**	**5**

Calculate the Risk Rating

The risk rating is derived from the consequence and likelihood levels above, in accordance with the Woodside Risk Matrix shown in **Figure 2-6**. A likelihood and risk rating are only applied to environmental risks, not environmental impacts from planned activities.

This risk rating is used as an input into the risk evaluation process and ultimately for prioritising further risk reduction measures. Once each risk is treated to ALARP, the risk rating articulates the ALARP baseline risk as an output of the ENVID studies.

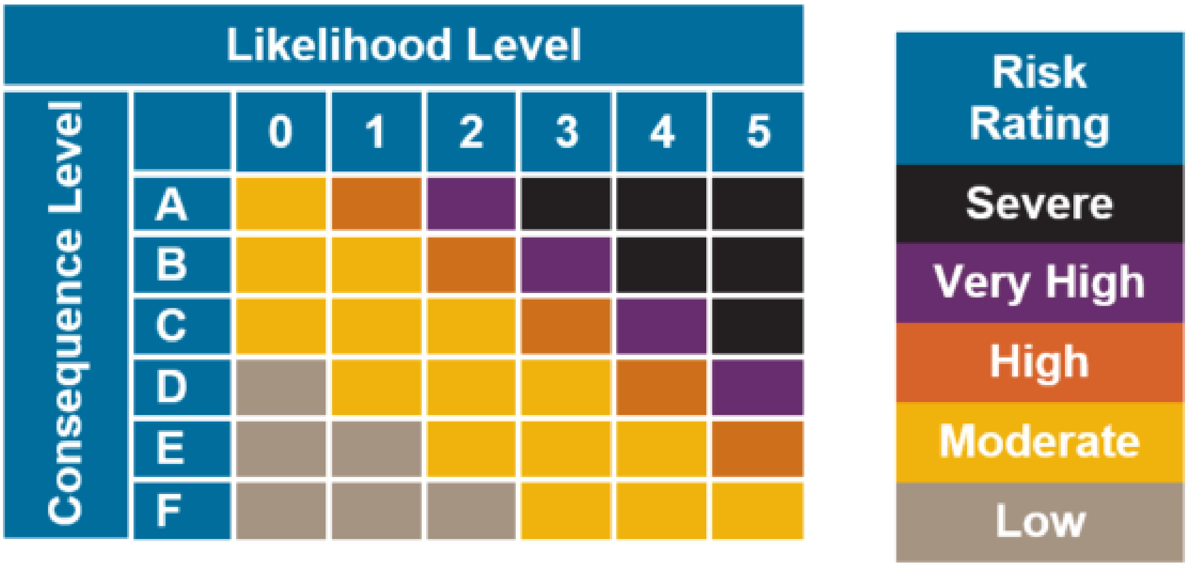


Figure 2-6: Woodside risk matrix – risk level

To support ongoing risk management (as a key component of Woodside's Process Safety Management Framework – refer to the implementation strategy in **Section 7**), Woodside uses the concept of 'current risk' and applies a Current Risk Rating to indicate the current or 'live' level of risk, considering controls that are currently in place and effective on a day-to-day basis. The Current Risk Rating is effective in articulating potential divergence from baseline risk, such as if certain controls fail or could potentially be compromised. Current Risk Ratings aid in communicating and making visible the risk events and ensures the continual management of risk to ALARP by identifying risk reduction measures and assessing acceptability.

2.7 Impact and Risk Evaluation

Environmental impacts and risks cover a wider range of issues, differing species, persistence, reversibility, resilience, cumulative effects, and variability in severity than safety risks. Determining the degree of environmental risk, and the corresponding threshold for whether a risk/impact has been reduced to ALARP and is acceptable, is evaluated to a level appropriate to the nature and scale of each impact or risk. Evaluation includes considering the:

- Decision Type
- principles of ESD – as defined under the EPBC Act
- internal context – ensuring the proposed controls and risk level are consistent with Woodside policies, procedures and standards (**Section 7** and **Appendix A**)
- external context – the environment consequence (**Section 6**) and stakeholder acceptability (**Section 5**)
- other requirements – ensuring the proposed controls and risk level are consistent with national and international standards, laws and policies.

In accordance with Environment Regulation 10A(a), 10A(b), 10A(c) and 13(5)(b), Woodside applies the process described in the subsections below to demonstrate ALARP and acceptability for environmental impacts and risks, appropriate to the nature and scale of each impact or risk.

2.7.1 Demonstration of ALARP

The descriptions in **Table 2-5** articulate how Woodside demonstrates that different risks, impacts and Decision Types identified within the EP are ALARP.

Table 2-5: Summary of Woodside's criteria for ALARP demonstration

Risk	Impact	Decision Type
Low and Moderate (below C level consequence)	**Negligible, Slight, or Minor (D, E or F)**	**A**
Woodside demonstrates these risks, impacts and decision types are reduced to ALARP if: • identified controls meet legislative requirements, industry codes and standards, applicable company requirements and industry guidelines, or • further effort towards impact/risk reduction (beyond using opportunistic measures) is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained.		
High, Very High or Severe (C+ consequence risks)	**Moderate and above (D, E or F)**	**B and C**
Woodside demonstrates these higher-order risks, impacts and decision types are reduced to ALARP where it can be shown good industry practice and RBA have been employed, if legislative requirements are met, societal concerns are accounted for, and the alternative control measures are grossly disproportionate to the benefit gained.		

2.7.2 Demonstration of Acceptability

The descriptions in **Table 2-6** articulate how Woodside demonstrates how different risks, impacts and Decision Types identified within the EP are Acceptable.

Table 2-6: Summary of Woodside's criteria for acceptability

Risk	Impact	Decision Type
Low and Moderate	**Negligible, Slight, or Minor (F, E or D)**	**A**
Woodside demonstrates these risks, impacts and decision types are 'Broadly Acceptable' if they meet legislative requirements, industry codes and standards, applicable company requirements and industry guidelines. Further effort towards risk reduction (beyond using opportunistic measures) is not reasonably practicable without sacrifices that are grossly disproportionate to the benefit gained.		
High, Very High or Severe	**Moderate and above (A, B, C)**	**B and C**
Woodside demonstrates these higher order risks, impacts and decision types are 'Acceptable' if it can be demonstrated that the predicted levels of impact and/or residual risk, are: • at or below the defined acceptable level(s) for that impact or risk, and • managed to ALARP (as described in Section 2.7.1). Acceptable levels are defined appropriate to the nature and scale of each impact and risk and in consideration of the following criteria: • the Principles of Ecological Sustainable Development as defined under the EPBC Act • the internal context – the proposed controls and consequence/risk level are consistent with Woodside policies, procedures and standards • the external context – consideration of the environment consequence (**Section 6**) and stakeholder acceptability (**Section 5**) are considered • other requirements – the proposed controls and consequence/risk level are consistent with national and international industry standards, laws and policies ad consideration of applicable plans for management and conservation advices, conventions and significant impact guidelines (e.g. MNES). Once acceptable levels have been defined, a statement of acceptability is made to summarise how a given impact/residual risk will be managed to at or below these levels and appropriate EPOs which are linked to these acceptable levels are established. For potential C or above consequence/impact levels where significant uncertainty exists in analysis of the risk or impact (such as, for predicted or potential high risk of significant environmental impacts, significant project risk/exposure, novel activities, lack of consensus on standards, and significant stakeholder concerns. E.g. Decision Type C), defined acceptable levels and assessment of acceptability may be required to be conducted separately for key receptors. Additionally, Very High and Severe risks require 'Escalated Investigation' and mitigation. If after further investigation the risk remains in the Very High or Severe category, the risk requires appropriate business engagement with		

Risk	Impact	Decision Type
increasing involvement of senior management in accordance with Woodside's Risk Management Procedure to accept the risk. This includes due consideration of regulatory requirements.		

2.8 Environmental Performance Outcomes, Environmental Performance Standards, and Measurement Criteria

EPOs, EPSs and measurement criteria (MC) are defined to address the potential environmental impacts and risks. These are explored in **Section 6**.

2.9 Implement, Monitor, Review and Reporting

An implementation strategy for the Petroleum Activities Program describes the specific measures and arrangements to be implemented for the duration of the program. The strategy is based on the principles of AS/NZS ISO 14001 Environmental Management Systems, and demonstrates:

- control measures are effective in reducing the environmental impacts and risks of the Petroleum Activities Program to ALARP and Acceptable levels
- EPOs and EPSs set out in the EP are met through monitoring, recording, auditing, managing non-conformance, and reviewing
- all environmental impacts and risks of the Petroleum Activities Program are periodically reviewed in accordance with Woodside's risk management procedures
- roles and responsibilities are clearly defined, and personnel are competent and appropriately trained to implement the requirements set out in this EP, including in emergencies or potential emergencies
- arrangements are in place for oil pollution emergencies, to respond to and monitor impacts
- environmental reporting requirements are met, including 'reportable incidents'
- appropriate stakeholder consultation is undertaken throughout the activity.

The implementation strategy is presented in **Section 7**.

2.10 Stakeholder Consultation

A stakeholder assessment is undertaken to identify relevant people (as defined under Regulation 11A of the Environment Regulations) to whom an activity update is issued electronically; reasonable consultation periods are included. Further details and information are provided to any stakeholder if requested.

A summary and assessment of each stakeholder response is undertaken and a response, where appropriate, is provided by Woodside.

The stakeholder consultation, along with the process for ongoing engagement and consultation throughout the activity, is presented in **Section 5**. A copy of the full text correspondence with relevant people is provided in **Appendix F**.

3. DESCRIPTION OF THE ACTIVITY

3.1 Overview

This section has been prepared in accordance with Regulation 13(1) of the Environment Regulations and describes the activities to be undertaken as part of the Petroleum Activities Program under this EP.

3.2 Project Overview

The GWF-3 and LD Project (Petroleum Activities Program) consist of subsea tie-backs to the GWA and Angel facilities, respectively.

The GWF-3 Development is located within the Goodwyn Field (GDA) south-west of the GWA platform in 125 m water depth. The development lies within petroleum production licence WA-5-L.

The GWF-3 Development intends to develop incremental volumes from the Goodwyn GH reservoir via existing GWF-1 infrastructure, providing gas and condensate production to partially fill ullage in Karratha Gas Plant emerging from 2021. The development consists of three wells: GDA-03, GDA-04 and GDA-05, tied in via the existing GDA manifold which has four spare slots equipped with single isolations (**Figure 3-1**). Each well will be connected to the GDA manifold by a nominal eight-inch internal diameter (ID) flexible flowline and by an electro-hydraulic umbilical (EHU) which provides monoethylene glycol (MEG) and subsea control.

The LD Field lies in 130 m water depth and is located approximately 15 km north-west of the Angel Platform (80 m water depth). The field lies mainly within petroleum production licence WA-16-L with a minor extension into production licence WA-3-L.

The LD development consists of one well, LDA-01, connected to a new two-slot production manifold using an eight-inch ID flexible jumper. The manifold will then be connected to the Angel Platform via a nominal 10-inch ID flexible flowline and flexible riser utilising an existing 30-inch J-tube. A new EHU, installed via an existing 12-inch J-Tube, will provide MEG for well start-up and subsea control (**Figure 3-2**).

Wells will be drilled, completed and unloaded using a moored semi-submersible mobile offshore drilling unit (MODU). Typically, two or three support vessels will support the MODU during drilling activities, with at least one vessel in the vicinity to complete standby duties, if required. Supply vessels from Dampier Port will frequent the MODU at regular intervals throughout operations.

Installation of the subsea infrastructure, including flowlines, umbilicals, manifold, mattresses, flying leads and pre-commissioning are undertaken using a primary installation vessel (PIV) such as the *Deep Orient (see* **Table 3-5***)*. Another installation vessel, similar to vessels used for Inspection, Maintenance and Repair (IMR), may be used to install the xmas trees. Support vessels associated with subsea installation activities may transit between the Operational Area (see **Section 3.3.1**) and port.

The scope for this EP covers drilling, completion and subsea installation along with pre-commissioning. Activities starting from hot-commissioning are outside the scope of this EP and are covered in the relevant operations EP. An overview of the Petroleum Activities Program is provided in **Table 3-1.**

Figure 3-1: Generalised schematic of Greater Western Flank 3 development

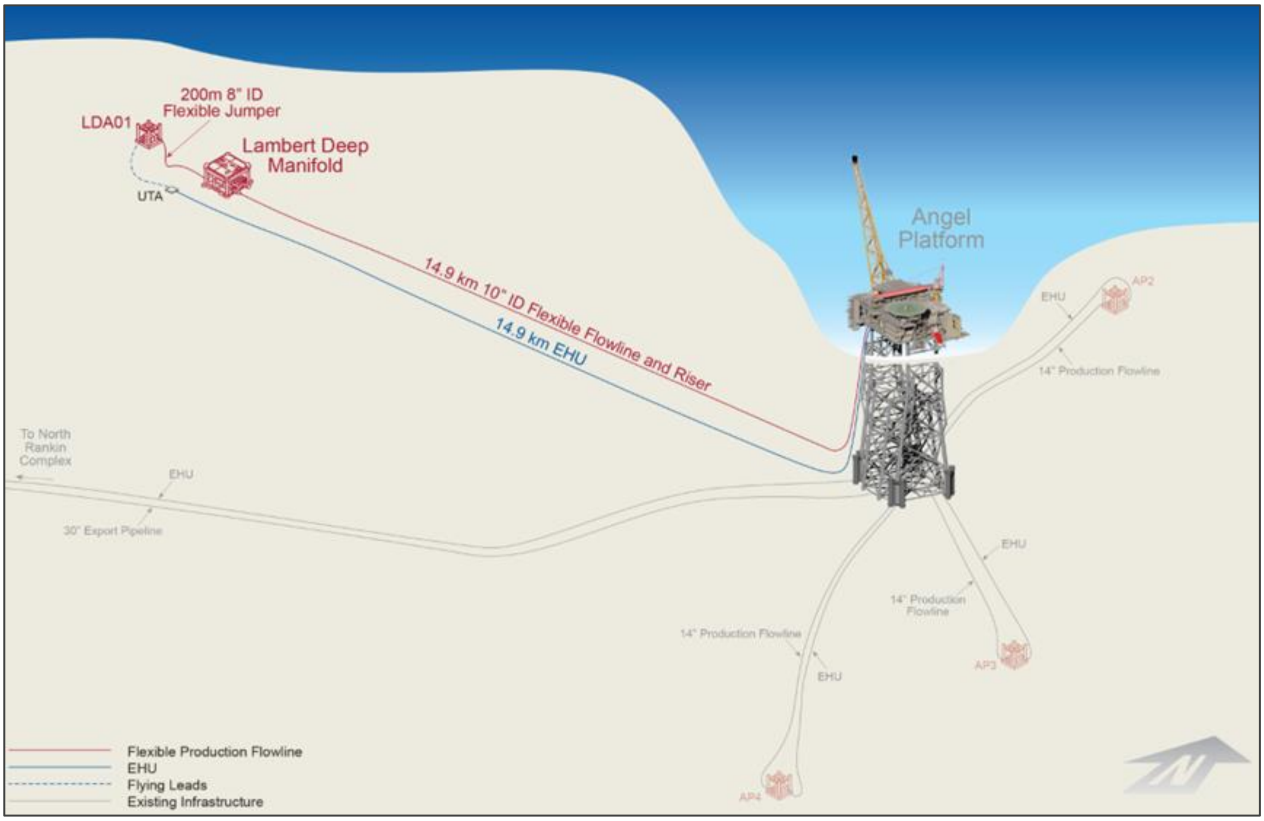


Figure 3-2: Generalised schematic of Lambert Deep development

Table 3-1: Petroleum Activities Program overview

Item	Description
Permit Area	GWF-3: WA-5-L LD: WA-16-L (*LDA-01 and flowline*) and WA-3-L (*flowline*)
Location	North West Shelf
Water depth	GWF-3: Approximately 125 m LD: Approximately 80 m (*Angel facility tie-in*) – 130 m (*LDA-01*)
Number of wells	GWF-3: Three production wells (GDA-03, GDA-04 and GDA-05) LD: One production well (LDA-01)
Subsea infrastructure	***GWF-3 development*** • existing GDA manifold (previously installed during GWF-1) • three subsea xmas trees and wellheads • three 8” ID flexible flowlines (approximately 1.2 km, 1.6 km and 2.9 km long) connecting trees to spare GDA manifold slots • tie-in of flexible flowlines at trees and GDA manifold using UCON diverless connectors • three EHU terminated with UTAs at each end (approximately 1.2 km, 1.6 km and 2.9 km long) • interconnecting HFLs and EFLs to provide hydraulic / electrical controls and MEG to the xmas trees • crossings at GDA manifold using concrete mattresses • concrete mattresses for flowline/umbilical stabilisation. ***LD development*** • one production manifold • one subsea xmas tree and wellhead • 10” ID flexible flowline approximately 14.9 km long between manifold and Angel Platform • 8” ID flexible jumper approximately 200 m long between manifold and tree • tie-in of flexible flowline and jumper at tree and manifold using UCON diverless connectors • EHU approximately 14.9 km long between tree (terminated with UTA) and Angel Platform • interconnecting HFLs and EFLs, to provide hydraulic / electrical controls and MEG to the tree • flowline and umbilical pulled in at Angel Platform using spare J-tubes and hung-off topsides • J-tube seals where the umbilical and flowline enter the J-tubes at Angel Platform • crossings of existing subsea infrastructure at Angel Platform using concrete mattresses • concrete mattresses for flowline/umbilical stabilisation.
MODU	A semi-submersible moored MODU will be used for drilling of the wells, and may also be used for activities such as xmas tree installation where required operationally.
Vessels	• PIV for installing the subsea infrastructure • IMR vessel for xmas tree installation, isolation testing or contingent activities • support vessels including barge(s), heavy lift vessel(s) (HLVs), multi-service construction vessel(s), anchor handling vessel(s) and general supply/support vessels.
Key activities	• mooring installation for the MODU • development drilling, completions and unloading, via MODU • prelay survey for flexible flowlines • installation of flowlines, umbilicals, LD production manifold, subsea trees, concrete mattresses, UTAs, HFLs and, EFLs • tie-in to existing subsea infrastructure • J-tube pull-ins and tie in at the Angel Platform

Item	Description
	• pre-commissioning of the new subsea infrastructure, including dewatering of the LD flexible flowline • contingent intervention, workover, or re-drill for existing wells and new wells

3.3 Location

The Petroleum Activities Program is located in Permit Areas WA-5-L (GWF-3), WA-16-L and WA-3-L (LD) in Commonwealth waters approximately 128 km north-north-west of Dampier. The closest landfall to the Petroleum Activities Program is the Montebello Islands, which are approximately 74 km south-east of the Operational Area at their closest point. Glomar Shoal is 1 km south-east of the LD Operational Area and Rankin Bank is 19 km west of the GWF-3 Operational Area, at their closest points. Approximate location details for the Petroleum Activities Program are provided in **Table 3-2** with connections via subsea infrastructure (e.g. flowlines, umbilicals etc.). Proposed infrastructure locations are subject to refinement during detailed engineering but will be within the defined Operational Area (**Section 3.3.1**).

Table 3-2: Approximate location details for the Petroleum Activities Program

Activity	Water Depth (Approx. m LAT)	Latitude[2]	Longitude
New wells			
LDA-01 well	130	19° 26' 07.220" S	116° 28' 51.314" E
GDA-03 well	125	19° 43' 04.890" S	115° 51' 58.911" E
GDA-04 well	125	19° 42' 35.697" S	115° 53' 14.475" E
GDA-05 well	125	19° 43' 15.968" S	115° 51' 10.743" E
Subsea infrastructure			
LDA manifold[1]	130	19° 26' 15.029" S	116° 29' 28.721" E
Existing subsea infrastructure			
Angel Platform	80	19° 29' 55.144" S	116° 35' 53.066" E
GDA Manifold	127	19° 42' 24.795" S	115° 52' 32.722" E

[1]*The location of the LDA Manifold is approximate and subject to construction related optimisation.*
[2]*Datum: GDA94 MGA50*

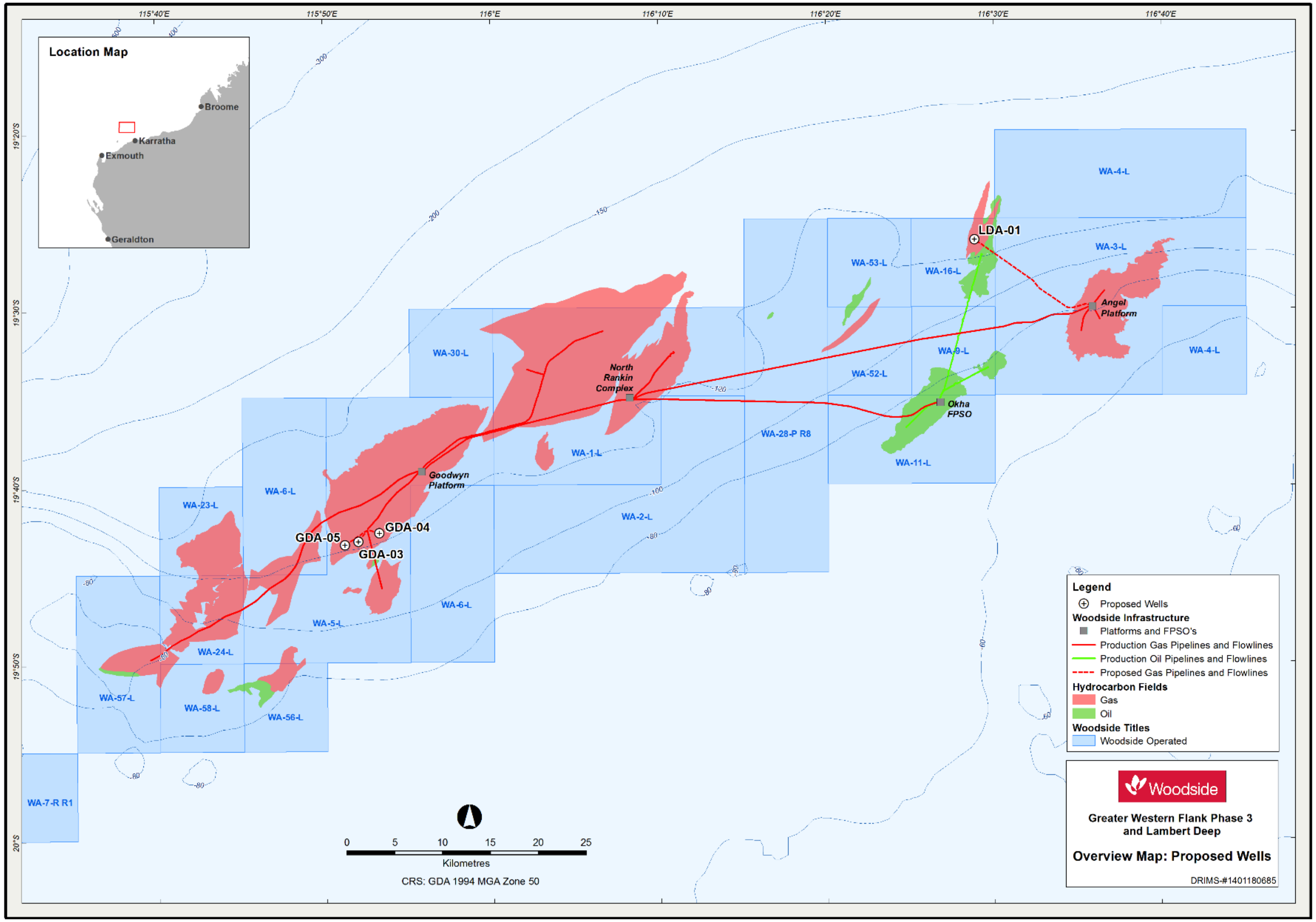


Figure 3-3: Location of the Greater Western Flank 3 and Lambert Deep fields within the North West Shelf area

3.3.1 Operational Area

The Operational Area (**Figure 3-4** and **Figure 3-5**) defines the spatial boundary of the Petroleum Activities Program, as described, risk assessed and managed by this EP, including vessel-related petroleum activities within the Operational Area.

For the purposes of this EP, the following Operational Areas will apply, which are collectively referred to as a single Operational Area[4]:

- GWF-3 Operational Area is a radius of 4000 m from each well centre which encompasses subsea infrastructure.
- LD Operational Area is a radius of:
  - 4000 m from the LDA01 well centre
  - 1500 m (3000 m corridor) around subsea infrastructure.

MODU mooring operations (if required), drilling, installation of subsea infrastructure (including flowlines), pre-commissioning and related petroleum activities will take place within the Operational Areas and are managed under this EP.

The 4000 m (radius) Operational Area allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel-related petroleum activities. The Operational Area for drilling activities includes a 500 m petroleum safety zone (PSZ) around the MODU to manage vessel movements. The 1500 m (radius) Operational Area around subsea installation activities allows for the movement and positioning of large vessels.

[4] Vessels supporting the Petroleum Activities Program operating outside of the Operational Area (e.g. transitioning to and from port) are subject to all applicable maritime regulations and other requirements, which are not managed under this EP.

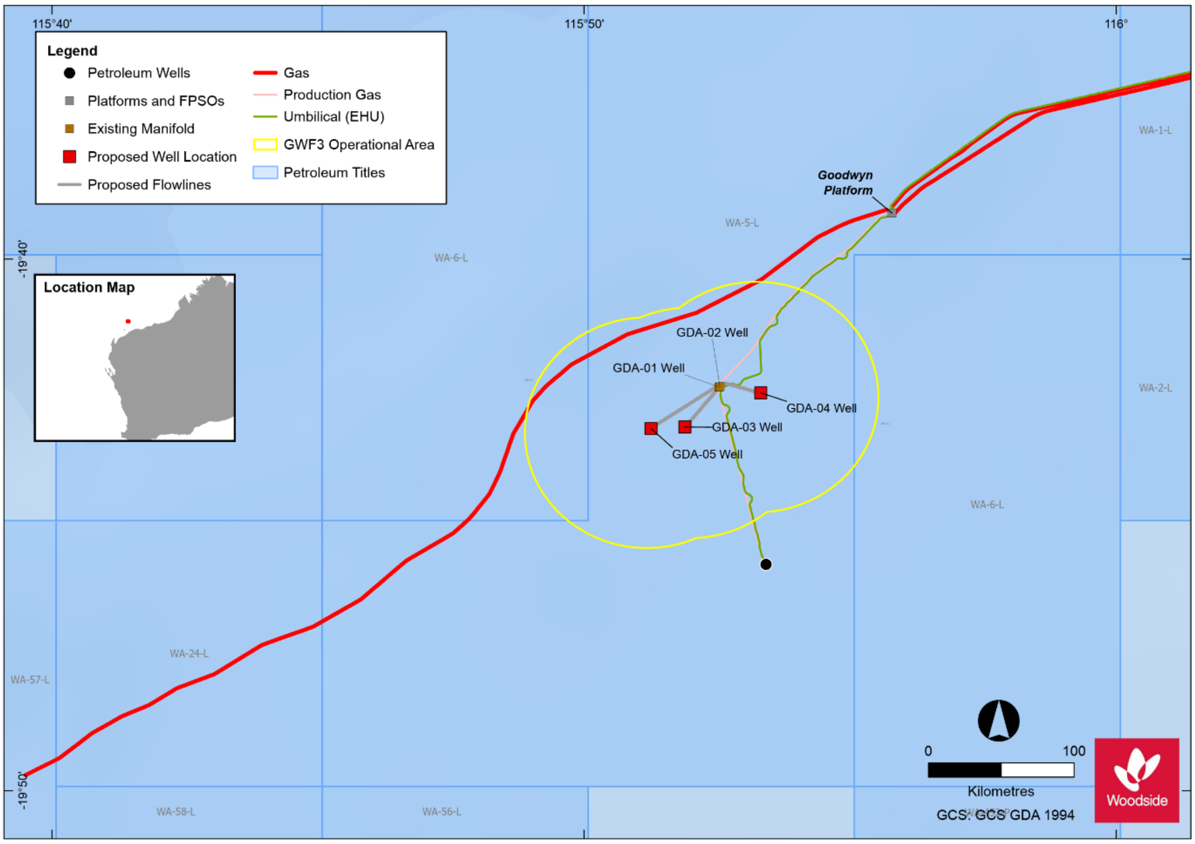


Figure 3-4: Greater Western Flank 3 Operational Area

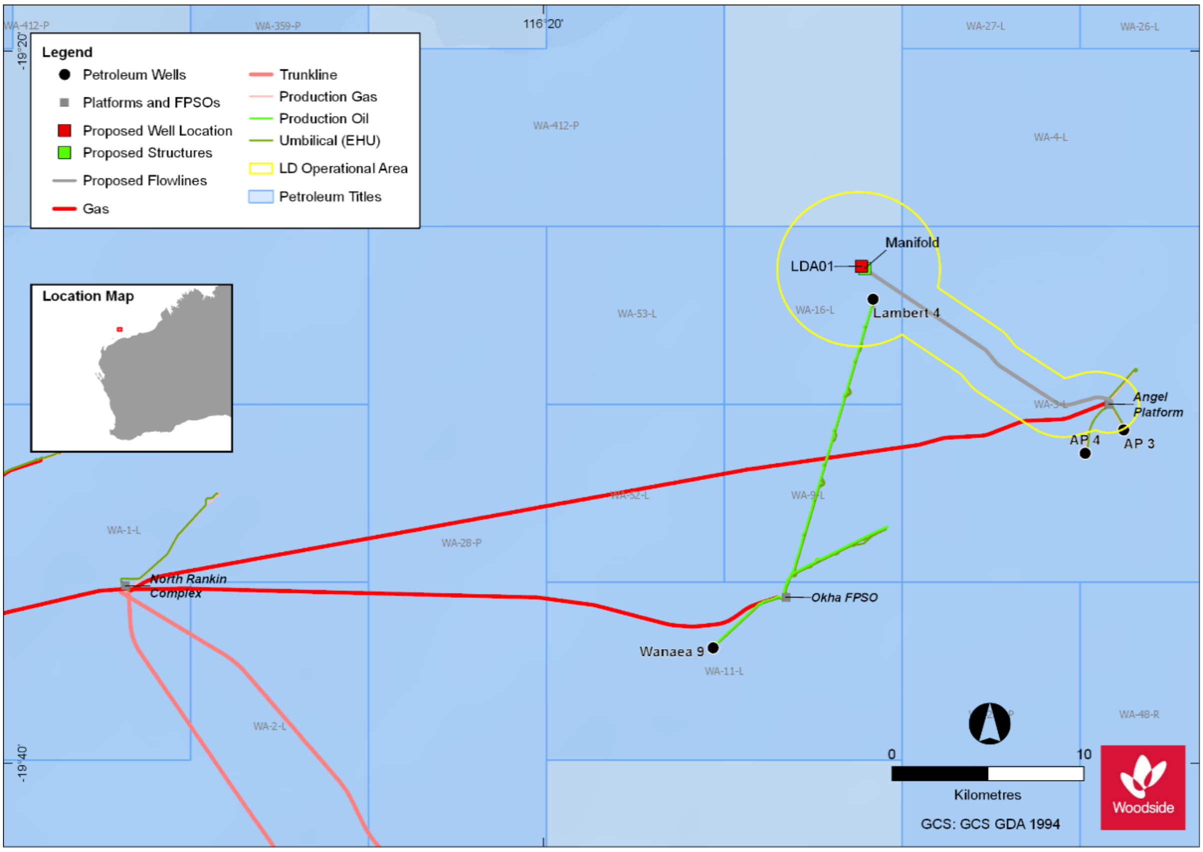


Figure 3-5: Lambert Deep Operational Area

3.4 Timing

The Petroleum Activities Program is planned to commence in Q2 2021 with the drilling of the LD (LDA01) well and the three GWF-3 Wells (GDA03, GDA04, GDA05) and related subsea installation (Table 3-3).

Drilling operations for the four production wells are expected to take about 70 days per well to complete, including mobilisation, demobilisation and contingency. Installation of subsea infrastructure and pre-commissioning is anticipated to commence when the relevant wells have been drilled and is expected to have a cumulative duration of about 100 days (including mobilisation, demobilisation and contingency). Drilling and installation of subsea infrastructure may be performed over multiple campaigns.

When underway, activities are 24 hours per day, seven days per week. There are no planned concurrent drilling activities under the EP. Simultaneous Operations (SIMOPS) activities with subsea installation may occur. Timing and duration of all activities is subject to change due to project schedule requirements, MODU/vessel availability, unforeseen circumstances and weather.

The EP has risk-assessed drilling activities, subsea infrastructure installation, pre-commissioning activities and intervention, workover, or re-drilling activities throughout the year (all seasons) to provide operational flexibility for requirements and schedule changes and vessel/MODU availability. The timeframes are therefore subject to change within the defined calendar years and, as no particular windows have been nominated for avoidance based on environmental and/or stakeholder sensitivities, changes to the above will not be interpreted as ‘new stages’ against Regulation 17(5).

Table 3-3: Summary of timing for the Petroleum Activities Program

Activity	Approximate timing (and cumulative duration in the field*)
Installation of anchors for MODU	Q2 2021
Drilling and completions	2021-2022 (~280 days over multiple campaigns) 2023 (contingency)
Subsea installation	2022 (~100 days over multiple campaigns) 2023 (contingency)

3.5 Project Vessels

Several vessel types will be required to complete the activities associated with the Petroleum Activities Program. These are discussed in further detail in the following section and may include:

- semi-submersible moored MODU
- primary installation vessel (PIV)
- installation vessel (IMR-type vessel)
- support vessels, including but not limited to:
  - anchor handling vessels (AHVs) required to set anchors and support the MODU during operations
  - HLVs for providing floating storage facilities to the installation vessel
  - activity support vessels for transportation of hardware from port/staging area to the Operational Area and installation vessels, and for general re-supply and support for the MODU and the installation vessels.

Description and assessment of project vessel (PIV, IMR type vessel and support vessels) environmental impacts and risks, credible spill scenarios and environmental sensitivities for the activities within the scope of this EP are included in **Section 4**. For power generation, vessels may use diesel-powered generators and/or LNG.

3.5.1 MODU

The Petroleum Activities Program will be drilled by the *Ocean Apex* MODU or similar. Due to variabilities, such as supply chain interruption, contractual and operational matters, a second MODU may be used to complete some of the work scope. If this occurs, a MODU meeting the required technical specifications and with similar specifications as listed in **Table 3-4** will be utilised.

Table 3-4: Typical moored MODU specification ranges for the Ocean Apex

Component	Specification Range
Rig type/design/class	Semi-submersible MODU
Accommodation	120 to 200 personnel (maximum persons on board)
Station keeping	Minimum eight-point mooring system
Bulk mud and cement storage capacity	283 to 770 m^3
Liquid mud storage capacity	576 to 2500 m^3
Fuel oil storage capacity	966 to 1400 m^3
Drill water storage capacity	3500 m^3

3.5.2 Primary Installation Vessel (PIV)

The Petroleum Activities Program subsea and flowline installation scopes of work will require a vessel, with sufficient capacity to accommodate hardware and equipment such as flexible flowlines, flexible jumpers, umbilicals and the pre-commissioning/dewatering spreads.

A typical PIV for subsea and flowline installation would be a Dynamic Positioning (DP) vessel (usually DP2 Class) equipped with a primary differential global surface positioning system (DGPS) and an independent secondary DGPS backup. The specification of a typical PIV (*Deep Orient*) is provided in **Table 3-5**.

PIVs are typically equipped with various material handling equipment, which includes cranes, winches, remotely operated vehicles (ROVs) and ROV launch and recovery systems, vertical lay system (VLS) with either vertical reel drive or horizontal reel drive (carousel) and pre-commissioning spread.

Lifting operations may involve loading and unloading equipment from support and supply vessels onto the PIV and subsequently onto the seabed. Cranes are typically equipped with active heave compensation and auto tension modes, and have lifting capacities in excess of lifting loads expected to be encountered during operations.

Table 3-5: Typical DP2 Class subsea PIV for the *Deep Orient*

Component	Specification Range
Vessel Type	DP2 Class as a minimum
Crane Capacity	200 T active heave compensation crane (typical)
ROVs	Two Work Class ROVs
Deck Space	Approximately 1900 m^2
Deck Strength	Approximately 15 T/m^2
Accommodation	Approximately 120 people

Component	Specification Range
Fuel Oil	Approximately 2200 m^3
Potable Water	Approximately 800 m^3

3.5.3 Installation Vessel (IMR-Type Vessel)

During the Petroleum Activities Program, a subsea installation (IMR Type Vessel) vessel is an option for subsea installation (e.g. subsea xmas trees), isolation testing and other activities. An example of this vessel type is the *Fugro Etive*, which is a 93m long subsea support vessel equipped with two Work Class ROVs, a helideck, moon pool and accommodation for 100 persons. The final vessel selection, if required, will be subject to commercial and/or operational considerations.

3.5.4 Support and Other Vessels

During the Petroleum Activities Program, the MODU and installation vessels will be supported by other vessels, such as general support vessel(s), cargo vessel(s), anchor handling vessel(s), barges, multiservice construction and HLVs. During the installation campaign, there may potentially be two HLVs and two platform supply vessels for field support and floating storage facilities.

Support vessels are used to transport equipment and materials between the MODU/installation vessel and port (e.g. Dampier, Onslow, Exmouth). If required, one of the vessels may be at the MODU to perform standby duties, and others will make regular trips between the Operational Area and port for routine, non-routine and emergency operations.

Support vessels do not anchor within the Operational Area during the activities due to water depth.

3.5.5 Vessel Mobilisation

Vessels may mobilise from the nearest Australian port or directly from international waters to the Operational Area, in accordance with biosecurity and marine assurance requirements.

3.6 Other Support

3.6.1 Remotely Operated Vehicles

The MODU and project vessels may be equipped with an ROV system that is maintained and operated by a specialised contractor aboard the vessel. ROVs may be used during drilling operations and subsea installation, for activities such as:

- anchor holding testing
- pre-drill seabed and hazard survey
- blowout preventer (BOP) land-out and recovery
- BOP well control contingency
- visual observations at seabed during riserless drilling operation
- pre and post installation survey
- subsea xmas tree control systems hook-up and contingency control
- removal of sediments on or around subsea infrastructure
- installation, testing and pre-commissioning of subsea infrastructure.

An ROV can be fitted with various tools and camera systems that can be used to capture permanent records (both still images and video) of the operations and immediate surrounding environment.

Specifically, during installation, the ROV is fitted with hydraulically driven tools to facilitate flowline tie-in.

An ROV may also be used in the event of an incident to deploy the Subsea First Response Toolkit. This is discussed further in **Appendix D**.

3.6.2 Helicopters

During the Petroleum Activities Program, crew changes may be performed using helicopters. Helicopter operations within the Operational Area are limited to helicopter take-off and landing on the helideck. Helicopters may be refuelled on the helideck. This activity will take place within the Operational Area and has been included in the risk assessment for this EP.

3.7 Project Vessel-based Activities

3.7.1 Holding Station: Mooring Installation and Anchor Hold Testing/Soil Analysis

Mooring uses a system of chains/ropes and anchors, which may be pre-laid before the MODU arrives at the location, to maintain position when drilling. Mooring analysis will be undertaken to determine the appropriate mooring system for the Petroleum Activities Program. The mooring analysis will identify whether the mooring systems are pre-laid or set by the rig, proof tension values, and if synthetic fibre mooring ropes are required. Pre-laid systems are often selected and designed to withstand higher sea states than the rig's mooring system when deemed necessary in the mooring analysis.

Installation and proof tensioning of anchors involves some disturbance to the seabed. AHVs are used in the deployment and recovery of the mooring system.

As part of mooring preparations, anchor hold testing may be conducted at the well locations. Anchor hold testing would be undertaken if Woodside determines that further assurance is required to ensure a robust mooring design.

Anchor hold testing may consist of an AHV or similar vessel deploying an anchor at a potential mooring location. The AHV would then tension the anchor to determine its ability to hold, embed and not drag at location. This may have to be repeated several times at each location. An ROV may also be utilised to evaluate how deep the anchor has embedded and independently verify the seabed condition. Anchor hold testing activities would occur prior to the MODU arriving on location.

Soil analysis may also be necessary to provide data on composition and rock/substrate strength as input into the mooring design and to verify seabed conditions for anchor holding. Soil analysis could include taking a physical sample of the seabed using ROV or other tools, or using measuring devices such as a cone penetrometer. These tests would be carried out up to several months prior to MODU arriving on location, and may occur from a support vessel or anchor handling vessel.

Suction piling may be required as a contingent activity and will be reviewed with the MODU contractor.

3.7.2 MODU and Support Vessel Activities

A variety of materials are routinely bulk transferred from support vessels to the MODU including drilling fluids (e.g. muds), base fluids, cements, and drill water. A range of dedicated bulk transfer stations and equipment are in place to accommodate the bulk transfer of each type of material. There is also a capacity to bulk transfer waste oil from the MODU to the support vessel, for back-loading and disposal on shore.

The loading and back-loading of equipment, materials and wastes is one of the most common supporting activities conducted during drilling programs. Loading and back-loading is undertaken using cranes on the MODU to lift materials in appropriate offshore rated containers (e.g. ISO tanks, skip bins, containers) between the MODU and support vessel.

Seawater is pumped on board and used as a heat exchange medium for the cooling of machinery engines and high temperature drilling fluid on the MODU. It is subsequently discharged from the MODU to the sea surface at potentially a higher temperature. Alternatively, MODUs may utilise closed-loop cooling systems.

Potable water, primarily for accommodation and associated domestic areas, may be generated on vessels using a reverse osmosis (RO) plant. This process will produce brine, which is diluted and discharged at the sea surface.

The MODU and support vessels will also discharge deck drainage from open drainage areas, bilge water from closed drainage areas, putrescible waste and treated sewage and grey water. Solid hazardous and non-hazardous wastes generated during the Petroleum Activities Program are disposed of onshore by support vessels.

3.7.3 Subsea Installation and Support Vessel Activities

The installation vessels may be used for various activities such as pre and post installation survey, installation of subsea structures, installation of subsea infrastructure (e.g. manifold), installation of flexible flowlines and EHUs, installation of interconnecting HFLs/EFLs, tie-in to existing infrastructure, and pre-commissioning activities.

To support the installation vessels' activities, HLVs will store equipment and hardware for direct loading/offloading to the installation vessel. Other support vessels may also be used to transport equipment, hardware from shore to vessels in the field and MEG from shore or HLV to the installation vessels.

3.7.4 Refuelling

The MODU may be refuelled via support vessels approximately once a month, or as required. This activity will take place within the Operational Area of the well being drilled at the time and has been included in the risk assessment for this EP. Other fuel transfers that may occur on board the MODU include refuelling of cranes, helicopters or other equipment as required.

The installation vessel is expected to be in the field for relatively short durations and therefore may not require refuelling whilst in the field. However, this activity has been included in the risk assessment for this EP.

3.8 Drilling Activities

Well construction activities are conducted in a number of stages, as described below. Well designs will be optimised for ultimate recovery.

Detailed well designs will be submitted to the Well Integrity department of NOPSEMA as part of the Approval to Drill and the accepted Well Operation Management Plan (WOMP), as required under the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011.

3.8.1 Cement Unit Test

Upon arrival on location at the Operational Area, the MODU may need to perform a cement unit test, or 'dummy cement job', to test the functionality of the cement unit and the MODU's bulk cement delivery system before performing an actual cement job. This operation is usually performed after a MODU has been out of operation for an amount of time (warm-stack), if maintenance on the cement unit has been performed, or if it is the first time a MODU is being used in-country and commissioning of the cement unit system is required.

A 'dummy cement job' involves mixing a sacrificial cement slurry at surface which is discharged through the usual cement unit discharge line (which may be up to 10 m above the sea level) or through drill pipe below sea level, and occurs as a cement slurry. The slurry is usually a mix of cement and water; however, it may sometimes contain stabilisers or additives.

3.8.2 Top Hole Section Drilling

Petroleum Activities Program drilling commences with the top hole section as follows:

- The MODU arrives and establishes position over the well site.
- A pilot hole or holes may be drilled close to the intended well location. Pilot holes are used when geology and shallow hazards need to be confirmed or further understanding of the structural integrity of the rock is required. Pilot holes are drilled riserless, as described below, and result in additional cuttings, sweeps and potentially mud deposition to seabed.
- Top hole sections are drilled riserless using seawater with pre-hydrated bentonite sweeps/XC Polymer sweeps or drilling fluids to circulate drilled cuttings from the wellbore; these are deposited to the seabed.
- Once the top hole sections of the well have been drilled, steel tubulars (called conductor or casing) are inserted into the wellbore to form the conductor/surface/intermediate casing, and secured in place by pumping cement into the annular space back to about 300 m above the casing shoe or to surface (seabed), which involves discharging excess cement at the seabed.
- At some well locations, top hole sections may be batch drilled. Batch drilling is where one (or more) hole sections are completed for a group of wells before the subsequent sections are commenced.

3.8.3 Blowout Preventer and Marine Riser Installation

After setting the surface or intermediate casing, a blowout preventer (BOP) is installed on the wellhead, and the marine riser above it, to provide a physical connection between the well and MODU. This enables a closed circulation system to be maintained, where weighted drilling fluids and cuttings can be circulated from the wellbore back to the MODU, via the riser.

In addition, the BOP provides a means for sealing, controlling and monitoring the well during drilling operations. The BOP components operate with open hydraulic systems, using water-based BOP control fluids. Each time the BOP is operated (including pressure testing approximately every 21 days and a function test about every seven days, excluding the week a pressure test is conducted), the volume of BOP control fluid released to the marine environment is up to about 90 L per test.

Hydraulic fluid used for operating the BOP rams is subject to the chemical assessment process outlined in **Section 3.8.11**.

3.8.4 Bottom Hole Section Drilling

A closed system (riser in place), is used for drilling bottom hole sections to the planned wellbore Total Depth (TD). The preference is for bottom hole sections to be drilled using water-based mud (WBM) drilling fluids; however, non-water-based mud (NWBM) may be used (**Section 3.8.10**).

Protective steel tubulars (casings and liners) are inserted as required. The size, grade, weight, length and inclination of the casing/liner sections within the wellbore are determined by factors such as the geology/subterranean pressures likely to be encountered in the area and any specific information or resource development requirements.

After a string of casing/liner has been installed into the wellbore, it is cemented into place. The casing/liner is then pressure-tested. Once the pressure testing is passed, drilling of the next section can take place, with the riser in place to circulate drill cuttings and drilling fluids back to the MODU.

Cementing operations are also performed to:

- provide annular isolation between hole sections and structural support of the casing/liner as required
- set a plug in an existing well to sidetrack
- plug a well so it can be suspended/abandoned.

Cement is transported as dry bulk to the MODU by the support vessels, mixed as required by the cementing unit on the MODU and pumped by high pressure pumps to the surface cementing head then directed down the well.

Excess cement (dry bulk) after well operations are completed, will either be held onboard and used for subsequent wells, provided to the next operator at the end of the program, or discharged to the marine environment. Excess cement that does not meet technical requirements during the Petroleum Activities Program may also be bulk discharged to the environment. Bulk discharges of cement may occur as a slurry through the usual cement discharge line or blown as dry bulk and discharged.

3.8.5 Formation Evaluation

Formation evaluation is the interpretation of a combination of measurements taken inside a wellbore to detect and quantify hydrocarbon presence in the rock adjacent to the well once TD is reached. Formation Evaluation While Drilling (FEWD) is formation evaluation conducted via tools in the drilling bottom hole assembly. It may include extracting small cores, full diameter cores and other down-hole technologies, as required. FEWD tools are incorporated into the drill string during development drilling and may include gamma ray, directional deep resistivity, callipers, density-neutron, sonic, and tools which can measure formation pressures and take formation fluid samples. Some FEWD tools contain radioactive sources; however, no radioactive material will be released to the environment and radiation fields are not generally detectable outside the tool when the tool is not energised, therefore, they do not present an environmental risk.

3.8.6 Wellbore Clean Out

During construction, wells are often displaced from one fluid system to another. Various types of ‘displacement pills’ and ‘clean out trains’ may be circulated between the two fluid systems to facilitate efficient displacement and/or cleaning of the well. Displacement and clean out pills will typically be discharged after use. If there is potential for oil within any fluid, it will be captured, tested and discharged only if oil concentration is <1% by volume. It will be returned to shore if discharge requirements cannot be met. Displacement pills and clean out trains are typically between 5 m^3 and 100 m^3, depending on application.

3.8.7 Xmas Tree Installation/Tubing Head Spool Installation

Before the upper completion is installed into the wells, the xmas trees and/or flow base/tubing head are installed from an installation vessel (IMR Type) in SIMOPS with the MODU, or directly from the MODU. Due to the subsea well layout, if installation was to occur from the installation vessel, the MODU will be required to kedge off or reposition away from the drill centre to allow the installation vessel to install the xmas trees and flow base/tubing head. Once the xmas trees and/or flow base/tubing head have been installed, they are pressure-tested to confirm integrity before the MODU BOP is reconnected to continue with drilling and completions activities.

The xmas trees and flow bases/tubing heads are installed with a preservation mixture in the production and annulus bores.

3.8.8 Completions Activities

Once a well has been drilled, completion activities are undertaken including installation of the lower completion, intermediate completion, production tubing, and subsea tree. Throughout construction any safety critical element is tested for integrity. Following unloading, the well is suspended with a gas column and tested dual barriers in the subsea tree.

3.8.9 Well Unloading

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

The well test water treatment package is used to treat produced/reservoir water before discharge. Prior to discharging, the fluids are cycled through a water filtration system and gauge surge tanks. Water filtration is standard practice for well unloading operations. Fluids that cannot be treated or flared are sent onshore for disposal.

During well unloading it is expected that condensate, base oil and methanol will be flared. The flare may be extinguished due to water ingress, lack of fuel (propane), weather impact or equipment failure resulting in cold venting of gas from the flare for several minutes.

In the event that well unloading to the GWA or Angel Platforms is required, it will be managed in accordance with the GWA Facility Operations EP or Angel Operations EP respectively.

3.8.10 Drilling Fluid System

3.8.10.1 Water-based Mud System

A water-based drilling fluid system is the preferred option for the Petroleum Activities Program.

In addition to the base fluid, drilling muds contain a variety of chemicals, incorporated into the selected drilling fluid system to meet specific technical requirements (e.g. mud weight required to manage pressure, or for borehole stability). The WBM drilling fluid will either be mixed on the MODU or received pre-mixed, then stored and maintained aboard the MODU. The top hole sections are drilled riserless with seawater containing pre-hydrated gel sweeps. The bottom hole sections may be drilled using WBM in a closed circulation system which enables reuse of the WBM drilling fluids.

WBM drilling fluids that cannot be reused (e.g. due to bacterial deterioration or if they do not meet required drilling fluid properties) or are mixed in excess of required volumes, may be operationally discharged to the ocean under the MODU's Permit to Work (PTW) system.

3.8.10.2 Non-water-based Mud System

The decision to use NWBM drilling fluids for the bottom hole sections of a particular well is based on a variety of technical factors relevant to wellbore conditions, such as well temperature, well shape and depth, reactivity of the formation to water, and well friction. The technical justification to use NWBM includes environment, health, safety and waste management considerations.

The use of NWBM drilling fluids is subject to a formal written commercial and/or technical justification approved in accordance with the Best Practice – Overburden Drilling Fluids Environmental Requirements. The main ingredient of NWBM is base oil, and a range of standard solid and liquid additives may be added in the pits to alter specific mud properties for each section of the well, dependent on the conditions encountered while drilling.

The NWBM drilling fluid is primarily mixed onshore (new or reuse of existing stock) and transferred to the MODU by a support vessel, where it is stored and maintained in the mud pits. During drilling operations, the NWBM drilling fluid, like the WBM, is pumped by high pressure pumps down the drill string and out through the drill bit, returning via the annulus between the drill string and the casing back to the MODU via the riser.

The used NWBM pumped back to the MODU contains drill cuttings and is pumped to the solids control equipment (SCE), where the drill cuttings are removed (see **Section 3.8.10.4**). The NWBM is then pumped back to the pits ready for reuse. The technical properties of the NWBM drilling fluids are maintained/altered (e.g. to increase weight) using additives as required when in the mud pits.

The NWBM drilling fluids that cannot be re-used (i.e. do not meet required drilling fluid properties or are mixed in excess of required volumes) are recovered from the mud pits and returned to the shore base for onshore processing, recycling and/or disposal. Wash water associated with the cleaning of mud pits and associated equipment/infrastructure, when NWBM is no longer required, is discharged or returned to shore for disposal if discharge criteria cannot be achieved (refer to Mud Pits section below - **Section 3.8.10.3**).

3.8.10.3 Mud Pits

There are typically a number of mud pits (tanks) on the MODU that provide a capacity to mix, maintain and store fluids required for drilling activities. The mud pits form part of the drilling fluid circulating system. The mud pits and associated equipment/infrastructure are cleaned out at the end of drilling and completions operations. Mud pit wash residue is discharged overboard with less than 1% oil contamination by volume. Mud pit residue over 1% oil volume is sent to shore for disposal.

3.8.10.4 Drill Cuttings

Drill cuttings generated from the well are expected to range from very fine to very coarse (<1 cm) particle/sediment sizes. Cuttings generated during drilling of the top hole sections are discharged at the seabed. Estimated volumes of drill cuttings that may be discharged during the Petroleum Activities Program are presented in **Table 6-4**.

The bottom hole sections are drilled with a marine riser that enables cuttings and drilling fluid to be circulated back to the MODU, where the cuttings are separated from the drilling fluids by the SCE. The SCE comprises, but is not limited to shale shakers, cuttings dryers and centrifuges. The SCE uses shale shakers to remove coarse cuttings from the drilling mud. After being processed by the shale shakers, the recovered mud from the cuttings may be directed to centrifuges, which are used to remove fine solids (4.5 to 6 µm). The cuttings are usually discharged below the water line and the mud is recirculated into the fluid system.

If NWBMs are needed to drill a well section, the cuttings which are separated from the NWBM via the shakers will also pass through a cuttings dryer and associated SCE to reduce the average oil on cuttings for the entire well (only sections using NWBM) to 6.9% wt or less on wet cuttings prior to discharge.

3.8.11 Assessment of Project Fluids

All chemicals that may be operationally released or discharged to the marine environment by the Petroleum Activities Program are evaluated using a defined framework and set of tools to ensure the potential impacts are acceptable, ALARP and meet Woodside's expectation for environmental performance. All approved drilling and completion chemicals are included on the Drilling and Completions – Master Chemical List which is reviewed during a six-month chemical review to drive continuous environmental improvement.

The chemical assessment process follows the principles outlined in the Offshore Chemical Notification Scheme (OCNS) which manages chemical use and discharge in the United Kingdom (UK) and the Netherlands. It applies the requirements of the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention). The OSPAR Convention is widely accepted as best practice for chemical management.

All chemical substances on the OCNS ranked list of registered products have an assigned ranking based on toxicity and other relevant parameters, such as biodegradation and bioaccumulation, in accordance with one of two schemes (as shown in **Figure 3-6**):

- Hazard Quotient (HQ) Colour Band: Gold, Silver, White, Blue, Orange or Purple (listed in order of increasing environmental hazard).
- OCNS Grouping: E, D, C, B or A (listed in order of increasing environmental hazard). Used for inorganic substances, hydraulic fluids and pipeline chemicals only.

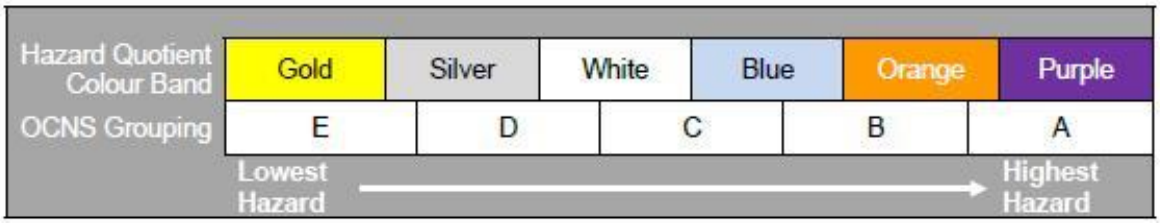


Figure 3-6: OCNS ranking scheme

Chemicals fall into the following assessment types:

- No further assessment: Chemicals with an HQ band of Gold or Silver or an OCNS ranking of E or D with no substitution or product warnings do not require further assessment. Such chemicals do not represent a significant impact on the environment under standard use scenarios and are therefore considered ALARP and acceptable.
- Further assessment/ALARP justification required: The following types of chemicals require further assessment to understand the environmental impacts of discharge into the marine environment:
  - chemicals with no OCNS ranking
  - chemicals with an HQ band of White, Blue, Orange or Purple or an OCNS ranking of A, B or C
  - chemicals with an OCNS product or substitution warning.

This includes assessing the ecotoxicity, biodegradation and bioaccumulation of the chemicals in the marine environment in accordance with the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) Hazard assessment and the Department of Mines and Petroleum (DMP) Chemical Assessment Guide: Environmental Risk Assessment of Chemicals used in WA Petroleum Activities Guideline.

3.8.11.1 Ecotoxicity

Chemical ecotoxicity is assessed using the criteria used by CEFAS to group chemicals based on ecotoxicity results (**Table 3-6**). If a chemical has an aquatic or sediment toxicity within the criteria for the OCNS grouping of D or E, this is considered acceptable in terms of ecotoxicity.

Table 3-6: CEFAS OCNS grouping based on ecotoxicity results

Initial Grouping	A	B	C	D	E
Results for aquatic-toxicity data (ppm)	<1	>1-10	>10-100	>100-1000	>1000
Results for sediment toxicity data (ppm)	<10	>10-100	>100-1000	>1000-10,000	>10,000

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

3.8.11.2 Biodegradation

The biodegradation of chemicals is assessed using the CEFAS biodegradation criteria, which align with the categorisation outlined in the DMP Chemical Assessment Guide: Environmental Risk Assessment of Chemicals used in WA Petroleum Activities Guideline.

CEFAS categorises biodegradation into the following groups:

- readily biodegradable: results of >60% biodegradation in 28 days to an OSPAR harmonised offshore chemical notification format (HOCNF) accepted ready biodegradation protocol
- inherently biodegradable: results >20% and <60% to an OSPAR HOCNF accepted ready biodegradation protocol or result of >20% by OSPAR accepted inherent biodegradation study
- not biodegradable: results from OSPAR HOCNF accepted biodegradation protocol or inherent biodegradation protocol are <20%, or half-life values derived from aquatic simulation test indicate persistence.

Chemicals with >60% biodegradation in 28 days to an OSPAR HOCNF accepted ready biodegradation protocol are considered acceptable in terms of biodegradation.

3.8.11.3 Bioaccumulation

The bioaccumulation of chemicals is assessed using the CEFAS bioaccumulation criteria, which align with the categorisation outlined in the DMP Chemical Assessment Guide: Environmental Risk Assessment of Chemicals used in WA Petroleum Activities Guideline.

The following guidance is used by CEFAS:

- non-bioaccumulative: Log Pow <3, or BCF ≤100 and molecular weight is ≥700
- bioaccumulative: Log Pow ≥3 or BC >100 and molecular weight is <700.

Chemicals that meet the non-bioaccumulative criteria are considered acceptable.

If a product has no specific ecotoxicity, biodegradation or bioaccumulation data available, the following options are considered:

- Environmental data for analogous products can be referred to where chemical ingredients and composition are largely identical.
- Environmental data may be referenced for each separate chemical ingredient (if known) within the product.

3.8.11.4 Alternatives

If no environmental data is available for a chemical or if the environmental data does not meet the acceptability criteria outlined above, potential alternatives for the chemical will be investigated, with preference for options with an HQ band of Gold or Silver, or OCNS Group E or D with no substitution or product warnings.

3.8.11.5 Decision

Once the further assessment/ALARP justification has been completed, the relevant environment adviser must concur that the environmental risk as a result of chemical use is ALARP and acceptable.

3.9 Subsea Installation and Pre-commissioning Activities

The subsea installation scope of work will include installing and pre-commissioning the infrastructure summarised in **Table 3-7**. The Petroleum Activities Program includes directly installing flowlines and infrastructure from the installation vessels in the relevant location. During hook-up and pre-commissioning of the new and existing facilities there is potential for discharges associated with the testing and connection activities of the subsea systems. The pre-commissioning associated with subsea infrastructure generally includes leak testing of the flexibles, subsea control systems verification and function-testing of valves to verify that the subsea umbilicals, electric and hydraulic flying leads are ready for entry into the commissioning phase.

There will also be discharge of the contents of the LD flexible flowline during the dewatering operation.

Table 3-7: Subsea installation component summary

Description	Detail	Dimensions (approx.) L × W × H
GWF-3 development		
Wells	Three xmas trees	5.0 x 4.0 x 4.0 m (typical)
Subsea flowlines	8" ID flexible flowline between GDA manifold and GDA-03 xmas tree 8" ID flexible flowline between GDA manifold and GDA-04 xmas tree 8" ID flexible flowline between GDA manifold and GDA-05 xmas tree	~ 1.6 km ~ 1.2 km ~ 2.9 km
Subsea control	Umbilical between GDA manifold and GDA-03 xmas tree Umbilical between GDA manifold and GDA-04 xmas tree Umbilical between GDA manifold and GDA-05 xmas tree Various EFLs c/w stabilisation sand bags Various HFLs c/w stabilisation sand bags	~ 1.6 km ~ 1.2 km ~ 2.9 km Up to ~ 200 m in length Up to ~ 150 m in length
Subsea structures	Six UTAs (two per umbilical) complete with mudmats	4.9 x 3.7 x 1.5 m (typical)
Mattresses	GWF-3 flowline crosses GWF-1 umbilical and flowlines at GDA manifold. Some crossings of new and existing flying leads. Flowline and umbilical stabilisation.	6.0 x 3.0 x 0.3 m
LD development		
Well	One Xmas tree	5.0 x 4.0 x 4.0 m (typical)
Subsea flowlines	10" ID flexible flowline between LDA manifold and Angel Platform 8" ID flexible jumper between LDA manifold and LDA-01 xmas tree	~ 14.9 km ~350 m
Subsea control	Umbilical between LDA-01 xmas tree and Angel Platform Various EFLs and HFLs c/w stabilisation sand bags	~ 14.9 km Up to ~ 200 m in length
Subsea structures	LDA manifold c/w mudmat One UTA complete with mudmat	11.3 x 11.3 x 5.6 m 4.9 x 3.7 x 1.5 m (typical)
Mattresses	Flowline and umbilical crosses existing umbilical and rigid flowline at the Angel Platform approach Flowline and umbilical stabilisation. Scour protection at LDA manifold	6.0 x 3.0 x 0.3 m 6.0 x 3.0 x 0.3 m

3.9.1 Existing Subsea Infrastructure

The main components of the existing subsea infrastructure include:

- GWF-3 development (existing infrastructure part of GWF-1):
  - GDA manifold
  - GDA-01 and 02 trees and rigid jumpers
  - GWF-1 umbilical, UTAs and HFLs/EFLs
  - GWF-1 pipeline.
- Lambert Deep development (existing infrastructure part of Angel):
  - 30" export pipeline
  - rigid infield flowlines

- rigid tie-in spools
- umbilicals
- subsea isolation valve (SSIV).

3.9.2 Underwater Acoustic Positioning

Long base line (LBL) transponders and/or Ultra Short Baseline transponders (USBL) are commonly used acoustic positioning methods and may be installed on the seabed as required by the installation activities. The USBL subsea transponder transmits an acoustic pulse back to the vessel receiver, hence providing an accurate positioning of the subsea transponder location. The LBL array provides accurate positioning by measuring ranges to three or more transponders deployed at known locations on the seabed and structures.

These transponders are utilised for the correct positioning of the subsea infrastructure. Transmissions are not continuous but consist of short ‘chirps’ with a duration that ranges from three to 40 milliseconds. If used, the LBL transponders are installed in stands on the seabed. Both the transponders and stands are recovered after installation. The USBL transponders are mounted on the subsea infrastructure (e.g. manifold) and removed post installation.

Transponders may also be installed in stands on the seabed for vessel positioning. Both transponders and stands shall be removed post installation.

3.9.3 Installation of Structures

The LDA manifold, UTA structures and mudmats are transported to the field/staging area by cargo vessel/HLV and then transferred by supply vessel to the PIV on site for installation. Alternatively the structures may be loaded onto the PIV during mobilisation or interim mobilisation. Structures are lowered to the seabed using the PIV’s main crane to a pre-determined depth before engaging the ROV to guide it to the correct position. The manifold and UTA may be installed with its associated mudmat or they may be installed separately.

As described above, the structures may be positioned using LBL array or USBL. Additional pre-deployed clump weights or sandbags can potentially be used to provide further assurance that the structures are positioned in the correct location and orientation.

3.9.4 Flowline Initiation/Initiation Anchor Deployment

Commencement of the flowline installation may require using an initiation anchor to pull against in order to provide the required tension to the flowline as it transitions from the PIV to the seabed. The initiation anchor, which will be recovered after use, may consist of a clump weight.

Installation aids such as sandbag markers or concrete mattresses may be used for positioning aids or wet storage as required.

3.9.5 General Flowline, EHU, HFL, EFL and Jumper Installation

The installation contractor will mobilise a PIV to the field to install the flowlines, jumpers, flying leads and EHU sections to the seabed. The PIV will operate in DP during installation activities.

Optimum flowline and umbilical routes are selected by considering seabed bathymetry, pre-installation surveys and installation risk management, including dropped object risks. Due to the water depth, both flowlines and EHUs will be installed using a vertical lay system.

The indicative installation methodology and principle applied when installing the flowline and EHU, is as follows:

1. Both flowline and EHU are reeled onto either horizontal or vertical reels.
2. VLS are installed on the vessel to lay both flowline and EHU.

3. During installation, a hydraulically-driven centre reel drive is engaged to the reel to rotate the reel in synchronised speed with the VLS.
4. Installation sequence for flowline is as follows, noting similar principle for the EHU, except that there is no midline connection:
   - prepare universal connection system and VLS onboard the vessel
   - fit applicable subsea components (anodes, bend restrictors) to flowline, perform tests and pre-deployment checks
   - deploy flowline, crane and connect ROV to tail end
   - continue flexible flowline lay as per lay route while monitoring touchdown with ROV
   - complete flowline reel change-over and midline connections when required until the total length of flowline has been laid to its connection point on the manifold
   - short flexible sections of flexible flowline and/or jumpers may be installed using a lighter installation spread on the installation vessel, via a deck-mounted powered reel system in combination with a deployment chute mounted on the side of the installation vessel and temporary installation aids placed on the seabed.

The HFLs and EFLs are configured into deployment basket(s) and landed on the seabed using a crane. ROVs will complete the final subsea tie-in. Jumper(s) are deployed and installed as per **Section 3.9.7**.

3.9.6 Span/Scouring Rectification and Stabilisation

Spans are undulations in the seabed that do not provide sufficient support to the flowline. Spans are generally mitigated by installing structures, such as concrete mattresses, before installing the flowline. Engineering validation will determine if concrete mattresses need to be installed to mitigate spans. The dimensions for each concrete mattress are typically 6 m by 3 m by 0.3 m.

Post-lay span rectification may also be required after flowline installation. This process typically involves placing grout bags under the span section. The empty bag is moved into position using ROV, then filled with grout supplied from a mixing and pumping spread on the vessel via a downline. Typical grout volumes depend on the size of the span and may vary from about 200 kg to 2000 kg per span.

If grout bags are used, the downline recovery time risks exceeding the grout curing time. If grout cures within the downline and pump, the equipment is likely to be rendered unserviceable, as well as the downline not being safely recoverable in the normal way. Therefore, after grouting activities at each span site, the downline and pump will need to be purged using seawater. This results in an amount of grout, approximately equivalent to the downline volume (5 m^3), being discharged to the ocean. This flushing is required once per grout site. The actual number is not known until the line is laid and need for span rectification determined, if any.

Scouring is the movement of seabed sediment (e.g. silt, sand and gravel) from around the base of a subsea structure to further afield due to prevailing hydrodynamic conditions, potentially compromising the integrity of a structure. Scouring is generally mitigated by installing mattresses along the perimeter of the installed structure. Concrete mattresses are planned to be installed at the LD manifold; however, further engineering may dictate the same requirement for other structures.

Stabilisation is a post-lay activity to ensure that items, such as HFL, EFL and jumpers, remain at their installed positions; i.e. not being shifted due to strong seabed current. Stabilisation of flying leads and short jumpers is generally mitigated by installing sandbags on top of HFLs, EFLs and jumpers at a predetermined distance apart. Sandbags generally come in a standard size with 20 kg to 25 kg weight. Concrete mattresses may be used to stabilise larger elements such as flowlines and umbilicals. Sandbags or concrete mattresses may also be used to provide temporary stability of wet stored items if wet storage proves necessary.

3.9.7 Pre-commissioning of the Flexible Flowlines and Jumpers

Leak testing is performed to test the integrity of subsea infrastructure, test isolations and identify any leaks. Pressure may be applied to the component from the facility (Angel Platform for LD flowline) but can also be applied via a downline from the PIV (GWF-3 and LD jumper). Failure of testing equipment or integrity of the tested infrastructure may lead to a loss of leak test fluids to the marine environment. After the GWF-3 flowlines leak testing is completed, the system pressurisation volume may be released to the environment to mitigate the risk of hydrocarbons returning to the PIV.

During tie-in and pre-commissioning activities, any subsea connection break-outs will be preserved with chemical sticks. A small amount of chemically treated MEG/ water may be discharged to the environment from the structure and tie-in flexible prior to final make up of the connection. All chemicals used in pre-commissioning activities will be subject to the chemical selection assessment process described in **Section 3.8.11.**

3.9.7.1 Flooding

All GWF-3 flexible flowlines will be installed filled with chemically treated 55 wt% MEG/water. The LD flowline may be installed with either:

- chemically treated water over all or the majority of its length, possibly including smaller length of near 100% MEG; or
- chemically treated 55 wt% MEG/water over the full length.

The LD jumper will be installed filled with at least 62 wt% chemically treated MEG/water, but possibly up to near 100% MEG. MEG is used to prevent formation of hydrates during start-up. Topping up of the flowlines will occur when pulling heads are removed to install diverless connectors or perform a midline connection.

3.9.7.2 Leak Testing

Leak test/system pressure tests are performed to confirm the integrity of subsea connections, flowlines and jumpers. During leak testing there may be small volumes of test fluids discharged to environment during connection and disconnection of hot stabs.

3.9.7.3 Dewatering

The LD flexible flowline will be dewatered and inerted after installation and leak testing. The dewatering philosophy depends on the flooding medium that is selected during detailed design (**Section 3.9.10**). If the flowline is pre-flooded with chemically treated 55 wt% MEG (minimum of 55% with range between 55-60%) pre-lay, then a single bi-directional pig is used, propelled by nitrogen gas to displace the fluid. The pig train may consist of bi-directional pigs if required. If the flowline is pre-flooded with treated water over all or most of its length, then slugs of MEG separated by pigs are pushed along the flowline using nitrogen gas to displace the fluid and condition the flowline for start-up.

The pig runs will discharge the MEG/water mix, subsea at the LD manifold. The maximum estimated discharge volumes (including contingency volume) and chemical additives are shown in **Table 6-4**. There is also potential that some debris remaining within the line from flowline installation activities may be discharged.

The direction of pig run is from a temporary pig launcher installed at the Angel Platform topsides, to a temporary pig receiver installed on the subsea production manifold.

After the pigging is completed, the flowline is left filled with nitrogen, at a pressure of at least 8.5 MPa, in preparation for hot-commissioning (introduction of hydrocarbons). The relevant LD manifold valves and topsides valves are closed, and the pig launchers/receivers are removed. Hot-commissioning is outside of scope of this EP.

The contents of the LD jumper and the GWF-3 flowlines will be produced to the Angel and GWA Platforms, outside of the scope of this EP.

3.9.8 Electro-hydraulic Umbilical

The EHU cores are pressurised at loadout and the pressure monitored throughout the lay. After laydown of each EHU section, the cores may be pressure-tested and the electrical cores subject to testing. Before connecting to the existing system, pressure is checked to match existing system pressure.

The flying leads are connected between the UTAs, manifold and to the xmas trees. This system will be subject to further pressure-testing and electrical continuity and signal tests.

During tie-in of the EHU, a small amount of chemically treated MEG/ water and hydraulic fluid Oceanic HW443 may be released to the environment.

Water jetting and/ or acid injection may be used to clean the connections on the infrastructure prior to tie in.

3.9.9 Tie-in of Flowlines at GDA Manifold

Prior to tie-in of the GWF-3 flowlines to GDA manifold, verification testing of any leakage from the manifold branch isolation valves may be undertaken. This testing will verify that suitable isolations for safe tie-in are available, thereby preventing a major hydrocarbon release during tie-in. This verification may result in the release of hydrocarbons to the environment. The hydrocarbons are predominately gas with a small quantity of condensate.

Additionally, when the flowline tie-ins take place, a quantity of hydrocarbons may be released. A conservative estimate of hydrocarbons that may be released during each flowline tie-in at the GDA manifold is up to 0.9 m^3 condensate and 3.7 Te gas over a 24 hour period (total of 3 tie-ins).

Water jetting and/ or acid injection may be used to clean the connections on the infrastructure prior to tie-in.

3.9.10 J-tube Pull-in

The LD flexible flowline and umbilical are pulled through and installed within existing spare 30” and 12” J-tubes at the Angel Platform. These J-tubes currently have blind flanges installed at each end (subsea and topsides) and are partially filled with seawater.

An internal inspection of the J-tubes is undertaken prior to commencement of offshore activities. Localised water jetting and mechanical tools may be used at the base of the J-tubes to clean external surfaces prior to removal of the blind flange and internal surfaces to ensure that the best possible seal can be established. Following removal, the blind flanges will be placed on the seabed for retrieval. A brush pig is pulled through each of the J-tubes to remove any debris which may be present.

A J-tube seal is installed at the base of each of the J-tubes after the flowline and umbilical have been installed, and the J-tubes filled with treated seawater and a nitrogen blanket to prevent any internal corrosion taking place.

3.9.11 Wet Storage of Equipment

Wet storage of infrastructure may be required intermittently throughout the duration of susbsea installation activities (~100 days) as part of the Petroleum Activities Program. There are two categories of equipment that may require wet storage as part of the Petroleum Activities Program, as summarised in **Table 3-8**. At completion of the Petroleum Activities Program there will be no wet stored infrastructure remaining on the seabed.

Table 3-8: Wet storage that may be required as part of the Petroleum Activities Program

Wet Storage Category	Reason for wet storage	Typical equipment	Retrieval method
Installation Aids	To facilitate safe installation of infrastructure.	Predominately installation aids (subsea/ROV baskets, clump weights, etc)	Retrieval will be undertaken using project vessels (**Section 3.5**) and associated equipment such as cranes, ROV, etc.
Subsea installation	Prior to connection of infrastructure, wet storage may be necessary to optimise project schedule and support SIMOPs	Items may include flexible flowlines, jumper, umbilicals and flying leads etc	Retrieval is not required, as infrastructure will be used for production operations and once connected is no longer considered wet stored.

3.9.12 Maintenance of Subsea Infrastucture

All subsea structures installed during the Petroleum Activities Program has been designed for full removal. As per **Table 3-8**, wet stored items will be removed during the subsea installation activities. Due to the design of equipment, the materials selected and short duration of susbsea installation activities, all equipment will be in a condition that allows for removal.

The as-built survey will confirm that structures installed for production operations are in good condition and repair.

3.10 Site Surveys

Site surveys will be undertaken at various stages throughout the installation of subsea infrastructure. An initial pre-lay survey will be undertaken by the flowline installation contractor before starting installation activities. The pre-lay survey may be performed by a dedicated pre-lay survey vessel which is typically similar in size to support vessels, or potentially by the Primary Installation Vessel.

The pre-lay survey is a debris and hazard identification survey and not a full geophysical survey along the pre-determined route or proposed design route. While it is not anticipated that any significant debris may need to be removed before flowline installation, if required, these activities will fall under this EP and will be performed by an installation vessel, a support vessel or similar.

Additional surveys, with an ROV, will be undertaken throughout the installation activities. These surveys will identify the location of all items placed on the seabed (including wet stored items and installed infrastructure). The survey data will be input into a computer program to track all subsea equipment and displayed on the ‘survey screen’ (comprising an auto-cad file). This file will be progressively updated throughout the activities as items are put down on, and removed from the seabed (and in the title).

An as-built survey will be conducted by ROV at the completion of the installation campaign to ensure installation of equipment is in the designed location. This data will be used to update the ‘survey screen’ to develop the as-built report, which is considered the inventory of items remaining on the seabed (and in the title). In addition, any material items dropped to the marine environment and not recovered (See **Section 6.7.10**) will be added to the inventory for the title.

3.11 Contingent Activities

The following sections present contingencies that may be required, if operational or technical issues occur during the Petroleum Activities Program. These contingencies have been considered within the relevant impact assessment sections and do not represent significant additional risks or impacts but may generate additional volumes of drilling fluids and cuttings being discharged operationally and may add to the duration of the Petroleum Activities Program.

3.11.1 Respud

A respud may be required for a number of reasons, such as if the conductor or wellhead slumps or fails installation criteria (typically during top hole drilling). Re-spudding involves moving the MODU to a suitably close location (e.g. approximately 50 m from the original location, entirely within the Operational Area) to recommence drilling. A respud activity would result in repeating top hole drilling (**Section 3.7.2**).

The environmental aspects of re-spudding are the same as those for drilling and are considered to be adequately addressed by this EP (**Section 6.6.5**), with no significant changes to existing environmental risks or any additional environmental risks likely. The net environmental effect will be limited to an increase in the volume of cuttings generated (**Table 6-2**) and discharged at the seabed, from the repeat drilling of the top hole section, plus an increase in the quantity of cement discharged at seabed from cementing the conductor and surface casing strings along with potential increase in the use of drilling fluids and the additional emissions (atmospheric and waste) associated with an extended drilling program.

3.11.2 Sidetrack

The option of a sidetrack instead of a respud may be required if operational issues are encountered during drilling. The environmental aspects of a sidetrack well are the same as those for routine drilling activities, which are considered to be adequately addressed by this EP (**Section 6.6**), with no significant changes to existing environmental risks or any additional environmental risks likely. The net environmental effect is limited to an increase in the volume of cuttings generated (**Table 6-2**), potential increase in the use of drilling fluids and the additional emissions (atmospheric and waste) associated with an extended drilling program, as it may add to the duration of the Petroleum Activities Program.

3.11.3 Workover

It is possible the wells may be worked over by recovering and replacing the completion string and associated components.

A workover or intervention may be required to restore production or integrity due to a failed completion or component in the well. The environmental aspects of a workover operation are the same as those for well completion activities and are considered to be adequately addressed by this EP (**Sections 6.6 and 6.7**), with no significant changes to existing environmental risks or any additional environmental risks likely.

3.11.4 Well Suspension

During drilling activities, a well may need to be temporarily suspended. Suspension involves establishing suitable barriers, removing the riser and disconnecting the MODU from the well. The BOP may sometimes be left in place to act as a barrier. Suspension may be short term (e.g. in the case of a cyclone) or longer term (more than one year). On return to a well after suspension, the MODU reconnects to the well via the riser, and with BOP in place, barriers are removed and drilling and completions activity resumes.

3.11.5 Wireline

Wireline contingencies that may be in place for development drilling include gamma ray and casing collar locator for depth correlation, ultrasonic imaging tool and cement bond log to measure cement integrity, formation pressures (XPT), density, neutron and resistivity and punch perforators/tubing cutters suitable for all tubing sizes. Wireline contingency work would be performed with appropriate isolation barriers in place, e.g. an overbalanced fluid column. If wireline work is required to occur in a live well, or where there is a risk of barrier failure, the operation is performed with full pressure control equipment at the surface.

Some logging tools may contain low activity radiation sources. Radiation fields are not generally detectable outside the tool when the tool is not energised; therefore, they do not present an environmental risk.

3.11.6 Well Intervention

An intervention may be performed on any of the Petroleum Activities Program wells. Interventions may be performed due to down-hole equipment failure or to address underperformance of a well. Key well intervention methods include wire-line and coiled tubing. Potential environmental impacts from intervention activities have been included in this EP, including discharge of suspension fluids and brines and small volume subsea gas releases due to removal of a tree cap which may be in place if the well was previously suspended.

3.11.7 Well Abandonment

The Petroleum Activities Program covers the drilling of production wells, which are not envisaged to be abandoned until the end of field life. For technical reasons, it may be required to abandon the lower section of a well, prior to sidetracking, or in the event that a respud is required.

Well abandonment activities are conducted in accordance with Woodside's Engineering Standards - Well Barriers. Base oil may be used for inflow testing prior to abandonment, to verify barrier integrity. Base oil would be pumped down the drill string and reverse-circulated back to the rig, with collection of fluids for disposal onshore. If stored in a mud pit, the base oil and other fluids associated with the test may result in pit-wash water contaminated with hydrocarbons. If this is the case, mud pit wash water would be discharged in accordance with requirements in this EP; with a hydrocarbon content <1% by volume.

If required, wells will be abandoned with abandonment cement plugs, including verification of the uppermost cement plug by tagging and/or pressure testing through a prescribed program. Abandonment of a lower section of a well may also occur prior to sidetracking.

Following abandonment activity, the marine riser and BOP are removed and wellhead retrieval will be attempted. Conventional wellheads are removed by deploying a cutting device on drill pipe which then cuts through the conductor allowing the wellhead to be retrieved to surface. The conductor cutting equipment is very reliable with a high success rate of cutting wellheads.

3.11.8 Wellhead Assembly Left in-situ

If a well is abandoned due to the requirement to respud, reasonable attempts would be made to remove the wellhead. However, if the attempts to remove the wellhead are unsuccessful, the wellhead assembly would be left in-situ. Well abandonment activities would be performed as outlined in **Section 3.11.7** but the wellhead assembly would remain. The integrity of the wellbore is not affected by the wellhead assembly remaining in-situ. The environmental aspects of the wellhead assembly remaining in-situ as a contingent activity are considered to be adequately addressed by this EP (**Section 6.6.1**), with no significant changes to existing environmental risks or any additional environmental risks likely.

Final decommissioning of the development wellhead assembly and other subsea infrastructure at the end of field life are subject to a separate EP.

3.11.9 Sediment Mobilisation and Relocation

If required, an ROV may be used to relocate sediment/cuttings (such as jetting and mass flow excavation etc) around the wellhead or other infrastructure, to keep the area clear and safe for operations and equipment. This technique may also be used to support subsea installation, such as to create a short corridor to submerge flowlines and umbilicals for crossings.

This activity has the potential to generate plumes of suspended sediment during pumping and disturb benthic fauna in the immediate area.

3.11.10 Venting

During drilling of the well, an influx of formation fluid into the well bore may occur. To maintain well integrity in this situation, a small volume of reservoir gas is released to the atmosphere via the mud-gas separator, in a well control operation known as ‘venting’.

3.11.11 Emergency Disconnect Sequence

An emergency disconnect sequence (EDS) may be implemented if the MODU is required to rapidly disengage from the well. The EDS closes the BOP (i.e. shutting in the well) and disconnects the riser to break the conduit between the wellhead/BOP and MODU. Common examples of when this system may be initiated include the movement of the MODU outside of its operating circle (e.g. due to a failure of one or more of the moorings or DP system) or the movement of the MODU to avoid a vessel collision (e.g. third-party vessel on collision course with the MODU). EDS aims to leave the wellhead and BOP in a secure condition but will result in loss of the drilling fluids/cuttings in the riser after disconnection. These would be discharged to the sea.

4. DESCRIPTION OF THE EXISTING ENVIRONMENT

4.1 Overview

In accordance with Regulation 13(2) and 13(3) of the Environment Regulations, this section describes the existing environment that may be affected (EMBA) by the activity (planned and unplanned as defined in **Section 2.4.1**). The description of the relevant values and sensitivities of the environment provided here has been used to inform the risk assessment (**Section 6**).

The EMBA is the largest spatial extent where unplanned events could have an environmental consequence on the surrounding environment. For this EP, the EMBA is the potential spatial extent of surface and in-water hydrocarbons at concentrations above ecological impact thresholds, in the event of the worst-case credible spill. The ecological impact thresholds used to delineate the EMBA are defined in **Section 6.7.1**. The EMBA also includes any areas that are predicted to experience shoreline contact with hydrocarbons above threshold concentrations.

For the purposes of this EP, Woodside has defined the EMBA by combining the potential spatial extent of surface and in-water (dissolved and entrained) hydrocarbons, resulting from a worst-case credible spill; loss of well integrity (**Section 6.7.2**) as modelled from two locations representing each reservoir (LD and Goodwyn GH).

Woodside recognises that hydrocarbons may be visible beyond the EMBA at lower concentrations than the ecological impact thresholds defined in **Section 6.7.1**. These visible hydrocarbons are not expected to cause ecological impacts. Surface oil may be visible beyond the EMBA to a concentration of approximately 1 g/m^2. In respect of this, an additional socio-cultural EMBA is defined, as the potential spatial extent within which social-cultural impacts may occur from the changes to the visual amenity of the marine environment. This socio-cultural EMBA for surface hydrocarbons encompasses an area fully within the boundaries of the EMBA for ecological impacts as presented in this EP.

The EMBA and socioeconomic EMBA are shown in **Figure 4-1**. It should be noted that the contours presented in **Figure 4-1** do not represent the predicted coverage of any one hydrocarbon spill, or a depiction of a slick or plume at any particular instant in time. Rather, the contours are a composite of a large number of theoretical paths, integrated over the full duration of the simulations under variations in metocean conditions from the two modelled release locations.

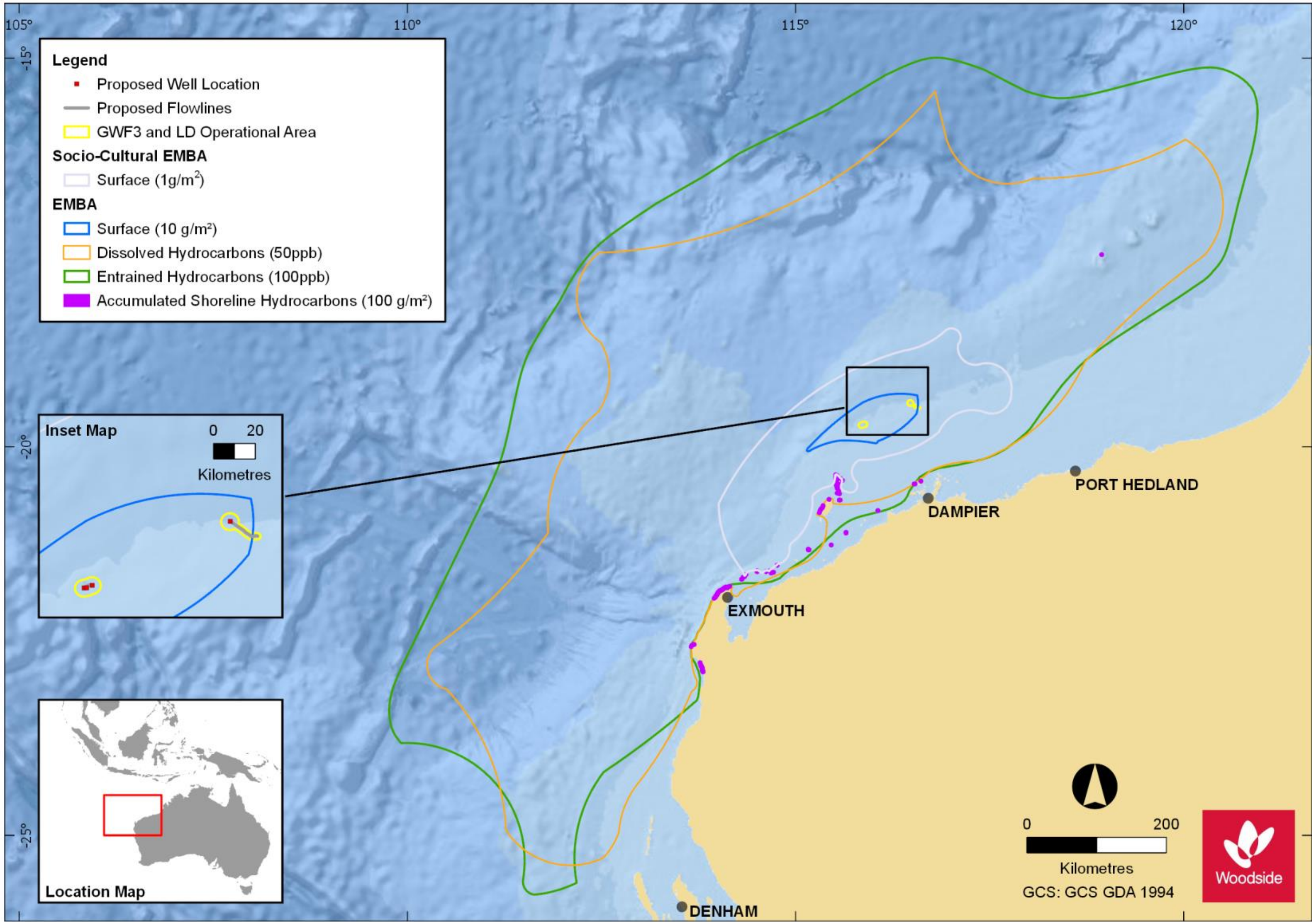


Figure 4-1: Hydrocarbon threshold contours resulting from worst-case credible spill, loss of well integrity for GWF-3 and Lambert Deep Drilling and Subsea installation activities.

4.2 Summary of Key Existing Environment Characteristics

Table 4-1 summarises the key existing environment characteristics, in line with the process of identifying and describing the existing environment in relation to the ‘nature and scale’ of the activity (refer to **Section 2.4.2**). These key existing environment characteristics are described in terms of the Operational Area and EMBA (as described in **Section 4**). The Operational Area describes the key existing environment characteristics and receptors that may be affected by the Petroleum Activities Program. Planned activities within the Petroleum Activities Program are not expected to impact receptors outside of the Operational Area. The EMBA, which has been identified by hydrocarbon spill modelling (**Figure 4-1**), encompasses all characteristics and receptors with the potential to be impacted if the worst-case credible hydrocarbon spill scenario occurs (i.e. a loss of well containment, as described in **Section 6.7.2**).

Table 4-1: Summary of key existing environment characteristics

Sensitive Receptor		EP Section	Description
Physical Environment	***Climate and Meteorology***	4.4.1	*Operational Area and EMBA* • tropical monsoon climate, with Distinct wet (October to April) and dry (May to September) seasons • winds vary seasonally, with a tendency for winds from the south-west during summer months (September to March) and the south-east in autumn and winter months (April to August) • tropical cyclone activity can occur between November and April (summer period) and is most frequent during December to March.
	Oceanography	4.4.2	*Operational Area* • locally generated wind surface currents are superimposed on geostrophic and tidal currents • geostrophic flow characterised by the southward flowing Leeuwin current, which strengthens in late summer and winter • water quality is expected to reflect the offshore oceanic conditions of the North West Shelf Province (NWS Province) and wider region • surface water temperatures are relatively warm, ranging seasonally from approximately 24.3 to 28.5°C • offshore waters are expected to be of high quality given the distance from shore and lack of terrigenous inputs. *EMBA* • water quality is regulated by the Indonesian Throughflow (ITF), which plays a key role in initiating the Leeuwin Current and brings warm, low-nutrient, low-salinity water to the North-west Marine Region (NWMR). It is the primary driver of the oceanographic and ecological processes in the NWS Province • tidally-driven currents are also a significant component of water movement along the NWS • variation in surface salinity throughout the year is minimal (35.2 and 35.7 practical salinity units (PSU)) • during summer, the Leeuwin Current typically weakens and the Ningaloo Current develops, facilitating upwelling of cold, nutrient-rich waters onto the continental shelf • other areas of localised upwelling in the NWMR include the Exmouth Plateau, where seabed topographical features force the surrounding deeper, cooler, nutrient rich waters up into the photic zone • turbidity is primarily influenced by sediment transport by oceanic swells and primary productivity.

Sensitive Receptor		EP Section	Description
	Bathymetry	4.4.3	*Operational Area* • located in waters approximately 80 to 130 m deep along the continental shelf • generally flat with gentle gradient • mapped as overlapping part of the Ancient Coastline at 125 m Depth Contour Key Ecological Feature (KEF). *EMBA* • relatively complex bathymetric features are found at Glomar Shoal 1 km to the south-east rising to 22 m below the surface and Rankin Bank 19 km to the west of the Operational Area rising to 18 m below the surface • numerous KEFs associated with bathymetric features in the EMBA.
	Marine Sediment	4.4.4	*Operational Area* • expected to consist of fine sediments (from muds to sands) of high quality (low levels of contaminants expected) • sediments are expected to consist primarily of carbonates. *EMBA* • sediment characteristics change with depth and distance from shore, with sediments becoming progressively finer with increasing depth and distance, particularly beyond continental shelf break • Rankin Bank and Glomar Shoal comprise predominantly sand (similar to other shoal ecosystems on the NWS).
	Air Quality	4.4.5	There is limited air quality data for the NWS Province. However, ambient air quality in the Operational Area and EMBA is expected to be of high quality.
Habitats	***Critical Habitat – EPBC Act Listed***	4.5.1.1	No Critical Habitats or Threatened Ecological Communities, as listed under the EPBC Act, are known to occur within, or in proximity to the Operational Area or EMBA.
	Marine Primary Producers	4.5.1.2	*Operational Area* • Given the water depth (80 – 130 m), benthic primary producers are not expected to occur within the Operational Area. *EMBA* • Nearest coral habitat to the Operational Area is the submerged feature Glomar Shoal (about 1 km, at the nearest point). Other coral reef habitats include the submerged shoal Rankin Bank, the Montebello/Barrow/Lowendal Islands Group, Barrow Island, Ningaloo Coast and the remote oceanic reef system of the Rowley Shoals. • Seagrass/macroalgal habitat is widely distributed in coastal waters that receive sufficient light to support seagrass and macroalgae. The closest seagrass/macroalgal habitat to the Operational Area is located at the Montebello and the Barrow Islands (74 km and 110 km respectively). • The nearest mangrove habitats to the Operational Area are at the Montebello/Barrow/Lowendal Islands Group (110 km at the closest point). Mangrove habitats are also found at specific locations along the Ningaloo Coast.

Sensitive Receptor		EP Section	Description
	Other Communities/ Habitats	4.5.1.3	*Operational Area* • Plankton communities in the Operational Area are likely to reflect the broader NWMR. • Fish communities in the Operational Area comprise small and large species pelagic fish, as well as demersal species. • Hard substrates associated with the Ancient Coastline at 125 m Depth Contour KEF may support demersal fish assemblages. • Filter feeders are generally located in areas with strong currents and hard substratum, and are expected to occur sparsely throughout the Operational Area. • Sparse assemblages of benthic biota, both epifauna and infauna are expected for the largely unconsolidated soft sediment seabed habitat of the Operational Area. *EMBA* • Offshore phytoplankton communities are typically characterised by smaller taxa (e.g. bacteria), whereas shelf waters are dominated by larger taxa (e.g. diatoms). • Demersal and pelagic fish are expected to occur within the Operational Area, although there are no key habitats for fish within the Operational Area. • The nearby submerged shoals features of Rankin Bank and Glomar Shoal support high demersal fish richness and abundance associated with the hard coral and macroalgal benthic communities of these shoal habitats. • The NWMR has been identified as a sponge diversity hotspot with a high variety of biodiverse areas, particularly in the Ningaloo Marine Park.
Protected Species	***Biologically Important Areas (BIAs)***	4.5.2.3	*Operational Area* • foraging area for the wedge-tailed shearwater during its breeding season (August to April) • whale shark migration route along the 200 m isobath with migration occurring mainly between July and November and foraging BIA defined as the same area northward from Ningaloo along the 200 m isobath. • the Operational Area also overlaps an internesting BIA for flatback turtles around the Montebello Islands (Hermite Island, Northwest Island and Trimouille Island) (nesting between October to March). *EMBA* • large number of BIAs within EMBA (refer to **Section 4.5.2.4**)

Sensitive Receptor		EP Section	Description
	Marine Mammals	4.5.2.6	*Operational Area* • sei whale – there are no known key aggregation areas (resting, breeding or feeding) located within the Operational Area. • Pygmy blue whale – there are no known key aggregation areas (resting, breeding or feeding) located within the Operational Area, however they may be likely to occur • fin whale – there are no known key aggregation areas (resting, breeding or feeding) located within the Operational Area. • humpback whale – humpback whales may transit through the Operational Area during their northbound and southbound migrations (although typically occur inshore of the Operational Area), likely between June and September (including northbound and southbound migration). • Bryde's whale – tropical and temperate waters, with inshore and offshore morphologies / populations. May be seasonally present between December and June. • killer whale– no recognised key localities, expected to rarely occur. • sperm whale – unlikely to occur in Operational Area due to preference for oceanic waters. *EMBA* • a range of migratory cetacean species may have transitory overlap with the EMBA, including several dolphin species and the migratory BIAs for pygmy blue whales and humpback whales. • resident coastal populations of small cetacean species. • dugong – known to occur in tropical coastal environments where seagrasses occur, including Ningaloo Marine Park. • Antarctic minke whale – migrates up to 20 °S for feed and possible breed. Unlikely to occur within Operational Area but may occur in EMBA. • southern right whale – unlikely to occur in Operational Area, may occur in southern extent of EMBA.
	Marine Turtles	4.5.2.7	*Operational Area* • The Operational Area does not overlap any known habitat critical to the survival of any species of marine turtle. • The Operational Area overlaps an internesting BIA for flatback turtles around the Montebello Islands (Hermite Island, Northwest Island and Trimouille Island) (nesting between October to March), however, scientific evidence has shown flatback turtle internesting movements do not extend into offshore waters. • Presence of the five species of threatened marine turtles (loggerhead, green, leatherback, hawksbill and flatback) within the Operational Area is likely to be infrequent and limited to individuals or small numbers transiting, as they seasonally move in and out of key foraging, internesting and nesting locations associated with shallow, coastal waters and sandy beaches. *EMBA*

Sensitive Receptor		EP Section	Description
			• Green, loggerhead, flatback and hawksbill turtles have significant nesting rookeries on beaches along the Montebello/Barrow/Lowendal Islands Group, Ningaloo coast and the Muiron Islands. There are habitats critical to survival of marine turtles for these species representing nesting and internesting areas for the listed offshore islands and mainland coast. All are within the EMBA. Leatherback turtles may occur within the EMBA but there are no known nesting beaches in WA. • Marine turtles may forage in shallow waters on the continental shelf, including Rankin Bank and Glomar Shoal.
	Sea Snakes	4.5.2.7	*Operational Area* • Given the offshore location and deeper water depths of the Operational Area, sea snake sightings will likely be infrequent. *EMBA* • Sea snakes frequent the waters of the continental shelf and around offshore islands. • The short-nosed sea snake (critically Endangered) was identified by the Protected Matters Search Tool (PMST) as potentially occurring within the EMBA.
	Fishes and Elasmobranchs	4.5.2.8	*Operational Area* • The PMST identified ten species of Threatened and/or Migratory sharks (grey nurse shark, great white shark, green sawfish, whale shark, narrow sawfish, shortfin mako, longfin mako, reef manta ray and giant manta ray) that may occur in the Operational Area. • The Operational Area overlaps the whale shark foraging BIA (an identified migration route, with migration occurring between July and November with a portion of the whale shark population moving to and from an annual aggregation BIA off the Ningaloo Coast (March to July). *EMBA* • Whale sharks are known to aggregate annually, from March to July, in areas off Ningaloo and the North West Cape. After the aggregation period, a portion of the population migrates northwards along the 200 m isobath an area defined as a foraging BIA, with migration occurring mainly between July and November. The broader distribution of the whale sharks in the Indian Ocean is largely unknown but surveys suggest that the group disperses widely and up to 1800 km away to areas in Indonesia, Christmas Island and across to the Coral Sea. • Ningaloo Reef is an important area for giant and reef manta rays in autumn and winter, and they are known to occur in tropical waters throughout the EMBA. • grey nurse sharks are likely to be found in shallow waters of the EMBA • sawfish may occur in shallow coastal habitats • great white sharks, shortfin makos and longfin makos are all known to occur within the EMBA • Porbeagle shark may occur in temperate waters in the southern portion of the EMBA • Two Conservation Dependent listed species under the EPBC Act are considered likely to occur within the Operational Area and EMBA. These species, are the southern bluefin tuna and scalloped hammerhead.

Sensitive Receptor		EP Section	Description
	Birds	4.5.2.9	*Operational Area* • Eleven species of Threatened and/or Migratory bird species (Australian fairy tern, red knot, eastern curlew, common noddy, streaked shearwater, lesser frigatebird, great frigatebird, common sandpiper, sharp-tailed sandpiper, pectoral sandpiper, and osprey) were identified as potentially occurring within the Operational Area. No habitat critical to lifecycle stages associated with these species has been identified within the Operational Area and the offshore, open water location precludes likely presence of migratory shorebird species within the Operational Area. • A BIA for wedge-tailed shearwater, during their breeding season, overlaps the Operational Area. *EMBA* • There are several BIAs (key breeding/nesting, roosting, foraging and resting areas) for seabirds and migratory shorebirds in the EMBA, including areas on the islands of the Montebello/Barrow/Lowendal Islands group, Pilbara Islands, Ningaloo Coast and Muiron Islands.
Socioeconomic	***Cultural Heritage***	4.6.1	*Operational Area* • There are no known sites of Indigenous or European cultural or heritage significance within or in the vicinity of the Operational Area. *EMBA* • Barrow Island, Montebello Islands, Dampier Archipelago, Ningaloo Reef and the adjacent foreshore contain numerous registered Indigenous heritage sites. • The closest recorded Maritime Cultural Heritage site to the Operational Area is *McCormack* and *McDermott Derrick Barge No. 20* shipwrecks, both approximately 43 km south of the Operational Area. • World Heritage Areas include the Ningaloo Coast World Heritage Area. • National Heritage listed and proposed places include Barrow Island, Montebello Islands, Dampier Archipelago and Ningaloo Coast. • Commonwealth Heritage listed places include the Ningaloo Marine Area – Commonwealth Waters.
	Ramsar Wetlands	4.6.2	No Ramsar wetlands occur within the Operational Area or EMBA.

<table>
<tr><th colspan="2">Sensitive Receptor</th><th>EP Section</th><th>Description</th></tr>
<tr><td rowspan="2"></td><td>Fisheries – Commercial</td><td>4.6.3</td><td>Operational Area
There are a number of Commonwealth and State designated fisheries management areas that overlap the Operational Area; however, only the State Mackerel Managed Fishery and the Pilbara Demersal Scalefish Fishery are expected to be active within the Operational Area:
Commonwealth fisheries:
Western Tuna and Billfish Fishery
Southern Bluefin Tuna Fishery
Western Skipjack Tuna Fishery.
State fisheries:
Mackerel Managed Fishery
Pilbara Demersal Scalefish Fishery
South West Coast Salmon Managed Fishery
West Coast Deep Sea Crustacean Managed Fishery
Pilbara Crab Managed Fishery
Marine Aquarium Fish Managed Fishery
Specimen Shell Managed Fishery
Western Australian Abalone Managed Fishery
Pearl Oyster Managed Fishery
Onslow Prawn Managed Fishery.
There are no aquaculture activities within or adjacent to the Operational Area.
EMBA
A number of State and Commonwealth fisheries overlap the EMBA.</td></tr>
<tr><td>Fisheries – Traditional</td><td>4.6.4</td><td>Operational Area
There are no known traditional or customary fisheries within or adjacent to the Operational Area.
EMBA
Traditional fisheries are typically restricted to shallow coastal waters and/or areas with structure such as reef. Ningaloo Coast, Barrow Island and Montebello Islands and the adjacent foreshores have a known history of fishing, when areas were occupied (as identified from historical records). Traditional fishing still occurs within coastal waters of the Dampier Archipelago.</td></tr>
</table>

Sensitive Receptor		EP Section	Description
	Tourism and Recreation	4.6.5	*Operational Area* • Tourism activities in the Operational Area are not known to occur due to water depths and distance offshore. *EMBA* • Recreational fishing is expected to occur throughout EMBA, primarily in continental shelf waters including Rankin Bank. • The Ningaloo Marine Park and Montebello Islands are popular for marine nature-based tourist activities.
	Shipping	4.6.6	*Operational Area* • Several shipping fairways overlap the Operational Area. *EMBA* • The coastal and offshore waters of the region support significant commercial shipping activity, the majority of which is associated with the mining and oil and gas industries. • Major shipping routes are associated with entry to the ports of Barrow Island, Dampier, Onslow and Port Hedland.
	Oil and Gas Infrastructure	4.6.7	*Operational Area* • The Angel facility overlaps the LD Operational Area but is 15 km from the LDA-01 well. *EMBA* • NRC is approximately 27 km from the Operational Area, at the closest point • GWA lies approximately 4 km from the Operational Area, at the closest point • There are several fixed platforms in proximity to the Operational Area, including Pluto, Wheatstone, and Reindeer • numerous Petroleum Titles surrounding the Operational Area.
	Defence	4.6.8	*EMBA* • A designated defence practice area lies in the offshore marine waters off Ningaloo Reef and the North West Cape.
Values and Sensitivities	*The following Protected Areas and sites of high conservation value are located outside of the Operational Area, unless otherwise stated, and are considered due to the extent of the EMBA and socio-cultural EMBA:*		

	Montebello / Barrow / Lowendal Islands	4.7.1	Protected areas in this locality include:
			• Montebello Australian Marine Park (AMP)
			• State protection areas:
			  ○ Montebello Islands Marine Park, Barrow Island Marine Park, Barrow Island Marine Management Area
			  ○ Barrow Island Nature Reserve
			  ○ Lowendal Islands Nature Reserve.

Sensitive Receptor		EP Section	Description
	Ningaloo Coast and Gascoyne	4.7.2	Protected areas in this locality include: • Ningaloo Coast World Heritage Area and National Heritage Area • Ningaloo AMP • Ningaloo Marine Park and Muiron Islands Marine Management Area • Gascoyne AMP.
	Pilbara Coast and Islands	4.7.3	Sensitive areas in this locality include: • Pilbara Islands (north group) • Pilbara Islands (middle group) • Pilbara Islands (south group).
	Rowley Shoals	4.7.4	Protected areas in this locality include: • Argo-Rowley Terrace AMP • Mermaid Reef AMP • Rowley Shoals Marine Park.
	Carnarvon Canyon		Protected areas in this locality include: • Carnarvon Canyon AMP.
	Key Ecological Features	4.7.5	*Operational Area* • Ancient Coastline at 125 m Depth Contour. *EMBA* • A number of KEFs occur within the EMBA.
	Other Sensitive Areas	4.7.8	Other sensitive areas within the EMBA include: • Glomar Shoal located 1 km to the south-east of the Operational Area • Rankin Bank located approximately 19 km west of the Operational Area.

4.3 Regional Context

The Operational Area is located in Commonwealth waters within the NWS Province, in water depths of approximately 80 – 130 m. The NWS Province is part of the wider NWMR (**Figure 4-2**) as defined under the Integrated Marine and Coastal Regionalisation of Australia (IMCRA V4.0) (DEH 2006). The NWS Province encompasses the continental shelf between North West Cape and Cape Bougainville, and varies in width from approximately 50 km at Exmouth Gulf to greater than 250 km off Cape Leveque and includes water depths up to 200 m (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012a).

The NWS Province is characterised by the following biophysical features (DSEWPaC 2012a):

- Transitional climatic conditions, between dry tropics to the south and humid tropics to the north.
- Strong seasonal winds and moderate offshore tropical cyclone activity.
- Surface waters are tropical year-round and highly stratified during summer months (thermocline occurring at water depths between 30 and 60 m). In winter, surface waters are well mixed, with thermoclines occurring deeper around 120 m depth.
- Surface ocean circulation is strongly influenced by the ITF via the Eastern Gyre. During the summer when the ITF is weaker, south-west winds cause intermittent reversals in currents. These events may be associated with occasional weak, shelf upwellings.
- The seabed in the region consists of sediments that generally become finer with increasing water depth, ranging from sand and gravels on the continental shelf to mud on the slope and abyssal plain. Approximately 60–90% of the sediments in the region are carbonate derived (Brewer et al. 2007). The distribution and re-suspension of sediments on the inner shelf is strongly influenced by the strength of tides across the continental shelf as well as episodic cyclones. Further offshore, on the mid to outer shelf and on the slope, sediment movement is primarily influenced by ocean currents and internal tides, the latter causing re-suspension and net downslope deposition of sediments (Baker et al. 2008).
- The region has high species richness but a relatively low level of endemism (i.e. species particular to the region in comparison to other areas of Australian waters). Furthermore, the majority of the region's species are tropical and are recorded in other areas of the Indian Ocean and Western Pacific Ocean.
- Benthic communities within the region range from nearshore benthic primary producer habitats such as seagrass beds, coral communities and mangroves to offshore soft sediment seabed habitats associated with low density sessile and mobile benthos such as sponges, molluscs and echinoids (with noted areas of sponge hotspot diversity).
- Internationally significant migratory routes, resident populations, breeding and/or feeding grounds for a number of EPBC Act listed threatened and migratory marine species, including humpback whales, marine turtles, whale sharks, seabirds and migratory shorebirds, are present.

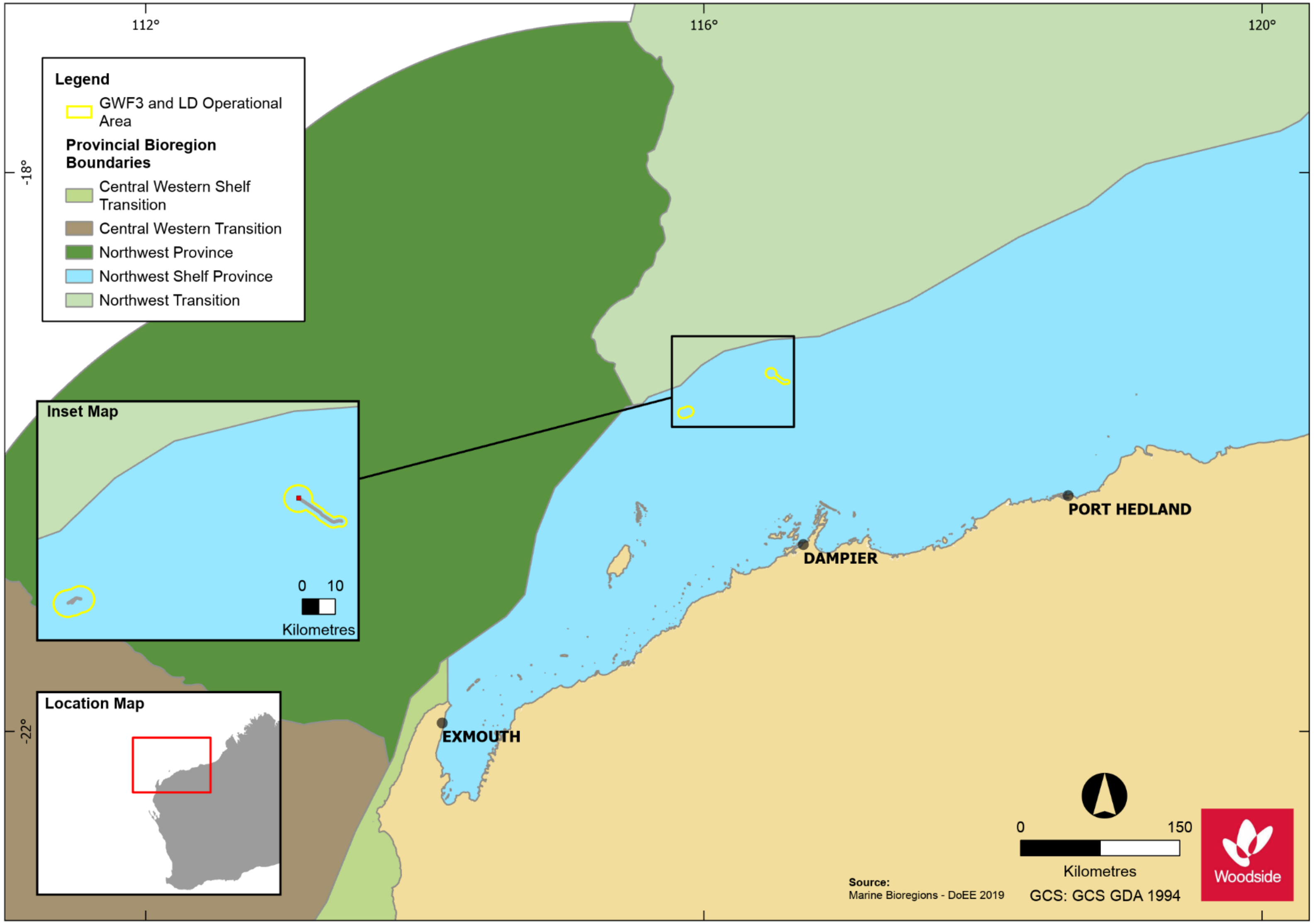


Figure 4-2: Location of the Operational Area within the North-west Marine Region (IMRCA V0.4)

4.4 Physical Environment

4.4.1 Climate and Meteorology

4.4.1.1 Seasonal Patterns

The climate of the NWMR is tropical, exhibiting a hot summer season from October to April and a milder winter season between May and September (**Figure 4-3**) (Bureau of Meteorology (BoM), 2019a). There are often distinct transitional periods between the summer and winter regimes, which are characterised by periods of relatively low winds (Pearce et al. 2003).

Air temperatures in the region, as measured at Karratha aerodrome (about 134 km from the Operational Area at the closest point) follow seasonal trends (**Figure 4-3**). Maximum temperatures reach an average of 36°C in March, falling to an average maximum of 26°C in July. Average minimum temperatures range from 27°C in January to 14°C in July.

The region experiences a tropical monsoon climate, with distinct wet (November to April) and dry (May to October) seasons. Rainfall in the region typically occurs during the wet season, with highest falls observed during late summer (BoM, 2019a) and is often associated with the passage of tropical low pressure systems and cyclones (Pearce et al., 2003). Rainfall outside this period is typically low.

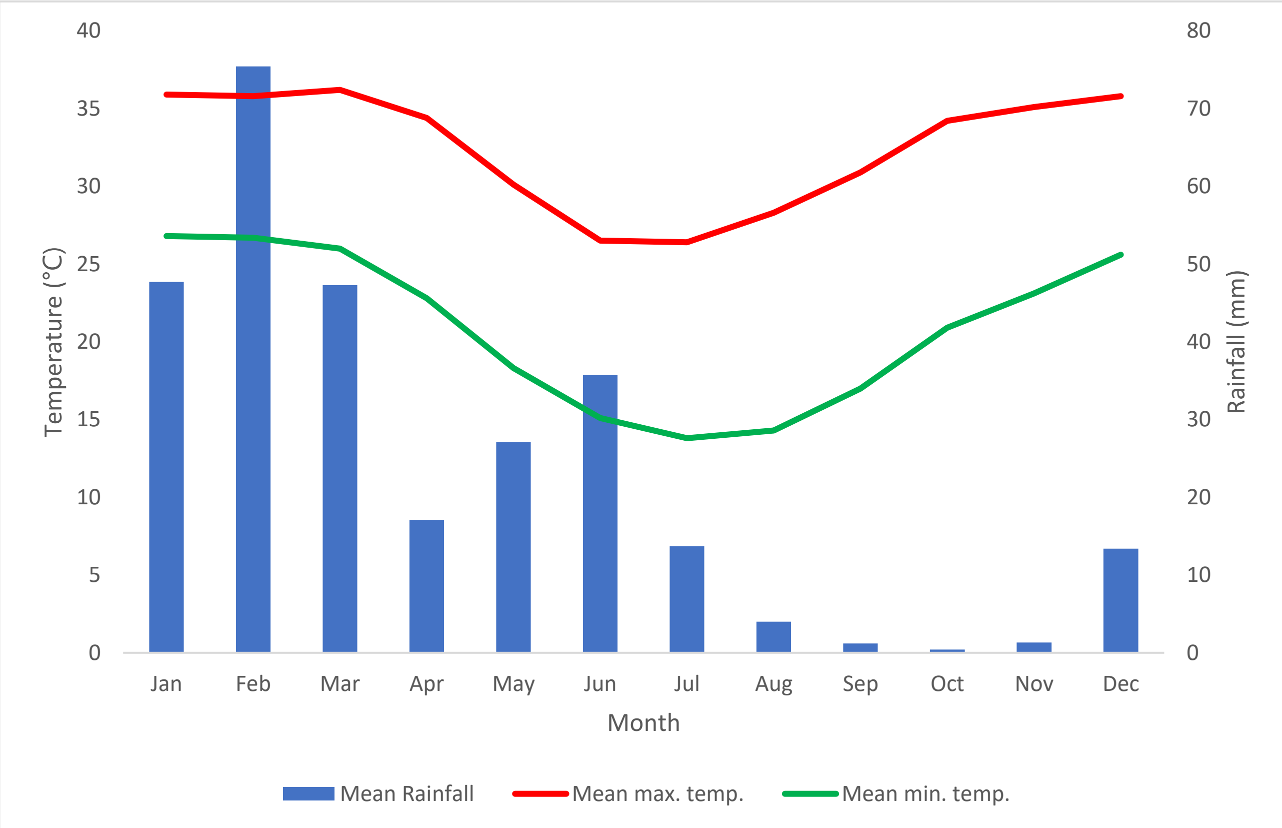


Figure 4-3: Mean monthly maximum temperature, minimum temperature and rainfall from Karratha Aerodrome meteorological station from January 1972 to December 2019

Source: BoM (2019a)

4.4.1.2 Wind

Winds in the NWMR typically vary seasonally, with a tendency for winds from the south-westerly quadrant during summer and the south-easterly quadrant in winter (**Figure 4-4**). The summer south-westerly winds are driven by high-pressure cells that pass from west to east over the Australian continent. During winter months, the relative position of the high-pressure cells moves further north, leading to prevailing south-easterly winds blowing from the mainland (Pearce et al. 2003). Winds typically weaken and are more variable during the transitional period between the summer and winter regimes, typically April and August.

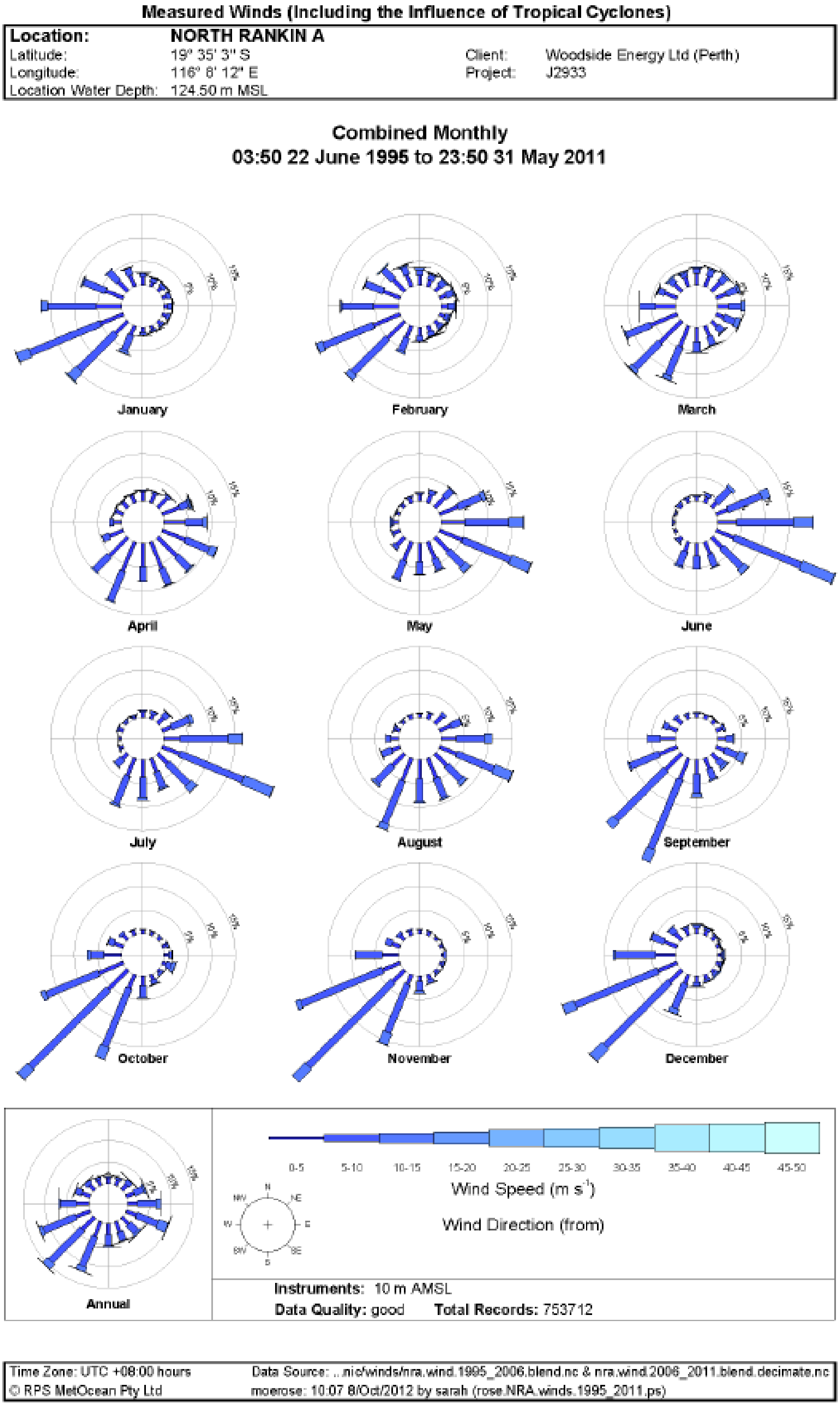


Figure 4-4: NWS monthly and annual wind roses derived from NRC measured 1995–2011 wind data

4.4.1.3 Tropical Cyclones

Tropical cyclones are a relatively frequent weather event in the NWMR (**Figure 4-5**), with the Pilbara coast experiencing more cyclonic activity than most other regions of the Australian mainland coast (BoM, 2019b). The tropical cyclone season officially runs from November to April each year, although tropical cyclones may also occur outside this period (BoM 2019b). Significant storm surge is associated with the passage of a cyclone, which can result in very high tides and coastal flooding (BoM 2019b, Pearce et al. 2003).

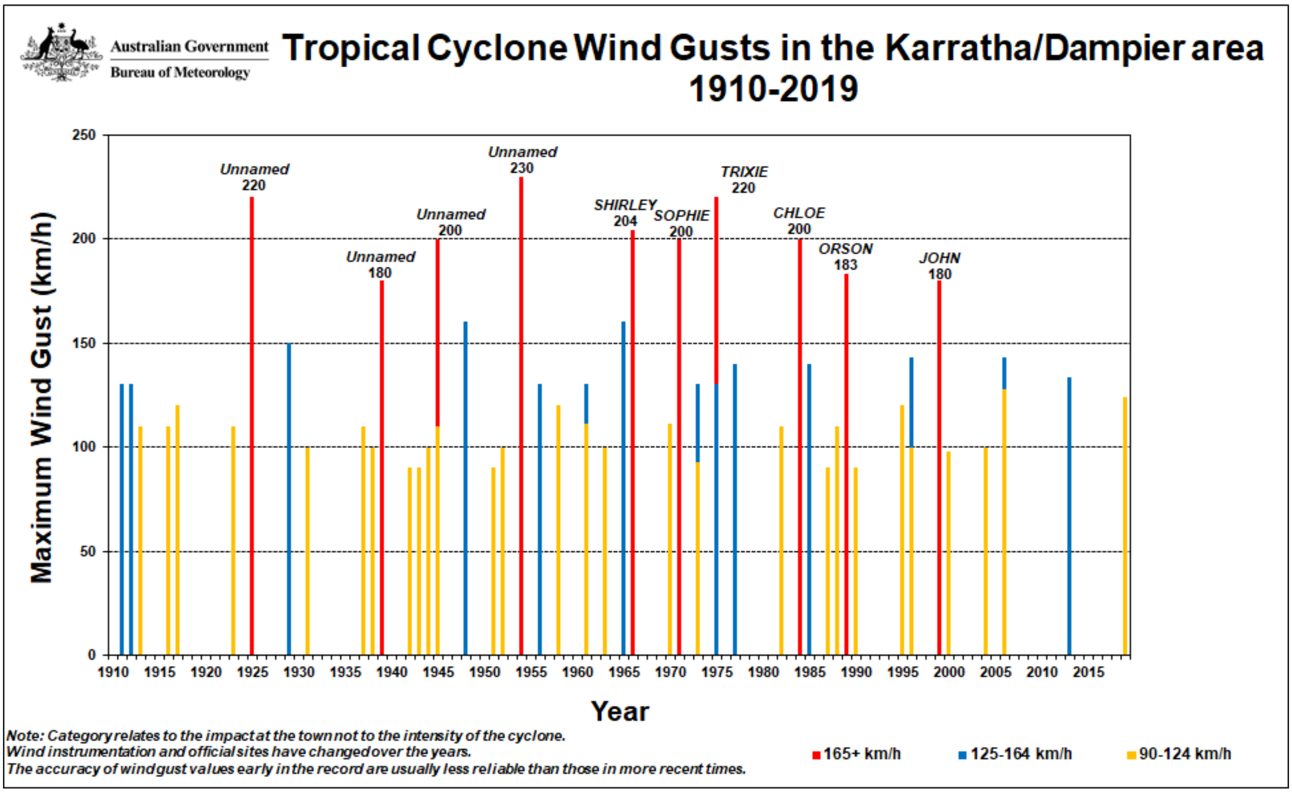


Figure 4-5: Tropical cyclone activity in the Dampier/Karratha region 1910–2019

Source: BoM (2019b)

4.4.2 Oceanography

4.4.2.1 Currents and Tides

Currents in the region consist of local currents driven by winds and tides, superimposed on geostrophic currents. Local winds generate stress on the water surface, forcing the surface layer in the general direction of wind movement, but with an offset (15–45%) in an anti-clockwise direction (Coriolis Effect). In the open ocean, sustained winds result in wind-forced currents of approximately 3% of the wind speed (Holloway and Nye 1985). Thus, a sustained wind of 20 knots may force surface currents of up to 0.6 knots. Wind patterns in the region are described in **Section 4.4.1.2** and shown in **Figure 4-4**.

The large-scale ocean circulation of the NWMR (**Figure 4-6**) is primarily influenced by the Indonesian Through Flow ITF (Potemra et al. 2003), and the Leeuwin Current (James et al. 2004). Both currents are significant drivers of the NWMR ecosystems. The currents are driven by pressure differences between the equator and the higher density cooler and more saline waters of the Southern Ocean, strongly influenced by seasonal change and El Niño and La Niña episodes (DSEWPaC 2012a). The ITF and Leeuwin Current are strongest during late summer and winter (Holloway and Nye 1985, James et al. 2004). Flow reversals to the north-east associated with strong south-westerly winds are typically weak and short-lived, but can generate upwelling of cold deep water onto the shelf (Condie et al. 2006, Holloway and Nye 1985, James et al. 2004).

The Leeuwin Current flows southward along the edge of the continental shelf and is primarily a surface flow (up to 150 m deep). The Ningaloo Current flows in the opposite direction to the Leeuwin Current, running northward along the outside of Ningaloo Reef and across the inner shelf from September to mid-April (**Figure 4-6**). In March, on the termination of the North-west Monsoon, an ‘extended Leeuwin Current’, currently known as the Holloway Current, develops, flowing to the south-east along the NWS (DSEWPaC 2012a).

In addition to the geostrophic current dynamics, tidally driven currents are a significant component of water movement in the NWMR. Wind driven currents become dominant during the neap tide (Pearce et al. 2003). In summer, the stratified water column and large tides can generate internal waves over the upper slope of the NWMR (Craig 1988). As these waves pass the shelf break at approximately 125 m depth, the thermocline may rise and fall by up to 100 m in the water column (Holloway 1983, Holloway and Nye 1985). Internal waves of the NWMR are confined to water depths between 70 and 1000 m and the dissipation energy from such waves can enhance mixing in the water column (Holloway et al. 2001).

Tides in the NWMR are semi-diurnal and have a pronounced spring-neap cycle, with tidal currents flooding towards the south-east and ebbing towards the north-west (Pearce et al. 2003). The NWMR exhibits a considerable range in tidal height, from microtidal ranges (<2 m) south-west of Barrow Island to macrotidal (>6 m) north of Broome (Brewer et al. 2007, Holloway 1983). Storm surges and cyclonic events can also significantly raise sea levels above predicted tidal heights (Pearce et al. 2003).

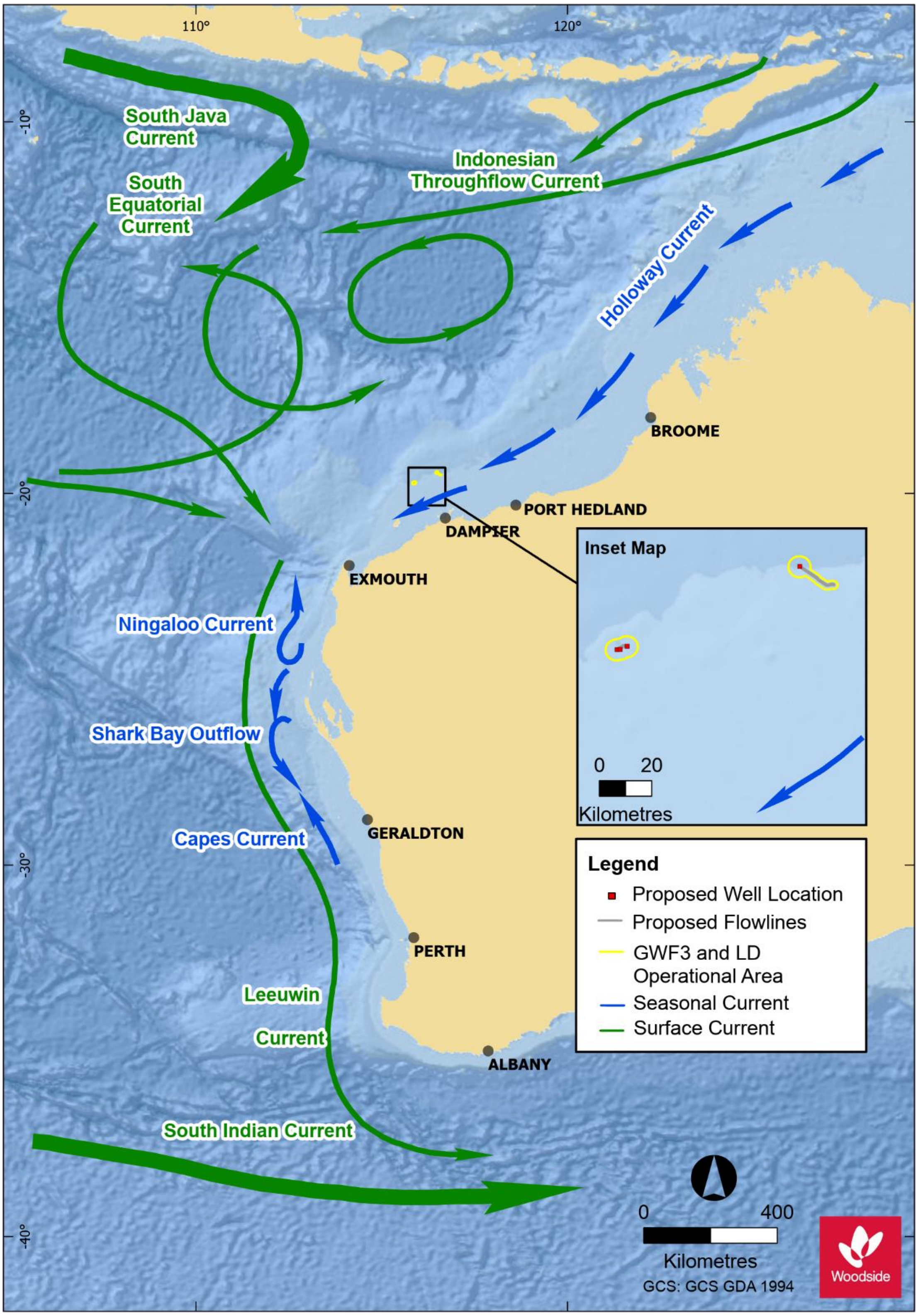


Figure 4-6: Large-scale ocean circulation of the NWMR including the location of the Indonesian Throughflow and other currents of significance

Source: Department of the Environment, Water, Heritage and the Arts (DEWHA) 2008

4.4.2.2 Wave Height

Datawell waverider buoys measured wave height from 1993 to 2005 near the Pluto platform about 55 km from the Operational Area, recording a maximum measured non-cyclonic significant wave height of 6.2 m and a combined non-cyclonic and cyclonic maximum wave height of 11.4 m.

Waves within the NWS Province reflect the direction of the synoptic winds and flow predominantly from the south-west in the summer, and from the east in winter (Pearce et al. 2003). Only 10% of significant wave heights off Dampier exceed 1.2 m, with the average wave height being 0.7 m (Pearce et al. 2003). Storms and cyclones may generate swells up to 8.0 m high (Pearce et al. 2003).

4.4.2.3 Seawater Characteristics

The offshore, oceanic seawater characteristics of the NWS Province exhibit seasonal and water depth variation in temperature and salinity, greatly influenced by major currents in the region (see **Section 4.4.2.1**). Surface waters are relatively warm year-round due to the tropical water supplied by the ITF and the Leeuwin Current, with temperatures reaching 30°C in summer and dropping to 22°C in winter (Pearce et al. 2003). Near seabed temperatures in deeper waters of the outer shelf (greater than 120 m water depth) are less variable, with temperatures averaging 22–24°C year-round.

During summer, the water column is thermally stratified due to surface heating, with the thermocline occurring between 50 and 100 m water depth, indicating surface waters are well mixed within the Operational Area (BMT Oceanica 2015a, James et al. 2004). Surface waters are also relatively well mixed in winter due to a weaker thermal gradient and persistent south-easterly winds promoting mixing, with the thermocline occurring at around 120 m depth (DSEWPaC 2012a, James et al. 2004).

Seawater temperature records at the Pluto platform (55 km south-west of the Operational Area) over a period of 13 months from December 2005 to January 2007 show surface waters reach their maximum average temperatures in March and April (average about 28.5°C) and are coolest in August, September and October (average about 24.3°C) (BMT Oceanica 2015a, Woodside Energy 2006).

Variation in surface salinity across the NWMR throughout the year is minimal (between 35.2 and 35.7 practical salinity unit (PSU)), with slight increases occurring during the summer months due to intense coastal evaporation (James et al. 2004, Pearce et al. 2003). This small increase in salinity during summer is then countered by the arrival of the lower salinity waters of the Leeuwin Current and ITF in autumn and winter (James et al. 2004).

Turbidity is primarily influenced by sediment transport by oceanic swells and primary productivity (Pearce et al. 2003). Upwelling of nutrient-rich waters may increase phytoplankton productivity in the photic zone, which may increase local turbidity (Wilson et al. 2003). In nearshore areas, turbidity is highly variable due to storm runoff, wind-generated waves and large tidal ranges (Pearce et al. 2003). Periodic events, such as major sediment transport associated with tropical cyclones, may influence turbidity on a regional scale (Brewer et al. 2007).

Water quality in the NWMR within the EMBA is regulated by the ITF, a low-salinity water mass that plays a key role in initiating the Leeuwin Current (DSEWPaC 2012a). It brings warm, low-nutrient, low-salinity water from the western Pacific Ocean through the Indonesian Archipelago to the Indian Ocean. It is the primary driver of the oceanographic and ecological processes in the region (DEWHA 2008). South of the NWMR, the Leeuwin Current continues to bring warm, low-nutrient, low-salinity water further south. Eddies formed by the Leeuwin Current transport nutrients and plankton communities offshore (DEWHA 2008). During summer, the Leeuwin Current typically weakens and the Ningaloo Current develops, facilitating upwellings of cold, nutrient-rich waters up onto the NWS (DSEWPaC 2012a). Other areas of localised upwelling in the NWMR include the Wallaby Saddle and Exmouth Plateau, where these seabed topographical features force the surrounding deeper, cooler, nutrient-rich waters up into the photic zone (DSEWPaC 2012a).

4.4.3 Bathymetry, Geomorphology and Seabed Habitat

The Operational Area lies in waters about 80 to 130 m deep on the continental shelf of the NWS (**Figure 4-7**). The bathymetry within the Operational Area indicates that the seabed is generally flat, which is consistent with the broader NWS Province shelf region (Baker et al. 2008). The seabed within this shelf region has a gentle (0.05°) seaward gradient, extending to a relatively steep outer slope about 200 to 300 km offshore, in water depths of about 200 m (Dix et al. 2005). The continental slope then descends more rapidly from the shelf edge to depths greater than 1000 m to the north-west (James et al. 2004).

The bathymetry indicates gently sloping seabed habitat for the Operational Area and predominately homogenous, soft, unconsolidated sediments typical of the middle and outer NWS shelf as defined by Baker et al. (2008). The middle shelf is classified as poorly sorted sediment: gravel, sand and aragonite carbonate muds, while the outer shelf and slope are classified as carbonate sand and gravel with very little mud (Baker et al. 2008), refer to **Section 4.4.4** for more details on marine sediments.

Extensive geophysical and geotechnical data are available and were used to describe the seabed features and general geomorphology of this area close to the edge of the continental shelf in water depth between 75-140 m (Woodside, 2019). The GWF-3 seafloor is described as mainly smooth, flat and featureless comprising of carbonate silty sandy containing scattered small pockmarks (diameter: 5-10 m and depth less than 2 m). The regional area is known to contain seafloor outcrops of calcarenite in the form of low (less than 2 m) high narrow linear ridges trending SE to NW replicating Pleistocene palaeo shorelines (features associated with the ancient coastline KEF).

Seabed habitat comprising hard substrates were not identified during a video benthic habitat and box grab seabed sediment sampling survey of the Lambert Deep development area (Jacobs 2014) and no extensive areas of hard substrate are expected within the GWF-3 development area, indicated by sediment sampling conducted around the GWA platform.

A reconnaissance survey undertaken of the proposed pipeline route linking the Angel platform and NRC (south and south-west of the proposed LDA01 well, north and north-east of the proposed GWF-3 wells) indicated occasional outcrops of cemented substrate occur in localised depressions, and identified a plateau-like structure up to 4 m higher than the flat, unconsolidated soft sediment seabed habitat of the south-west section of the proposed pipeline route (SKM 2006). Further supporting the potential for sparse outcrops of hard substrate within the Operational Area which is predominately composed of a flat, unconsolidated soft sediment seabed habitat.

The KEF Ancient Coastline at the 125 m depth contour is mapped as overlapping part of the Operational Area (DAWE 2019a), refer to **Section 4.7.7. and Figure 4-18**.

Recent mapping of this KEF in water depths of 110 to 170 m by AIMS as part of the North West Shoals to Shore research program reported that the KEF seabed habitat was predominately sandy sediments (AIMS 2019). Areas of this KEF comprise exposed limestone pavement (hard substrate) and though not extensive within the Operational Area they may occur, as indicated by the reconnaissance survey (SKM 2006).

Glomar Shoal (**Figure 4-7**) is a shallow sedimentary bank comprising coarser biogenic material than the surrounding seabed located about 1 km south-east of the Operational Area. This geomorphic feature has been defined as a KEF (see **Section 4.7.5**) and rises from about 70 m below sea level, to about 22 m at lowest astronomical tide (LAT) at its shallowest point (Falkner et al. 2009). Notably, the closest proposed well (LDA-01) for the Petroleum Activities Program is about 16 km from Glomar Shoal.

Rankin Bank (**Figure 4-7**) is a sedimentary bank located on the continental shelf about 19 km west of the Operational Area. The bank rises from about 40 to 50 m below sea level, to about 18 m from the sea surface. The formation includes three major shallow banks (18 to 30 m) defined by the 50 m bathymetric contour (Australian Institute of Marine Science (AIMS) 2014a). Glomar Shoal and Rankin Bank are described in further detail in **Section 4.7**.

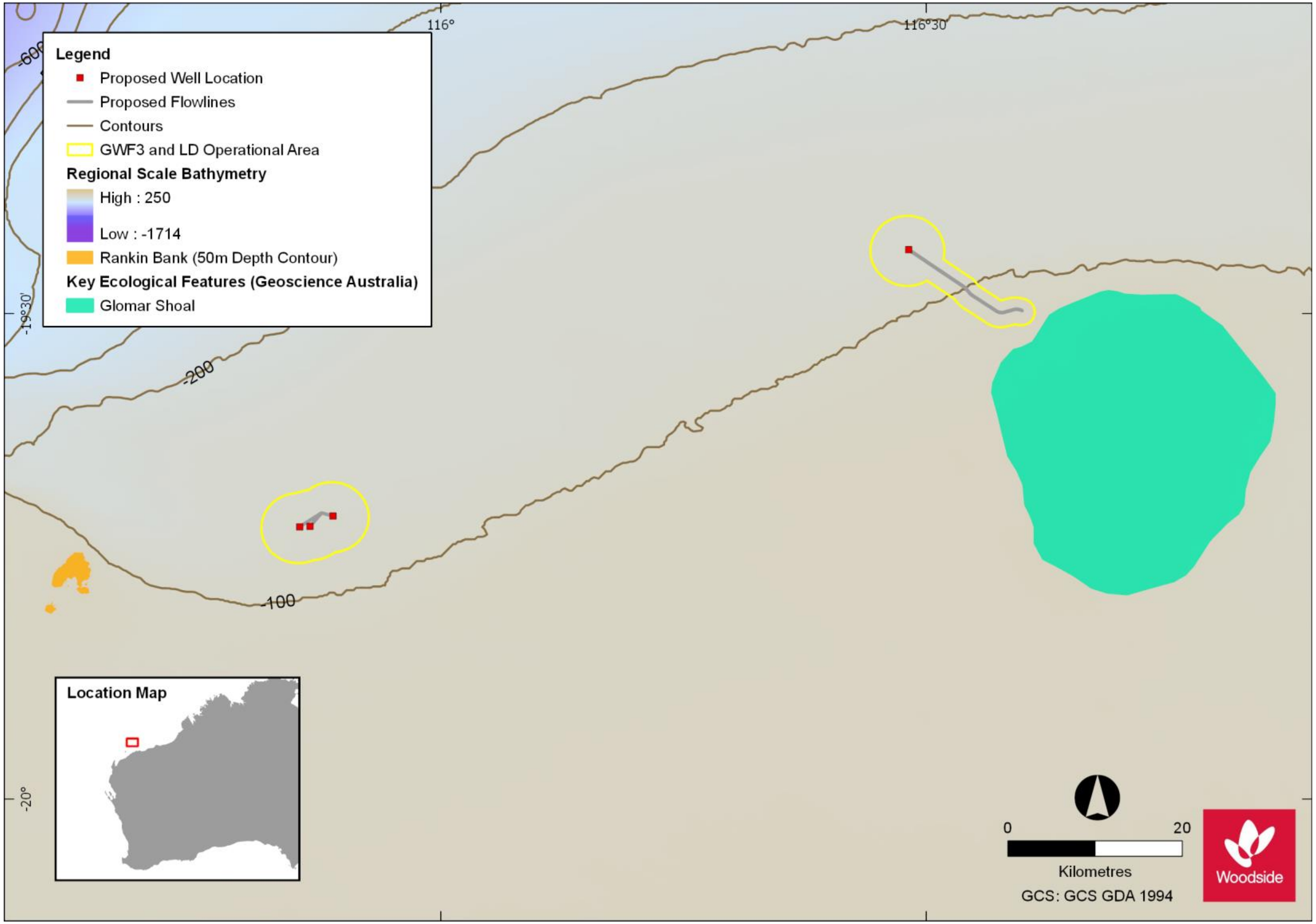


Figure 4-7: Bathymetry and seabed features of the Operational Area

4.4.4 Marine Sediment

Sediments in the Operational Area are expected to be broadly consistent with those in the NWS Province, which comprise primarily fine sands, very fine sands and silt (Baker et al. 2008). Surveys undertaken to inform previous petroleum activities in the vicinity of the Petroleum Activities Program have shown comparable results, including surveys for the GWA platform (about 4 km north-east of the Operational Area, **Figure 3-4**; BMT Oceanica 2015a); the Angel development area and pipeline corridor (within the Operational Area, **Figure 3-5**; SKM 2006, Jacobs 2014); and the Okha FPSO (13 km south-west of the Operational Area; BMT Oceanica 2015b), as discussed below.

A baseline environmental survey undertaken for the Lambert Deep development which sampled five locations (along the proposed pipeline corridor between the Angel Platform and proposed LD well locations) using a box corer at depths of between 94 m and 128 m. The seabed sediment samples were described as offshore sub-littoral sediments that included poorly sorted fine sands, muddy sands, coarser silt sediments and shell fragments (Jacobs 2014). Sediments within the Lambert Deep Operational Area are expected to be similar. Finer sediments were associated with the deeper seabed areas sampled in this study (Jacobs 2014).

Sediments sampled during this survey were found to have concentrations of metals/metalloids below ANZECC & ARMCANZ (2000) guidelines, with the exception of barium, beryllium, cobalt, manganese and vanadium for which there are no guideline values available. Copper, manganese and nickel concentrations were found to be slightly higher at deeper sample locations (Jacobs 2014). This may be associated with the finer sediments and their increased surface area. Barium concentrations were found to be higher at the deeper sample locations (those farthest from the Angel platform). Barium is associated with drilling activities and most likely attributable to petroleum activities in the wider area as barium in the form of barite (barium sulphate) is commonly used in drilling fluids (IOGP 2016). Metal/metalloid concentrations found in this survey were similar to those found during a survey of the proposed Angel pipeline corridor (SKM 2006), which also featured some sites with elevated barium concentrations.

Sediments around the GWF-3 development are expected to be very similar to those in proximity of the GWA platform where sediments are typically carbonate and dominated by fine and very fine sands, with finer muddy sediments occurring in deeper waters to the north east of the platform (BMT Oceanica 2015a). Due to historic drilling activities, it is expected that sediments may contain elevated concentrations of drilling fluid additives such as barium. Barium has low solubility in seawater, limited environmental mobility and low toxicity to plants and animals (Neff, 2008).

4.4.5 Air Quality

There is a lack of air quality data for the offshore NWMR air shed. Studies have been undertaken for the nearshore Pilbara environment to monitor known sources of potential air pollution for locations such as the Burrup Peninsula and Port Hedland, but no monitoring has been undertaken offshore.

Due to the extent of the open ocean area and the activities that are currently undertaken, it is considered that the ambient air quality in the Operational Area and wider offshore NWMR are of high quality.

4.5 Biological Environment

4.5.1 Habitats

4.5.1.1 Critical Habitat and Threatened Ecological Communities

No Critical Habitats or Threatened Ecological Communities listed under the EPBC Act occur within the Operational Area or EMBA, as indicated by the PMST reports provided in **Appendix C**.

4.5.1.2 Marine Primary Producers

Seabed communities in deeper shelf waters receive insufficient light to sustain ecologically sensitive primary producers such as seagrasses, macroalgae or zooxanthellate corals. These benthic primary producer groups are, therefore, not likely to occur in the Operational Area given the depth of water is between 80 and 130 m, deeper than the phototrophic zone of the NWS which extends to approximately 70 m depth. Surveys undertaken for petroleum activities within the vicinity of the Operational Area have not recorded primary producers (SKM 2006, Jacobs 2014, Bowman Bishaw Gorham 2002). Benthic primary producer habitats are, however, widespread within the EMBA in relatively shallow waters (typically <30 m water depth), fringing the mainland coast, offshore islands, reefs and sedimentary banks (DSEWPaC 2012), as discussed below.

Coral Reef

Coral reef habitats typically feature a high diversity of corals, site-attached fish and other sessile and mobile invertebrate species of both commercial and conservation importance. Coral communities established in deeper waters on the middle to outer continental shelf in the region are termed mesophotic (low light dependent) and are hence restricted to benthic habitats that receive sufficient photosynthetically active radiation (PAR) to support zooxanthellate corals (Wahab et al. 2018). Turbidity strongly influences PAR reaching the seabed, with less turbid areas supporting zooxanthellate corals to greater depths (Wahab et al. 2018). As noted above, water depths within the Operational Area are unlikely to support benthic primary producers such as coral communities. The North West Shelf environment exhibits periods of relatively high turbidity due to strong tidal regimes and cyclonic activity (**Section 4.4.2.1**). Notable coral habitat within the EMBA includes, but is not limited to (approximate distance and direction from the closest point of the Operational Area in brackets):

- Submerged shoal features (supporting mesophotic coral habitat):
  - the Glomar Shoal KEF (1 km south-east of the LD Operational Area; see **Section 4.7.5**)
  - Rankin Bank (19 km west of the GWF-3 Operational Area
- Coastal, fringing coral habitat:
  - the Montebello Island group (68 km south-west to State Marine Park from the GWF-3 Operational Area)
  - the Barrow Island and Lowendal Island group (87 km south-west to Marine Management Area)
  - the Ningaloo Coast (incl. Muiron Islands) (271 km south-west to World Heritage Area (WHA))
- Oceanic remote reef systems:
  - the Rowley Shoals comprising three coral reef atolls (312 km north-east to the Rowley Shoals State Marine Park; see **Section 4.7.4.1**).

Encrusting corals were the most commonly observed hard coral morphology at both Rankin Bank and Glomar Shoal, the coral reef habitats closest to the Operational Area, with other morphologies (e.g. branching, foliose, etc.) less common (Wahab et al. 2018).

Hard corals in the NWMR typically have a distinct spawning season, with most species spawning during autumn (March/April) (Rosser and Gilmour 2008, Simpson et al. 1993). Further information on locations within the EMBA which support coral reef habitats is provided in **Section 4.7**.

Seagrass Beds/Macroalgae

Seagrass beds and macroalgal habitats are a main food source for many marine species and provide key nursery grounds for fish and invertebrates (Heck Jr. et al. 2003, Wilson et al. 2010). In the northern half of WA, and within the North West Shelf region in particular, these habitats are restricted to sheltered and shallow waters due to the large tidal movement, high turbidity, large seasonal freshwater run-off and cyclones experienced by the region (as described in **Section 4.4**). As mentioned, the Operational Area is not likely to feature seagrass or macroalgae habitats due to insufficient light penetrating depths of between 80-130 m. Seagrass beds and macroalgal habitats are, however, widely distributed in the shallow coastal waters within the EMBA, where they receive sufficient light. Further information on locations featuring seagrass and macroalgae habitats is provided in **Section 4.7**.

Mangroves

Mangroves provide complex structural coastal habitats that act as nurseries for many marine species, as well as nesting and feeding sites for many non-marine species such as birds, reptiles and insects (Robertson and Duke 1987). Mangroves also maintain sediment, nutrients and water quality within coastal environments, and reduce coastal erosion. The closest coastal habitats to the Operational Area are found 74 km south-west at the Montebello Islands, which feature mangrove habitat. Mangroves are also located in the EMBA at other offshore islands, such as Barrow Island, and sections of the WA coastline, including the west side of Exmouth Gulf and isolated sections of the Ningaloo Coast. Further information on sensitive locations with mangroves is provided in **Section 4.7**.

4.5.1.3 Other Communities/Habitats

Plankton

Plankton abundance, distribution and species within the Operational Area and EMBA are expected to fluctuate with metocean conditions, seasonality and nutrient availability, as for the wider NWMR. Primary productivity of the NWMR appears to be largely driven by offshore influences (Brewer et al. 2007), with periodic upwelling events and cyclonic influences driving coastal productivity with nutrient recycling and advection. There is a tendency for offshore phytoplankton communities in the NWMR to be characterised by smaller taxa (e.g. bacteria), whereas shelf waters are dominated by larger taxa such as diatoms (Hanson et al. 2007).

For example, along the shelf edge of Ningaloo reef (within the EMBA) peak primary productivity occurs in late summer/early autumn and is associated with a biologically productive period, including mass coral spawning events, and peaks in zooplankton and fish larvae abundance (Department of Conservation and Land Management 2005). Periodic upwelling also occurs throughout the year.

Pelagic and Demersal Fish Populations

Fish species in the NWMR comprise small and large pelagic fish, as well as demersal species. Small pelagic fish inhabit a range of marine habitats, including inshore and continental shelf waters. They feed on pelagic phytoplankton and zooplankton and represent a food source for a wide variety of predators including large pelagic fish, sharks, seabirds and marine mammals (Mackie et al., 2007). Large pelagic fish in the NWMR include commercially targeted species such as mackerel, wahoo, tuna, swordfish and marlin. Large pelagic fish are typically widespread, found mainly in offshore waters (occasionally on the shelf) and often travel extensively. Demersal fish live and feed on or near the seabed and are associated with a wide range of habitats in the NWMR including coastal and estuarine ecosystems, macroalgal and seagrass communities, and coral reefs (Hutchins, 2001; Blaber et al., 1985). Demersal fish also include commercially important species such as groper, cod and snapper. Fish species richness has been shown to correlate with habitat complexity, with more complex habitat supporting greater species richness and abundance than bare areas (Gratwicke & Speight, 2005).

The Operational Area is described as flat, generally homogenous, apart from patchy outcroppings of hard substrate within a seabed habitat dominated by unconsolidated soft sediment. Pelagic and demersal fish species typical of the NWS will be present but the lack of substantial seabed habitat would indicate diversity and abundance of fish life is most likely representative of the wider NWS. Areas of hard substrate which may support more diverse demersal fish assemblages such as reported for the Ancient Coastline at 125 m Depth Contour KEF overlapping part of the Operational Area may be the exception but seabed bathymetry indicates such areas are patchy and not extensive.

It has been noted, that the Glomar Shoal KEF (1 km south-east of LD Operational Area) and Rankin Bank (19 km west of GWF-3 Operational Area) have also been identified as supporting high demersal fish richness and abundance (Wahab et al. 2018). The Continental Slope Demersal Fish Communities KEF also lies about 35 km west of GWF-3 Operational Area at the closest point. This KEF is identified as one of the most diverse slope assemblages in Australian waters (see **Section 4.7.7.3**). Diversity of demersal fish assemblages on the continental slope between North West Cape and the Montebello Trough is the highest in Australia (>500 species of which 76 are endemic) (DEWHA, 2008). Further information on the ecological values of these KEFs and Rankin Bank is provided in **Section 4.7**.

Notably, surveys undertaken at the existing GWA facility (north-east of the GWF-3 Operational Area) have reported that the presence of this subsea infrastructure has likely resulted in the occurrence of pelagic and demersal fish communities that would otherwise not occur in the area (McLean et al. 2017, 2018, 2019). At least 57 species and 20 families were recorded from a 2019 survey of the GWA platform jacket. Of the 8676 individual fish, 51% were small unidentifiable species in schools or site-attached species. Fish abundance was highest at water depths of 25 to 50 m (McLean 2019). Dominant identifiable species were bigeye trevally, basslets, schooling bannerfish, wrasse and surgeonfish. Several commercial fish species were also recorded, including three species of snapper (McLean et al. 2019). Fish assemblages were found to vary with depth, as did marine growth on the infrastructure. Some of these species recorded at GWA may, therefore, be present within the Operational Area. Other existing petroleum infrastructure near to the Operational Area may also support similar fish assemblages.

Filter Feeders and other Invertebrate Benthic Fauna

Filter feeders such as sponges, ascidians, soft corals and gorgonians are sessile benthic biota that feed by actively filtering suspended matter and food particles from water by passing the water over specialised filtration structures (DEWHA 2008). Filter feeders establish on hard substrate in marine environments with strong currents and seabed habitat comprising hard substrate typically supporting more diverse epibenthic communities (Heyward et al. 2001).

Filter feeder communities within the Operational Area are likely to be associated with the patchy outcroppings and exposed hard substrate seabed areas which are not extensive within the soft sediment seabed habitat (as detailed in **Section 4.4.3**). An extensive area to the southeast of Rankin Bank (representing approximately 11,300 hectares of seabed habitat) was a focus of a study commissioned by Woodside and conducted by AIMS in 2014. The seabed habitat mapping and towed video survey verification of the NWS shelf in depths ranging from approximately 72 – 117 m (comparable in depth range to the GWF-3 operational area) confirmed that the seabed was composed primarily of soft sediments and patches of exposed limestone pavement. Benthic communities (eipfauna) were generally absent but there were patches of sparse (1-10% cover) filter feeders, primarily, sponges and gorgonians (sea whips and fans) associated with the exposed hard substrate (AIMS 2014b; Figure 4-8).

Sparse Filter Feeders (1-10% cover) Taxa include sea whips, sea fans (gorgonians) soft corals, sponges, hydroids and anemones.	

Figure 4-8: Sparse filter feeder benthic biota (1-10% cover) as recorded for seabed habitats in depths of deeper surveyed areas ranging from 80-112 m on NWS (AIMS, 2014b).

Benthic habitats were surveyed within the Angel development area using an ROV and box grab sampling (Bowman Bishaw Gorham 2002) confirmed the seabed habitat composition as predominately sand which did not support epifauna (benthic biota on the seabed) or patchy hard substrate supporting very sparse epifauna such as filter feeders, specifically sponges, hydroids, crinoids, black corals, soft corals and gorgonians. More recent seabed surveys have confirmed similar benthic biota for this area of the NWS and includes the 2014 survey of the Lambert Deep development area (Jacobs 2014). Benthic biota within the surface seabed sediments (infauna) have been sampled at several locations on the NWS including the proposed Angel pipeline corridor (SKM 2006), the seabed below the GWA and NRC platforms (RPS Environment and Planning 2012a) and GWF-1 development area. All surveys revealed infauna dominated by burrowing polychaete worms (Phylum Annelida) and crustaceans (Phylum Crustacea)

These surveys and others on the NWS have revealed that infauna associated with soft unconsolidated sediment habitat in the area of the NWS Province (within which the Operational Area is located) is widespread and well represented along the continental shelf and upper slopes (Brewer et al. 2007, LeProvost Dames & Moore 2000, Rainer 1991, RPS 2012, SKM 2007a, Woodside Energy 2005).

In contrast, the submerged shoal features of the NWS, Glomar Shoal (1 km south-east of LD Operational Area) and Rankin Bank (19 km west of GWF-3 Operational Area) support significant diversity and abundance of benthic habitats, communities and species; refer to **Section 4.7.7** for additional information.

4.5.2 Species

4.5.2.1 Protected Species

The PMST has been used to identify EPBC Act listed species and MNES that may occur within the Operational Area and the EMBA (**Appendix C**). These results inform the assessment of impacts from planned activities and unplanned events (**Section 6.6** and **Section 6.7**). It should be noted that the PMST is a general database that conservatively identifies areas in which protected species have the potential to occur.

A total of 65 EPBC Act listed species (41 Threatened species and 63 Migratory species) considered to be MNES were identified as potentially occurring within the EMBA, of which a subset of 31 and 33 species were identified as potentially occurring within the GWF-3 and LD Operational Area, respectively (**Table 4-2**). The full list of species identified from the PMST is provided in **Appendix C**.

Several MNES that are not considered to be credibly impacted (e.g. terrestrial species within the EMBA) were identified by the PMST, and were excluded from further consideration (see **Appendix C** for the excluded list of species and justification for exclusion). Two species listed as Conservation

Dependent under the EPBC Act (which were not identified by the PMST search) are considered likely to occur within the Operational Area and EMBA. These species, the southern bluefin tuna and scalloped hammerhead, are listed on the Species Profile and Threats Database (SPRAT) (DoEE, 2019) and are described in **Section 4.5.2.8**.

Table 4-2: Species identified by the EPBC Act Protected Matters search as potentially occurring within or using habitat in the Operational Area and/or EMBA

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area		EMBA
				GWF-3	LD	
Mammals						
Balaenoptera borealis	Sei Whale	Vulnerable	Migratory	Y	Y	Y
Balaenoptera musculus	Blue Whale	Endangered	Migratory	Y	Y	Y
Balaenoptera physalus	Fin Whale	Vulnerable	Migratory	Y	Y	Y
Megaptera novaeangliae	Humpback Whale	Vulnerable	Migratory	Y	Y	Y
Balaenoptera edeni	Bryde's Whale	N/A	Migratory	Y	Y	Y
Orcinus orca	Killer Whale	N/A	Migratory	Y	Y	Y
Physeter macrocephalus	Sperm Whale	N/A	Migratory	Y	Y	Y
Tursiops aduncus (Arafura/Timor Sea populations)	Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	N/A	Migratory	Y	Y	Y
Eubalaena australis	Southern Right Whale	Endangered	Migratory	N/A	N/A	Y
Balaenoptera bonaerensis	Antarctic Minke Whale	N/A	Migratory	N/A	N/A	Y
Sousa chinensis	Indo-Pacific Humpback Dolphin	N/A	Migratory	N/A	N/A	Y
Dugong dugon	Dugong	N/A	Migratory	N/A	N/A	Y
Reptiles						
Caretta caretta	Loggerhead Turtle	Endangered	Migratory	Y	Y	Y
Chelonia mydas	Green Turtle	Vulnerable	Migratory	Y	Y	Y
Dermochelys coriacea	Leatherback Turtle	Endangered	Migratory	Y	Y	Y
Eretmochelys imbricata	Hawksbill Turtle	Vulnerable	Migratory	Y	Y	Y
Natator depressus	Flatback Turtle	Vulnerable	Migratory	Y	Y	Y
Aipysurus apraefrontalis	Short-nosed Sea snake	Critically Endangered	N/A	N/A	N/A	Y

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area		EMBA
				GWF-3	LD	
Fishes and Elasmobranchs						
Carcharodon carcharias	Great White Shark	Vulnerable	Migratory	Y	Y	Y
Carcharias taurus	Grey Nurse Shark (west coast population)	Vulnerable	N/A	N/A	N/A	Y
Pristis zijsron	Green Sawfish	Vulnerable	Migratory	Y	Y	Y
Rhincodon typus	Whale Shark	Vulnerable	Migratory	Y	Y	Y
Anoxypristis cuspidata	Narrow Sawfish	N/A	Migratory	Y	Y	Y
Isurus oxyrinchus	Shortfin Mako	N/A	Migratory	Y	Y	Y
Isurus paucus	Longfin Mako	N/A	Migratory	Y	Y	Y
Manta birostris	Giant Manta Ray	N/A	Migratory	Y	Y	Y
Manta alfredi	Reef Manta Ray	N/A	Migratory	Y	Y	Y
Thunnus maccoyii	Southern Bluefin Tuna	Conservation Dependent	N/A	Y	Y	Y
Sphyrna lewini	Scalloped Hammerhead	Conservation Dependent	N/A	Y	Y	Y
Pristis clavata	Dwarf Sawfish	Vulnerable	Migratory	N/A	N/A	Y
Pristis pristis	Freshwater Sawfish	Vulnerable	Migratory	N/A	N/A	Y
Lamna nasus	Porbeagle, Mackerel Shark		Migratory	N/A	N/A	Y
Birds						
Calidris canutus	Red Knot, Knot	Endangered	Migratory	Y	Y	Y
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	Critically Endangered	Migratory	Y	Y	Y
Sternula nereis nereis	Australian fairy Tern	Vulnerable	N/A	Y	Y	Y
Anous stolidus	Common Noddy	N/A	Migratory	Y	Y	Y
Fregata ariel	Lesser Frigatebird	N/A	Migratory	Y	Y	Y
Actitis hypoleucos	Common Sandpiper	N/A	Migratory	Y	Y	Y

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area		EMBA
				GWF-3	LD	
Calidris acuminata	Sharp-tailed Sandpiper	N/A	Migratory	Y	Y	Y
Calidris melanotos	Pectoral Sandpiper	N/A	Migratory	Y	Y	Y
Calonectris leucomelas	Streaked Shearwater	N/A	Migratory	Y	Y	Y
Fregata minor	Great Frigatebird	N/A	Migratory	Y	Y	Y
Pandion haliaetus	Osprey	N/A	Migratory	N/A	Y	Y
Calidris ferruginea	Curlew Sandpiper	Critically Endangered	Migratory	N/A	N/A	Y
Macronectes giganteus	Southern Giant-Petrel	Endangered	Migratory	N/A	N/A	Y
Pterodroma mollis	Soft-plumaged Petrel	Vulnerable	N/A	N/A	N/A	Y
Ardenna carneipes	Flesh-footed Shearwater	N/A	Migratory	N/A	N/A	Y
*Limosa lapponica baueri**	Bar-tailed Godwit	Vulnerable	Migratory	N/A	N/A	Y
*Limosa lapponica menzbieri**	Northern Siberian Bar-tailed Godwit	Critically Endangered	Migratory	N/A	N/A	Y
Macronectes halli	Northern Giant Petrel	Vulnerable	Migratory	N/A	N/A	Y
Papasula abbotti	Abbott's Booby	Endangered	N/A	N/A	N/A	Y
Rostratula australis	Australian Painted-snipe	Endangered	N/A	N/A	N/A	Y
Thalassarche carteri	Indian Yellow-nosed Albatross	Vulnerable	Migratory	N/A	N/A	Y
Thalassarche cauta cauta	Shy Albatross, Tasmanian Shy Albatross	Vulnerable	Migratory	N/A	N/A	Y
Thalassarche cauta steadi	White-capped Albatross	Vulnerable	Migratory	N/A	N/A	Y
Thalassarche impavida	Campbell Albatross	Vulnerable	Migratory	N/A	N/A	Y
Thalassarche melanophris	Black-browed Albatross	Vulnerable	Migratory	N/A	N/A	Y
Apus pacificus	Fork-tailed Swift	N/A	Migratory	N/A	N/A	Y
Ardenna pacifica	Wedge-tailed Shearwater	N/A	Migratory	N/A	N/A	Y
Hydroprogne caspia	Caspian Tern	N/A	Migratory	N/A	N/A	Y
Onychoprion anaethetus	Bridled Tern	N/A	Migratory	N/A	N/A	Y

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area		EMBA
				GWF-3	LD	
Sterna dougallii	Roseate Tern	N/A	Migratory	N/A	N/A	Y
Charadrius veredus	Oriental Plover	N/A	Migratory	N/A	N/A	Y
Glareola maldivarum	Oriental Pratincole	N/A	Migratory	N/A	N/A	Y
Thalasseus bergii	Crested Tern	N/A	Migratory	N/A	N/A	Y
Tringa nebularia	Common Greenshank	N/A	Migratory	N/A	N/A	Y

** Listed as migratory at the species level*

4.5.2.2 Listed Threatened Species Recovery Plans

The requirements of the threatened species recovery plans and conservation advice (**Table 4-3**) were considered with reference to objectives, actions and threats for these species that may be applicable to the impact and risk assessments (**Section 6**). Recovery plans are enacted under the EPBC Act and remain in force until the species is removed from the threatened list. Conservation advice provides guidance on immediate recovery and threat abatement activities that can be undertaken to conserve a listed species or ecological community.

Table 4-3 outlines the recovery plans and conservation advice relevant to those species identified by the PMST search to potentially occur within or use habitat in the Operational Area and EMBA (**Appendix C**), and summarises the key threats and recovery plan actions documented for those threatened species.

Table 4-3: Conservation advice for EPBC Act listed species considered during environmental risk assessment

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant Conservation Actions	Relevant EP Section
All Vertebrate Fauna				
All vertebrate fauna	Threat abatement plan for the impacts of marine debris on vertebrate marine life (DoEE 2018)	Marine debris	No explicit management actions for non-fisheries-related industries (note that management actions in the plan relate largely to management of fishing waste (e.g. 'ghost' gear), and State and Commonwealth management through regulation)	**6.7.7**
Marine Mammals				
Sei whale	Conservation advice *Balaenoptera borealis* sei whale (Threatened Species Scientific Committee 2015a)	Noise interference	Assess and manage acoustic disturbance	**6.6.3**
		Vessel disturbance	Assess and manage physical disturbance and development activities	**6.7.8**
Blue whale	Conservation management plan for the blue whale: A recovery plan under the EPBC Act 1999 2015–2025 (Commonwealth of Australia 2015)	Noise interference	Action Area A.2: Assess and address anthropogenic noise • Assessing the effect of anthropogenic noise on blue whale behaviour • Anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area.	**6.6.3**
		Vessel disturbance	Action Area A.4: Minimise vessel collisions • Ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented.	**6.7.8**

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant Conservation Actions	Relevant EP Section
Fin whale	Approved conservation advice for *Balaenoptera physalus* (fin whale) (Threatened Species Scientific Committee 2015b)	Noise interference	Assess and address anthropogenic noise	**6.6.3**
		Vessel disturbance	Minimise vessel collisions	**6.7.8**
Humpback whale	Approved conservation advice for *Megaptera novaeangliae* (humpback whale) (Threatened Species Scientific Committee 2015c)	Noise interference	For actions involving acoustic impacts (e.g. pile driving, explosives) on humpback whale calving, resting, feeding area, or confined migratory pathways, site-specific acoustic modelling should be undertaken (including cumulative noise impacts)	**6.6.3**
		Vessel disturbance	Ensure the risk of vessel strike on humpback whales is considered when assessing actions that increase vessel traffic in areas where humpback whales occur and, if required, implement appropriate mitigation measures to reduce the risk of vessel strike	**6.7.8**
Southern right whale	Conservation management plan for the southern right whale: a recovery plan under the EPBC Act 1999 2011–2021 (DSEWPaC 2012b)	Noise interference	Assess and address anthropogenic noise	**6.6.3**
		Vessel disturbance	Minimise vessel collisions	**6.7.8**
Reptiles				
All marine turtle species (loggerhead, green, leatherback, hawksbill and flatback)	Recovery plan for marine turtles in Australia (Commonwealth of Australia 2017)	Chemical and terrestrial discharge (oil pollution)	Action Area A4: Minimise chemical and terrestrial discharge • Ensure spill risk strategies and response programs include management for marine turtles and their habitats	**6.6.5**, **6.6.6**, **6.7.5, 6.7.6**
		Light pollution	Action Area A8: Minimise light pollution • Artificial light within or adjacent to habitat critical to the survival	**6.6.9**

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant Conservation Actions	Relevant EP Section
			of marine turtles will be managed such that marine turtles are not displaced from the habitats (Section 3.3, Table 6 of the recovery plan)	
		Vessel disturbance	No explicit relevant management actions; vessel strikes identified as a threat	**6.7.8**
		Noise interference	No explicit relevant management actions; vessel strikes identified as a threat	**6.6.3**
Leatherback turtle	Approved conservation advice on *Dermochelys coriacea* (Threatened Species Scientific Committee 2008a)	Vessel disturbance	No explicit relevant management actions; vessel strikes identified as a threat	**6.7.8**
Short-nosed sea snake	Approved conservation advice for *Aipysurus apraefrontalis* (short-nosed sea snake) (Department of the Environment 2013a)	No additional threats identified (excluding marine debris)	None applicable	N/A
Sharks and Rays				
Grey nurse shark (west coast population)	Recovery plan for the grey nurse shark (*Carcharias taurus*) (Department of the Environment 2014)	No additional threats identified (excl. marine debris)	None applicable	N/A
White shark	Recovery plan for the white shark (*Carcharodon carcharias*) (DSEWPaC 2013b)	No additional threats identified (excl. marine debris)	None applicable	N/A
All sawfish (green, dwarf, freshwater and narrow)	Sawfish and river shark multispecies recovery plan (Commonwealth of Australia 2015b)	Habitat degradation/ modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat	**6.6.2**, **6.7.9**, **6.7.10**
Green sawfish	Approved conservation advice for *Pristis zijsron* (green sawfish) (Threatened Species Scientific Committee 2008b)	Habitat degradation/ modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat	**6.6.2**, **6.7.9**, **6.7.10**

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant Conservation Actions	Relevant EP Section
Dwarf sawfish	Approved conservation advice for *Pristis clavata* (dwarf sawfish) (Threatened Species Scientific Committee 2009)	Habitat degradation/ modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat	**6.6.2**, **6.7.9**, **6.7.10**
Largetooth/Freshwater sawfish	Approved conservation advice for *Pristis pristis* (largetooth sawfish) (Threatened Species Scientific Committee 2014)	Habitat degradation/ modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat	**6.6.2**, **6.7.9**, **6.7.10**
Whale shark	Approved Conservation Advice for *Rhincodon typus* (whale shark) (Threatened Species Scientific Committee 2015d)	Vessel strikes Habitat disruption	Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations, and along the northward migration route that follows the northern WA 200 m isobath.	**6.7.8**
Birds				
Migratory shorebird species	Wildlife conservation plan for migratory shorebirds (Commonwealth of Australia 2015c)	Habitat degradation/ modification	Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes	**6.6.3, 6.6.9, 6.7.2, 6.7.3**
Curlew sandpiper	Conservation advice *Calidris ferruginea* curlew sandpiper (Threatened Species Scientific Committee 2015f)	Habitat loss and degradation from pollution	Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment process	**6.6.3, 6.6.9, 6.7.2, 6.7.3**
Red knot	Approved Conservation Advice for *Calidris canutus* (Red knot) (Threatened Species Scientific Committee 2016a)	Pollution/contamination	No explicit relevant management actions; pollution identified as a threat	**6.6.3, 6.6.9, 6.7.2, 6.7.3**
Bar-tailed godwit (*baueri*)	Conservation advice *Limosa lapponica baueri* bar-tailed godwit (western Alaskan) (Threatened Species Scientific Committee 2016d)	Habitat degradation/ modification	No explicit relevant management actions; habitat degradation/modification identified as a threat	**6.6.3, 6.6.9, 6.7.2, 6.7.3 6.7.6**

Species	Recovery plan/conservation advice (date issued)	Key threats identified in the recovery plan/ conservation advice	Relevant Conservation Actions	Relevant EP Section
All Petrels and Albatrosses (southern giant-petrel, soft-plumaged petrel, northern giant petrel, indian yellow-nosed albatross, white-capped albatross, campbell albatross, black-browed albatross)	National recovery plan for threatened albatrosses and giant petrels (DSEWPaC 2011)	Marine pollution	No explicit relevant management actions; pollution identified as a threat	**6.6.3, 6.6.9, 6.7.2, 6.7.3**
Northern Siberian bar-tailed godwit	Conservation advice *Limosa lapponica menzbieri* bar-tailed godwit (northern Siberian) (Threatened Species Scientific Committee 2016e)	Habitat degradation/ modification	No explicit relevant management actions; habitat degradation/modification identified as a threat	**6.6.3, 6.6.9, 6.7.2, 6.7.3**
Eastern curlew	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew) (Threatened Species Scientific Committee 2015g)	Habitat loss and degradation from pollution	Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment process	**6.6.3, 6.6.9, 6.7.2, 6.7.3**
Abbott's booby	Conservation advice *Papasula abbotti* Abbott's booby (Threatened Species Scientific Committee 2015h)	No additional threats identified (ex. marine debris)	None applicable	**6.6.3, 6.6.9, 6.7.2, 6.7.3**
Australian painted snipe	Approved conservation advice on *Rostratula australis* (Australian Painted Snipe) (Threatened Species Scientific Committee 2013)	Habitat degradation/ modification	No explicit relevant management actions; habitat degradation/modification identified as a threat	**6.6.3, 6.6.9, 6.7.2, 6.7.3**
Australian fairy tern	Conservation advice for *Sterna nereis* (Fairy tern) (Threatened Species Scientific Committee 2011)	Habitat degradation/ modification	No explicit relevant management actions; habitat degradation/modification identified as a threat	**6.6.3, 6.6.9, 6.7.2, 6.7.3**

4.5.2.3 Habitat Critical to the Survival of a Species

In accordance with the EPBC Act ‘Significant Impact Guidelines 1.1 – Matters of National Environmental Significance’ (Commonwealth of Australia, 2013), an action is deemed to have a significant impact if there is a real chance or possibility that it will adversely affect habitat critical to the survival of a species.

Habitat critical to the survival of marine turtles has been identified for nesting and internesting habitat for each marine turtle species genetic stock based on a set criterion outlined in the ‘Recovery Plan for Marine Turtles in Australia 2017-2027’ (Commonwealth of Australia, 2017).

The Operational Area does not include any habitat critical to the survival of a species of marine turtle though the EMBA does overlap with habitat critical to the survival of green, hawksbill, loggerhead and flatback turtle nesting populations (as shown in **Table 4-4** and **Figure 4-9**). The closest being the flatback turtle habitat critical to survival internesting buffer (60 km) located around the Montebello Islands, 14 km south-west of the Operational Area.

Table 4-4: Nesting and internesting areas identified as habitat critical to the survival of marine turtles for each stock that overlap the EMBA.

Species	Nesting Location	Major nesting area	Internesting buffer	Nesting period	Hatching period
Green turtle (North West Shelf genetic stock)	Barrow Island	✓	20 km	Nov-Mar	Jan-May (peak: Feb-Mar)
	Montebello Islands (all with sandy beaches)	✓	20 km	Nov-Mar	Jan-May (peak: Feb-Mar)
	Serrurier Island	x	20 km	Nov-Mar	Jan-May (peak: Feb-Mar)
	Thevenard Island	x	20 km	Nov-Mar	Jan-May (peak: Feb-Mar)
	Northwest Cape	✓	20 km	Nov-Mar	Jan-May (peak: Feb-Mar)
	Ningaloo Coast	x	20 km	Nov-Mar	Jan-May (peak: Feb-Mar)
Loggerhead turtle (Western Australian genetic stock)	Muiron Islands	✓	20 km	Nov-May	Jan-May
	Gnaraloo Bay	✓	20 km	Nov-May	Jan-May
	Ningaloo Coast	x	20 km	Nov-May	Jan-May
Flatback turtle (Pilbara genetic stock)	Montebello Islands (all with sandy beaches)	x	60 km	Oct-Mar	Feb-Mar
	Barrow Island	✓	60 km	Oct-Mar	Feb-Mar
	Coastal islands from Cape Preston to Locker Island	x	60 km	Oct-Mar	Feb-Mar
	Dampier Archipelago (including Delambre Island and Huay Island)	x	60 km	Oct-Mar	Feb-Mar
	Mundabullangana Beach	✓	60 km	Oct-Mar	Feb-Mar
Hawksbill turtle (Western Australia genetic stock)	Montebello Islands (including Ah Chong Island, South East Island and Trimouille Island)	✓	20 km	Oct-Feb	all year (peak: Dec-Feb)
	Lowendal Islands (including Varanus Island, Beacon Island and Bridled Island)	x	20 km	Oct-Feb	all year (peak: Dec-Feb)
	Dampier Archipelago (including Rosemary Island and Delambre Island)	✓	20 km	Oct-Feb	all year (peak: Dec-Feb)

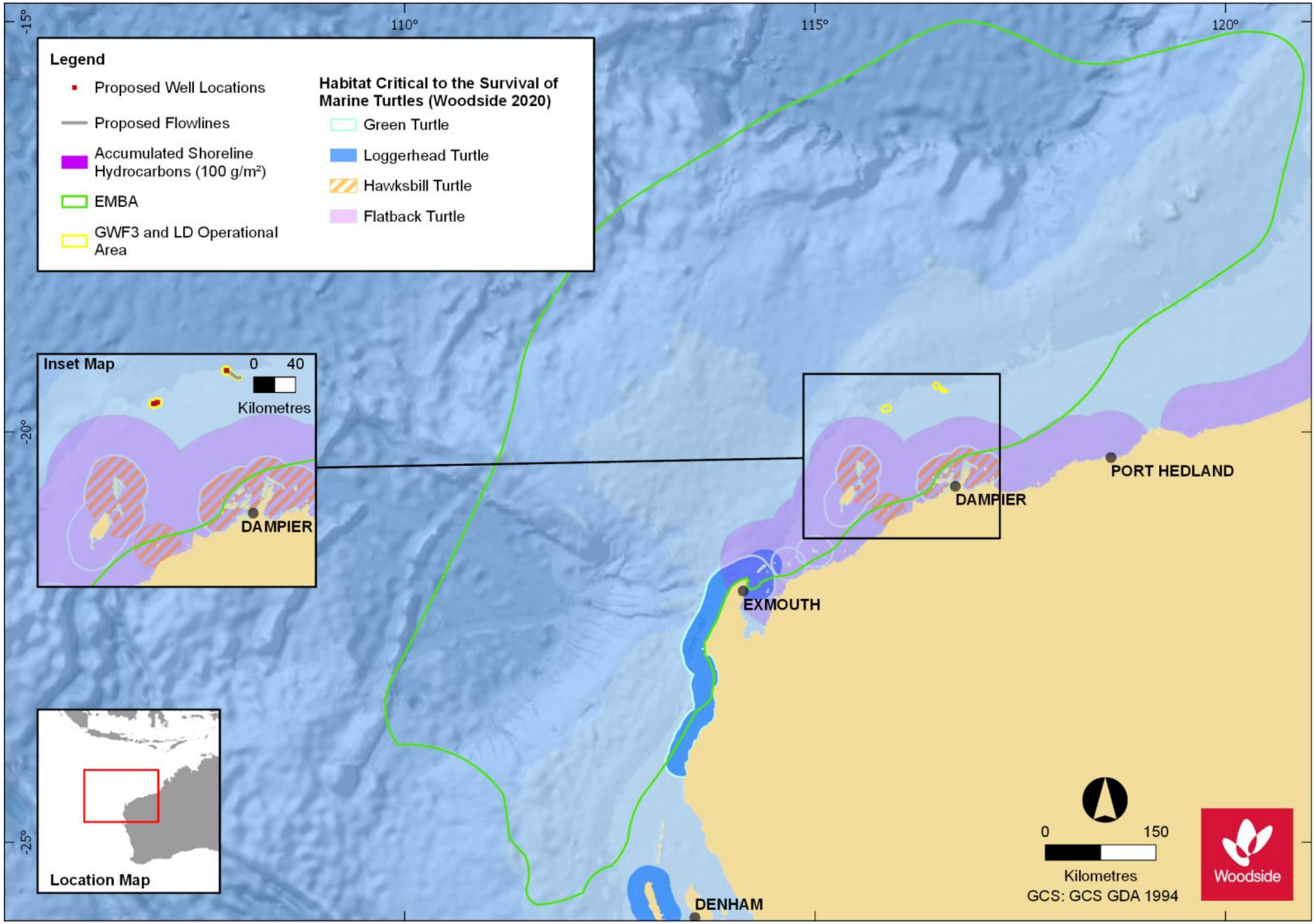


Figure 4-9: Habitat critical to the survival of marine turtles. Data derived by Woodside from the Recovery Plan for Marine Turtles in Australia 2017-2027 (DoEE, 2017).

4.5.2.4 Threatened Species Recovery Plans and Biologically Important Areas

A review of the DAWE threatened species Recovery plans and the National Conservation Values Atlas (DAWE 2019a) identified areas of distribution (as per the Recovery Plans) and a number of Biologically Important Areas (BIAs) overlap spatially with the Operational Area and EMBA.

Overlapping both the GWF-3 Operational Area and LD Operational Area and EMBA:

- breeding BIA with foraging buffer for the wedge-tailed shearwater during its breeding season (August–April)
- foraging BIA for whale sharks northward from Ningaloo along the 200 m isobath, with seasonally high use (April to June)
- Internesting BIA for the flatback turtle around the Montebello Islands extends 80 km from nesting beaches and overlaps with the GWF-3 Operational Area, only. Refer to Section 4.5.2.7, for explanation on the low likelihood of internesting flatback turtles being present in the Operational Area.

Overlapping the EMBA:

- Pygmy blue whale migration corridor BIA, annual seasonal migration passing the North West Cape area towards Indonesia between April – August, peak numbers between May and June (northerly migration) and their southerly return passing North West Cape from October to January (with the peak in late November – December).
- Habitat critical to survival internesting and nesting areas and BIAs for flatback, green, loggerhead and hawksbill turtles overlap with the EMBA as shown in **Table 4-4** and **Figure 4-9.**
- The ‘Marine Bioregional plan for the North-west Marine Region’ (Commonwealth of Australia, 2012) (prepared under the *Environment Protection and Biodiversity Conservation Act 1999*) defines a BIA as an area of spatial aggregations of individuals of a species are known from the literature to demonstrate biologically important behavior such as breeding, foraging, resting and migration. Several BIAs occur within the EMBA, as listed in **Table 4-5**. Additional information on BIAs is provided in the species-specific summaries in **Section 4.5.2**.

Table 4-5: BIAs overlapping the Operational Area and within the EMBA

Species	BIA Type (location)	Distance from Operational Area at closest point (km)
Marine Mammals		
Pygmy Blue Whale	Migration	33
	Possible Foraging Area	302
Humpback Whale	Migration	26
	Resting (Exmouth)	258
	Resting (Shark Bay)	584
Dugong	Multi-use (breeding/calving/foraging/nursing) (Exmouth Gulf and Ningaloo Reef)	254
Marine Reptiles		

Species	BIA Type (location)	Distance from Operational Area at closest point (km)
Flatback Turtle	Internesting (Montebello Islands[1], Dampier Archipelago, Legendre Island, Huay Island, Delambre Island, Thevenard Island)	Overlaps GWF-3 Operational Area[5]
	Nesting (Barrow Island[1], Thevenard Island, Montebello Islands)	70
	Foraging (Montebello Islands[1], Barrow Island)	70
	Mating (Montebello Islands[1], Barrow Island)	70
Green Turtle	Internesting (Montebello Islands [1], Dampier Archipelago, Barrow Island, North West Cape, Muiron Islands)	46
	Foraging (Montebello Islands[1], Barrow Island)	66
	Mating (Montebello Islands[1], Barrow Island)	66
	Nesting (Montebello Islands[1], Dampier Archipelago, Barrow Island, Muiron Islands, and North West Cape/Exmouth Gulf and Ningaloo Coast)	66
	Basking (Barrow Island)	106
Hawksbill turtle	Internesting (Montebello Islands [1], Barrow Island, Varanus Island, Dampier Archipelago, Lowendal Islands, Barrow Island, Thevenard Island, Ningaloo Coast and Jurabi coast)	51
	Nesting[2] (Montebello Islands [1], Barrow Island, Varanus Island, Dampier Archipelago, Lowendal Islands, Barrow Island, Thevenard Island, Ningaloo Coast and Jurabi coast)	70
	Mating (Montebello Islands[1], Lowendal Islands, Barrow Island)	70
	Foraging (Lowendal Islands[1], Barrow Island)	70
Loggerhead turtle	Internesting (Cohen Island[1] and Rosemary Island in the Dampier Archipelago, Montebello Islands, Ningaloo and Jurabi coast, Gnaraloo Bay)	60
	Nesting[2] (Cohen Island[1], Muiron Islands, Exmouth Gulf and Ningaloo Coast)	80
Sharks, Fish and Rays		
Whale shark	Foraging (northward from Ningaloo along 200 m isobath)	Overlaps Operational Area
	Foraging (Ningaloo Marine Park)	295
Birds		
Australian fairy tern	Breeding (Pilbara and Gascoyne coast and islands[1])	67
Roseate tern	Breeding (Pilbara and Gascoyne coast and islands[1])	65
Wedge-tailed shearwater	Breeding with a foraging buffer (Pilbara and Gascoyne coast and islands[1])	Overlaps Operational Area
Lesser crested tern	Breeding (Pilbara and Gascoyne coast and islands[1])	71
Lesser frigatebird	Breeding with a foraging buffer (Pilbara and Gascoyne coast and islands[1])	156
White-tailed tropicbird	Breeding with a foraging buffer (Rowley Shoals)	213
Little tern	Resting (Rowley Shoals)	353

[5] Note: BIA internesting buffer is 80 km, however, habitat critical to survival for the flatback turtle internesting area is defined as 60 km and does not overlap with the Operational Area. Furthermore, scientific studies have shown flatbacks do not travel into offshore, deep water habitat during internesting, refer to Section 4.5.2.7

Species	BIA Type (location)	Distance from Operational Area at closest point (km)
Bridled Tern	Foraging (in high numbers – Exmouth)	736
Sooty Tern	Foraging (Exmouth)	760

[1] Denotes the closest BIA to the Operational Area where multiple BIAs of the same type overlap the EMBA. Where relevant, distances have been provided for the BIAs closest to the Operational Area only.

4.5.2.5 Seasonal Sensitivities of Protected Species

Periods of the year coinciding with key environmental sensitivities for the Operational Area and the wider regional context, including EPBC Act listed threatened and/or migratory species, are presented in **Table 4-6**. These relate to breeding, foraging or migration of the indicated fauna.

Table 4-6: Key environmental sensitivities and indicative timings for migratory fauna identified within the Operational Area and/or EMBA

Species	January	February	March	April	May	June	July	August	September	October	November	December
Humpback whale – northern migration (Jurien Bay to Montebello)[1]												
Humpback whale – southern migration (Montebello to Jurien Bay)[2]												
East Indian Ocean pygmy blue whale – northern migration (North West Cape, Montebello)[2]												
East Indian Ocean pygmy blue whale – southern migration (Montebello, North West Cape)[2]												
Green turtle– various nesting sites [6]												
Flatback turtle– various nesting sites [7]												
Loggerhead turtle– various nesting sites [8]												
Hawksbill turtle– various nesting sites [9]												
Whale shark* – foraging/aggregation near Ningaloo[10]												
Manta ray – presence/aggregation/breeding Ningaloo[11]												
Australian fairy tern – breeding Ningaloo[10]												
Caspian tern – breeding Ningaloo[10]												
Crested tern – breeding Ningaloo[10]												
Osprey – breeding Ningaloo[10]												
Roseate tern – breeding Ningaloo[10]												
Wedge-tailed shearwater – various breeding sites within EMBA[12]												
Migratory shorebirds[13]												

Species	January	February	March	April	May	June	July	August	September	October	November	December
	Species likely to be present in the region											
	Peak period. Presence of animals reliable and predictable each year											

References for species seasonal sensitivities:

1. *CALM 2005, Environment Australia 2002, Jenner et al. 2001*
2. *McCauley and Jenner 2001, McCauley et al 2018*
3. *DSEWPAC, 2012, McCauley and Jenner 2010*
4. *DSEWPAC, 2012, McCauley and Jenner 2010*
5. *National Marine Fisheries Services 2006, Whitehead 2002a*
6. *Commonwealth of Australia 2017, CALM 2005, DSEWPaC 2012a*
7. *Commonwealth of Australia 2017, DSEWPaC 2012a*
8. *Commonwealth of Australia 2017, CALM 2005*
9. *Commonwealth of Australia 2017*
10. *CALM 2005, Environment Australia 2002*
11. *Environment Australia 2002*
12. *DSEWPaC 2012c, Environment Australia 2002*
13. *Bamford et al. 2008*

*(*Periods of sensitivity include whale shark foraging off Ningaloo Coast and foraging northward from the Ningaloo Marine Park along the 200 m isobath.)*

4.5.2.6 Marine Mammals

Cetaceans – Whales

East Indian Ocean Pygmy Blue Whale

Blue whales were identified by the PMST as potentially occurring within the Operational Area and EMBA. There are two recognised subspecies of blue whale within Australian waters; the Antarctic blue whale (*Balaenoptera musculus intermedia*) and the pygmy blue whale (*B. m. brevicauda*) (Commonwealth of Australia, 2015). These sub-species are differentiated by morphology, distribution, vocalisation and genetics (Commonwealth of Australia, 2015). Antarctic blue whales primarily occur in waters south of 60 °S and the pygmy blue whales occur in waters north of 55 °S (DEH 2005b). Subsequently, the pygmy blue whale is the only sub-species expected to occur within the NWMR and the EMBA. The Antarctic pygmy blue whale is, therefore, not discussed further.

The Conservation Management Plan (CMP) for the Blue Whale (Commonwealth of Australia, 2015a) has delineated the areas of blue whale distribution in Australian waters and defined areas of biological importance for WA waters (known distribution, foraging areas and possible foraging areas) which largely reflect BIAs for the migratory corridor and foraging as shown on the National Conservation Values Atlas (**Figure 4-10**, **Section 4.5.2.4**).

The pygmy blue whale population is seasonally distributed east across the Great Australian Bight and Bonney Upwelling to beyond the Bass Strait, round to Western Australia and the known foraging area off the Perth Canyon to Indonesia (breeding area) and this sub-species population is referred to as the East Indian Ocean (EIO) pygmy blue whale population. In the NWMR and within the EMBA, EOI pygmy blue whale migration is thought to follow deep oceanic routes (DEWHA, 2008) and the main migration corridor is between the 500 and 1,000 m depth contour on the edge of the continental slope (i.e. west of the Operational Area), where they are likely to carry out opportunistic feeding on ephemeral krill aggregations (DEWHA 2008). This migration corridor has been defined by the CMP and by the DAWE as a BIA for the species and spatially overlaps the EMBA (**Figure 4-10**). Sea noise loggers at various locations along the WA coast have detected an annual northbound migration past the North West Cape and the Montebello Islands between April and August, and southbound migration from October to the end of January, peaking in late November to early December for north of the Montebello Islands (McCauley and Duncan 2011, McCauley and Jenner 2010).

Satellite tagging confirmed the general migration distribution of EIO pygmy blue whales was offshore in water depths over 200 m and commonly over 1,000 m (Double et al., 2012) (**Figure 4-10**), generally west of the Operational Area but within the NWMR and EMBA. This data was revisited in 2014 and showed that whales tagged in WA during March and April migrated northwards post tag deployment. The tagged whales travelled relatively near to the Australian coastline (100.0 ± 1.7 km) in water depths of 1,369.5 ± 47.4 m, until reaching the North West Cape, after which they travelled offshore (238.0 ± 13.9 km) into progressively deeper water (2,617.0 ± 143.5 m). Whales reached the northern terminus of their migration and potential breeding grounds in Indonesian waters by June (Double et al., 2014). The tracking data and acoustic monitoring data (McCauley et al 2018) indicates pygmy blue whales transit the deeper waters off the shelf which is to the west of the Operational Area and timing between mid-April to early August with a peak period between May and June (**Figure 4-10**) during the northern migration and (from October to the following January with an identified peak period from November to December) for the southbound migration.

The migratory BIA for the pygmy blue whale encompasses a wide band in the deeper waters off the NWS and the Operational Area is located approximately 33 km away (at the closest point). The EMBA does overlap with the migratory BIA and also with the possible foraging area for the EOI pygmy blue whale population located off the Ningaloo Coast based on the satellite track of one whale (CMP, Commonwealth of Australia, 2015a) and as documented in Double et al. (2014).

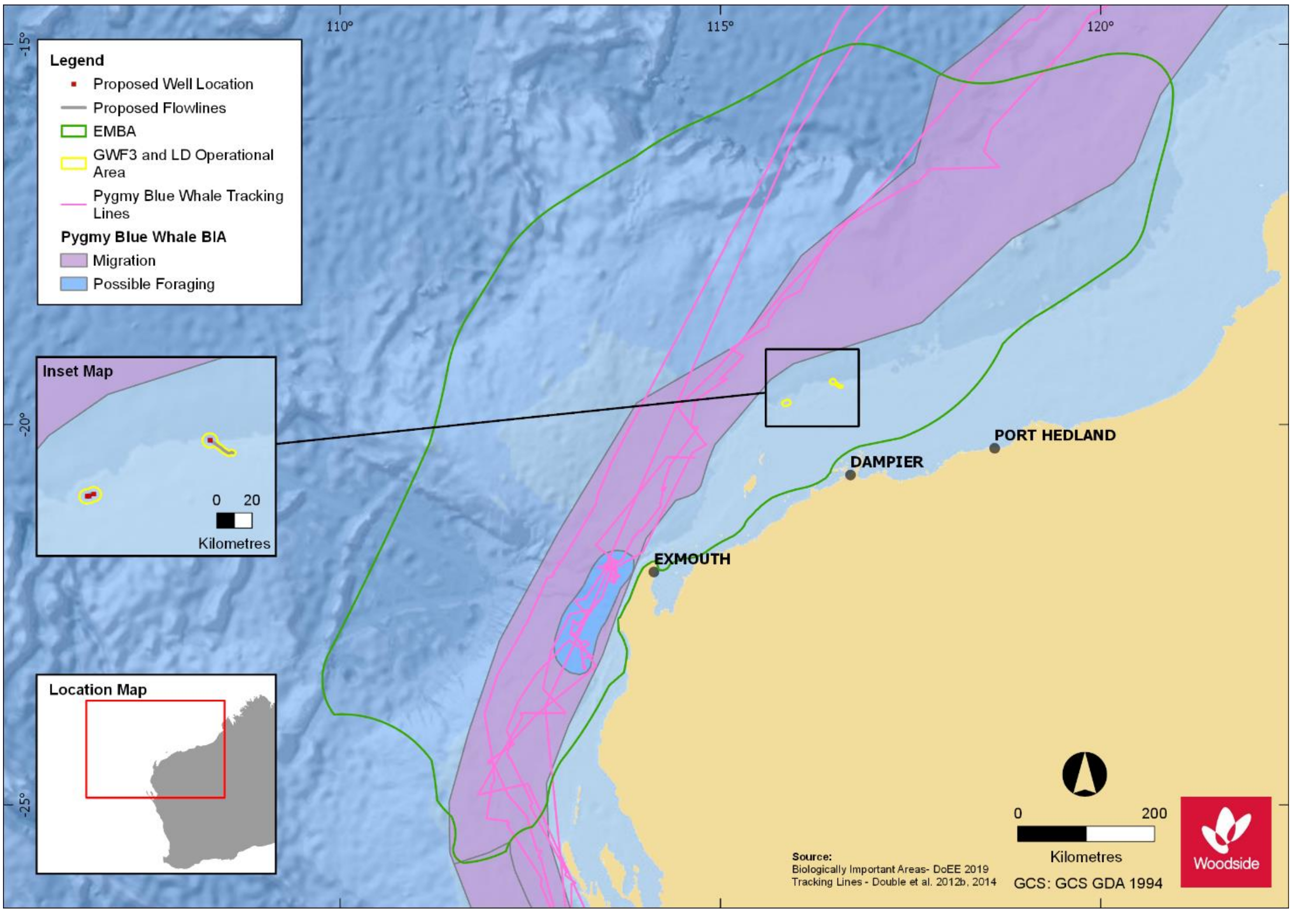


Figure 4-10: East Indian Ocean Pygmy blue whale satellite tracks and BIAs (migration and possible foraging)

Source: Double et al. 2012b, 2014, National Conservation Values Atlas for BIAs

Humpback Whale

The humpback whale was identified by the PMST as potentially occurring within the Operational Area and EMBA (EPBC Act listed Vulnerable and Migratory). This species migrates along the WA coastline annually as it undertakes its seasonal migration between high latitude feeding grounds and low latitude breeding and calving areas (Commonwealth of Australia, 2015b). Specifically, humpback whales in WA waters travel to and from the southern Kimberley region to the northern end of Camden Sound (the main breeding and calving area) in the winter and spring months (Jenner et al., 2001; Commonwealth of Australia, 2015a), after feeding in Antarctic waters during the summer months (Bannister & Hedley, 2001). The population is termed the Group IV humpback whale population (Commonwealth of Australia (2015).

The Commonwealth of Australia's (2015) Conservation Advice for humpback whales, describes the species distribution on the west and east coasts of Australia; in WA waters, calving occurs at the northern extent of the migration corridor (outside of the EMBA for the Petroleum Activities Program). The DAWE has defined the WA migration corridor (both north and southbound) as a BIA for humpback whales. This BIA is located about 26 km south of the Operational Area, at the closest point, and is within the EMBA (**Figure 4-11**).

Woodside has conducted marine megafauna aerial surveys that have confirmed the temporal distribution of migrating humpback whales off the North West Cape has remained consistent since baseline surveys were first conducted between 2000 to 2001 (RPS Environment and Planning 2010a). The majority of the whales occurred in depths less than 500 m, with the greatest density of whales concentrated in water depths of 200 to 300 m. Only small numbers of whales were observed to occur in the deeper offshore waters. These survey results are consistent with satellite tagging studies undertaken in more recent years (Double et al. 2010, 2012a) (**Figure 4-11**).

Current population growth for the humpback whale population that migrates along the WA coast is estimated to be between 9.7 and 13% per annum (Threatened Species Scientific Committee, 2015c). Using the Salago-Kent et al. (2012) estimate in 2008 of 26,100 individuals and an annual population growth rate of 10%, 2019 population estimates could be greater than 75,000 individuals. From the North West Cape, northbound humpback whales travel along the edge of the continental shelf passing to the west of the Muiron, Barrow and Montebello Islands (**Figure 4-11**), with a peak in numbers in late July (Jenner et al. 2001). The southern migratory route follows a relatively narrow track between the Dampier Archipelago and Montebello Islands. Exmouth Gulf and Shark Bay are known resting/aggregation areas for southbound humpback whales. In particular, Exmouth Gulf is an area where cow/calf pairs may stay for up to two weeks during September (Jenner et al. 2001) and more recently identified as a key resting and breeding area (Bejder et al. 2019).

Noise loggers deployed near Woodside's GWA facility detected humpback whales present at the end of September, likely migrating south, and from June to mid-August in deeper water, closer to the continental shelf, likely migrating north (RPS Environment and Planning 2012). The southward migration of cow/calf pairs is slightly later during October (extending into November and December). During the southbound migration, it is likely that most individuals, particularly cow/calf pairs, stay closer to the coast than the northern migratory path as shown by the tracking lines in **Figure 4-11.** During these migration periods, humpback whales are not likely to overlap the Operational Area.

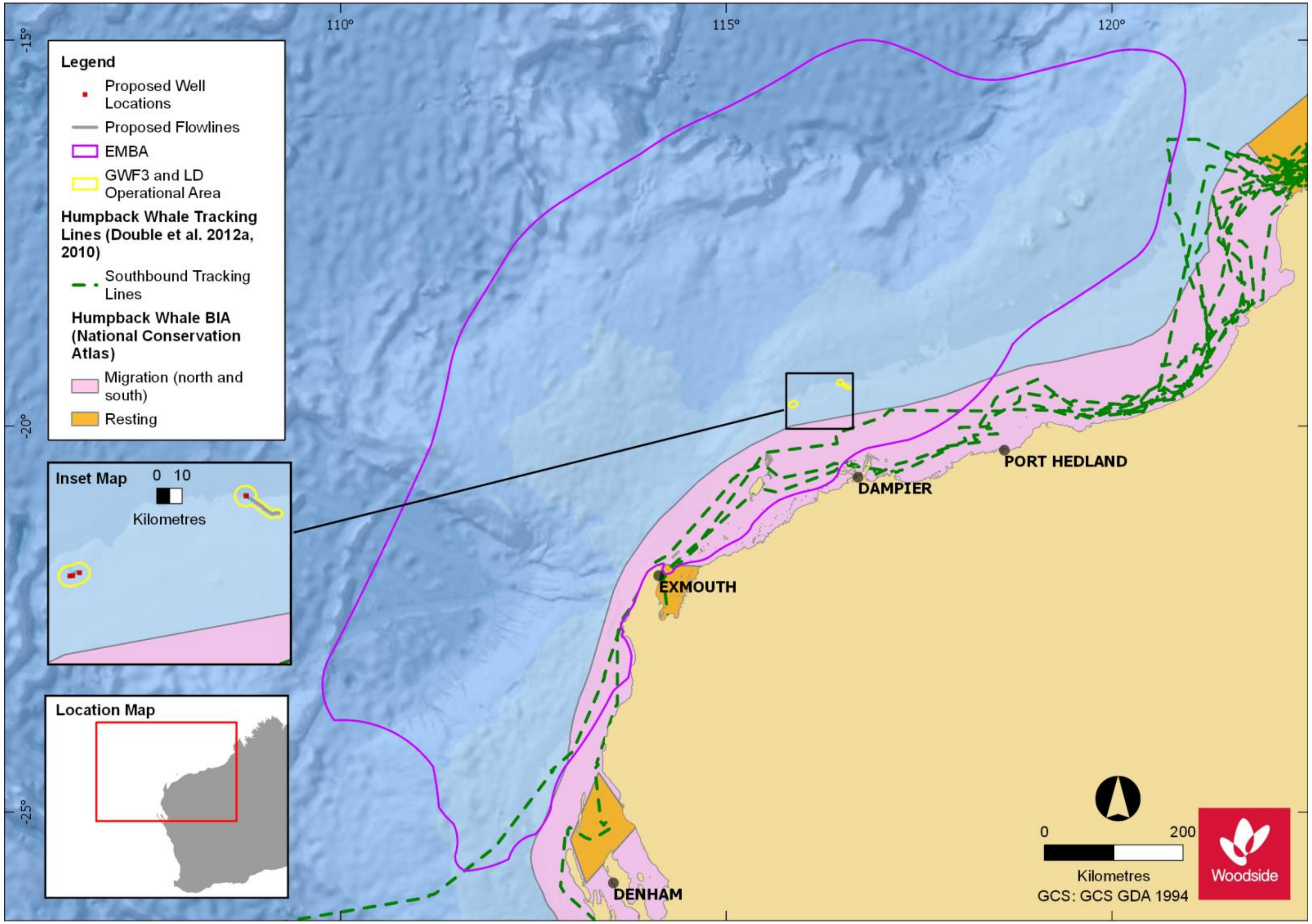


Figure 4-11: Humpback whale satellite tracks and BIA

Source: Double et al. 2010, 2012a

Sei Whale

The sei whale was identified by the PMST as potentially occurring within the Operational Area and EMBA. Like many species of baleen whales, this species was significantly reduced in numbers by commercial whaling operations. Sei whales have a worldwide oceanic distribution and are expected to migrate seasonally between low latitude wintering areas and high latitude summer feeding grounds (Bannister et al. 1996, Prieto et al. 2012). Sei whales have been infrequently recorded in Australian waters (Bannister et al. 1996), which could be due to the similarity in appearance of sei whales and Bryde's whales leading to incorrect sighting records.

The Threatened Species Scientific Committee's (2015) Conservation Advice for the Sei Whale, describes the species distribution being predominately found within Australian Antarctic waters and Commonwealth waters. More recent sightings have occurred off South Australia and south of Hobart, (outside of the EMBA for the Petroleum Activities Program).

There are no known mating or calving areas (including BIAs) for the sei whale in Australian waters (DoEE 2017). This species prefers deep waters, and typically occurs in oceanic basins and continental slopes (Prieto et al., 2012). Records of the species occurring on the continental shelf (<200 m water depth) are uncommon in Australian waters (Bannister et al., 1996). Neither the Operational Area or EMBA overlap with important habitat or BIAs for the sei whale, however, the species may frequent offshore waters of the NWMR and potentially overlap with the Operational Area and EMBA. Their presence is likely to be limited to a few individuals infrequently transiting the area.

Fin Whale

Fin whales were identified by the PMST as potentially occurring within the Operational Area and EMBA. The fin whale is a large baleen whale with a cosmopolitan distribution in all ocean basins between 20 and 75°S (DEH, 2005b). The global population of fin whales was reduced significantly by commercial whaling, with the species being targeted due to its large size and broad distribution. Like other baleen whales, fin whales migrate annually between high latitude summer feeding grounds and lower latitude over-wintering areas (Bannister et al. 1996).

The Threatened Species Scientific Committee's (2015) Conservation Advice for the Fin Whale, describes the species widespread distribution from polar to tropical waters, and has also been recorded within Commonwealth waters of Australia.

Fin whales are thought to follow oceanic migration paths and are uncommonly encountered in coastal or continental shelf waters. The Australian Antarctic waters are important feeding grounds for fin whales but there are no known mating or calving areas in Australian waters (Morrice et al. 2004). There are also no known BIAs for fin whales in the NWMR but their seasonal occurrence is possible. As such, it is likely individuals may infrequently occur within the Operational Area and EMBA, mainly during winter months when the species may move from their Antarctic feeding areas to lower latitude over-wintering areas.

Bryde's Whale

The Bryde's whale was identified by the PMST as potentially occurring within the Operational Area and as such also within the EMBA. The Bryde's whale occurs in tropical and temperate waters (Bannister et al. 1996, DoEE 2015). Bryde's whales occur in both oceanic and inshore waters, and recorded sightings made for the Abrolhos Islands and north of Shark Bay (outside the EMBA) (Bannister et al. 1996).

Two forms are recognised: inshore (largely sedentary) form and offshore (may undertake migration) form. Data suggests offshore whales may migrate seasonally, heading towards warmer tropical waters during the winter, however, information on migration is not well known (McCauley and Duncan, 2011).

The Bryde's whale has been recorded in waters off most Australian States and Territories; however, there are currently no population estimates available for Bryde's whales globally, or in Australian waters (Department of the Environment and Energy, 2019). Bryde's whales may occur through a broad area off the continental shelf in the NWMR (McCauley and Duncan 2011, RPS Environment and Planning 2012). This species has been detected within the NWS Province from mid-December to mid-June, with a peak in late February to mid-April (RPS Environment and Planning 2012). There are no known BIAs for Bryde's whales in the NWMR but their seasonal occurrence is recorded. As such, it is possible individuals may infrequently occur or transit the Operational Area and EMBA.

There are no approved recovery plan or conservation advice for this species.

Fin Whale

Fin whales were identified by the PMST as potentially occurring within the Operational Area and EMBA. The fin whale is a large baleen whale with a cosmopolitan distribution in all ocean basins between 20 and 75°S (DEH, 2005b). The global population of fin whales was reduced significantly by commercial whaling, with the species being targeted due to its large size and broad distribution. Like other baleen whales, fin whales migrate annually between high latitude summer feeding grounds and lower latitude over-wintering areas (Bannister et al. 1996).

Fin whales are thought to follow oceanic migration paths and are uncommonly encountered in coastal or continental shelf waters. The Australian Antarctic waters are important feeding grounds for fin whales but there are no known mating or calving areas in Australian waters (Morrice et al. 2004). There are also no known BIAs for fin whales in the NWMR. As such, it is likely individuals may infrequently occur within the Operational Area, mainly during winter months when the species may move away from their Antarctic feeding areas.

Sperm Whale

The PMST identified the sperm whale as potentially occurring within the Operational Area. The sperm whale has a worldwide distribution in deep waters (greater than 200 m) off continental shelves and sometimes near shelf edges, averaging 20–30 nautical miles offshore (Bannister et al., 1996a). Although both sexes range through temperate and tropical waters, only adult males occur in the higher latitudes. There is limited information about sperm whale distribution in Australian waters; however, they are usually found in deep offshore waters, with more dense populations close to continental shelves and canyons (DoE, 2013b). There are no recovery plans or conservation advice listed for this species.

Within the EMBA, sperm whales have been recorded in deep waters off North West Cape (Jenner et al., 2010; RPS, 2010c; Woodside, 2010). In the open ocean, there is a generalised movement of sperm whales southwards in summer, and corresponding movement northwards in winter, particularly for males (DoEE, 2019). Twenty-three sightings of sperm whales (variable pod sizes, ranging from one to six animals) were recorded by marine mammal observers during the North West Cape MC3D marine seismic survey conducted between December 2016 and April 2017. These animals were observed in deep, continental slope waters of the Montebello Saddle (maximum distance of about 90 km from North West Cape), and the waters overlying the Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEF. In deep water off the North West Cape, sperm whales have been sighted in pod sizes up to six animals between February and April from two separate surveys, in 2010 and 2017 (EPI Group 2017, RPS Environment and Planning 2010b).

There are no known BIAs for sperm whales in the NWMR. The only key locality recognised in WA waters for sperm whales is along the southern coastline between Cape Leeuwin and Esperance (Bannister et al., 1996). This is outside of the EMBA for the Petroleum Activities Program. Females with young may reside within the NWMR all year round, and males may migrate through the region, and the species may be associated with canyon habitats (Ceccarelli et al., 2011).

Given the wide distribution of sperm whales and their preference for deeper oceanic waters, the Operational Area and EMBA is unlikely to represent an important habitat for this species. Their presence is likely limited to a few individuals infrequently transiting the area.

Cetaceans – Dolphins and Porpoises

Killer Whale

The PMST identified killer whales as potentially occurring within the Operational Area and EMBA. Killer whales are found in all of the world's oceans, from the Arctic and Antarctic regions to tropical seas and have been recorded off all states of Australia (Bannister et al. 1996, DoE 2013, Ford et al. 2005). Killer whales appear to be more common in cold, deep waters, however they have been observed along the shallow coastal areas of WA, including the continental slope and shelf (RPS Environment and Planning 2010a, Bannister et al. 1996). Anecdotal evidence suggests killer whales may feed on dugongs in Shark Bay but there are no recognised key localities or important habitats for killer whales within the Operational Area or EMBA. There are no recovery plan or conservation advice listed for this species.

Given the wide distribution of killer whales and their preference for colder waters, the Operational Area is unlikely to represent an important habitat for this species; their presence is likely to be a rare occurrence and limited to a few individuals infrequently transiting the area. The species is expected to be similarly present within the EMBA.

Spotted Bottlenose Dolphin (Arafura/Timor Sea Populations)

The Arafura/Timor Sea sub-population of spotted bottlenose dolphin was identified as potentially occurring within the Operational Area and EMBA, in the PMST. The spotted bottlenose dolphin is generally considered to be a warm water subspecies of the common bottlenose dolphin. This species distribution is primarily within inshore waters, often in depths of less than 10 m (Bannister et al. 1996). Within WA they are known to occur north from Shark Bay to the western edge of the Gulf of Carpentaria. There are no recovery plan or conservation advice listed for this species.

Given the distribution of spotted bottlenose dolphins and their preference for shallow coastal waters, the Operational Area is unlikely to constitute important habitat for this species. Consequently, their presence is likely to be a rare occurrence and limited to infrequent transiting of the Operational Area, although they are expected to occur within nearshore and coastal waters of which there is overlap with the EMBA.

4.5.2.7 Marine Reptiles

Marine Turtles

The PMST identified five marine turtle species as potentially occurring within the Operational Area (**Appendix C**); the loggerhead turtle, green turtle, leatherback turtle, hawksbill turtle and flatback turtle. Section 4.5.2.3 details the habitat critical to survival for marine turtle species with no overlap of the habitat critical areas (nesting and internesting) with the Operational Area but overlap with the EMBA. There are also a number of BIAs for these species that overlap with the EMBA, however; the Operational Area overlaps just one BIA internesting buffer extending from the nesting location of the Montebello Islands for flatback turtles.

A recent paper has sought to define flatback turtle internesting habitat along the North West Shelf; a study by Whittock et al. (2016) developed a habitat suitability map to identify areas where internesting flatback turtles may be present along the North West Shelf, based on data compiled for a suite of environmental variables and satellite tracks of 47 internesting flatback turtles from five different mainland and island rookeries tracked over 1289 days. Whittock et al. (2016) defined suitable internesting habitat as water 0 to 16 m deep and within 5 to 10 km of the coastline, while unsuitable internesting flatback habitat was defined as waters >25 m deep and >27 km from the coastline. The primary environmental variables that influenced flatback internesting movement were found to be bathymetry, distance from coastline, and sea surface temperature. Suitable areas of internesting habitat were located close to many known flatback turtle rookeries across the region (Whittock et al., 2016). This modelling study clearly demonstrates that the BIA internesting buffer overlapped by the Operational Area is unlikely to present important internesting habitat to the flatback turtle, given it is a significant distance from the nesting habitat and in water depths greater than 25 m.

This study by Whittock et al. 2016 is further supported by Thums et al. 2017; data from satellite telemetry of 11 flatback turtles after nesting on the Lacepede Islands showed that during the inter-nesting phase, flatback turtles remained at an average distance of 15.75 ± 12.25 km from West Lacepede Island, in water depths of 16 ± 3 m (Thums et al., 2017). Hence it is highly unlikely that significant numbers of flatback turtles are in the offshore, deep waters of the Operational Area during their internesting period. However, the species is expected to occur within the EMBA, particularly in the vicinity of known nesting beaches between October and March.

The green, loggerhead, flatback and hawksbill turtles have significant nesting rookeries on beaches along the WA mainland coast and islands within the NWMR, including the Ningaloo Coast. This includes nesting beaches on the Muiron Islands and the North West Cape (Commonwealth of Australia 2017, Limpus 2007, 2008a, 2008b, 2009). Studies by Chevron Australia Pty Ltd (2015) and Guinea (2009) on the post-nesting migratory routes of the green, hawksbill and flatback turtle, from Barrow Island (110 km from the Operational Area), indicated no overlap with the Operational Area. The green and flatback turtle typically travelled east or south from Barrow Island then around or through the Dampier Archipelago, and along the WA coast toward foraging grounds to the north (north of Broome). The hawksbill turtle was an exception as it tended to travel south to the chain of coastal islands south of Barrow Island (Chevron Australia Pty Ltd 2015).

The tracking data indicates that the three marine turtle species forage in coastal waters that are relatively shallow (Chevron Australia Pty Ltd 2015):

- hawksbill turtle – less than 10 m deep
- green turtle – less than 25 m deep
- flatback turtle – less than 70 m deep.

With consideration of the distance offshore, the depth range of surrounding offshore waters (80 to 130 m), and absence of potential nesting or foraging sites (i.e. no emergent islands, reef habitat or shallow shoals), the Operational Area does not represent biologically important areas for any species of marine turtles and only isolated records of transient individuals is expected in this offshore, openwater environment.

Table 4-7 provides additional details of the marine turtle species identified as potentially occurring within the EMBA; including breeding seasons and nesting locations, diet and key habitats within the NWMR (including areas outside of the EMBA region).

Table 4-7: Key information on marine turtles in the NWMR

Turtle Species	Key Seasons within the NWMR	Diet	Key Habitats
Green turtle	**Breeding**: About September to December. **Nesting**: November to March. Peak period from December to February.	Seagrasses and algae	**Preferred habitat**: Nearshore reef habitats in the photic zone. **Distribution**: Ningaloo Coast to Lacepede Islands. **Major nesting sites**: Lacepede Islands, Montebello Islands, Barrow Island, Muiron Islands, Browse Island, and North West Cape. **Internesting habitat**: Generally within 10 km of nesting beaches (Waayers et al. 2011). **Nearest BIA** None overlap the Operational Area. Refer to **Table 4-5** for BIAs/habitat critical to the survival of marine turtles* within the EMBA.

Turtle Species	Key Seasons within the NWMR	Diet	Key Habitats
			Nearest habitat critical to the survival of green turtles (Commonwealth of Australia, 2017): The Operational Area lies about 53 km from the 20 km internesting buffer around Montebello Islands.
Loggerhead turtle	**Breeding**: About September to March. **Nesting**: November to March. Peak period in January.	Carnivorous, feeding mainly on molluscs and crustaceans	**Preferred habitat**: Nearshore and island coral reefs, bays and estuaries in tropical and warm temperate latitudes. **Distribution**: Shark Bay to North West Cape and as far north as Muiron Islands and Dampier Archipelago. **Major nesting sites**: Dirk Hartog Island, along the Gnaraloo and Ningaloo Coast to North West Cape and the Muiron Islands. There have been occasional records from Varanus and Rosemary Islands in the Pilbara. Late summer nesting recorded for Barrow Island, Lowendal Islands and Dampier Archipelago. **Internesting habitat**: Limited data on Australian loggerhead turtles; however, literature indicates internesting habitat for this species is generally within 20 km of nesting beaches (DSEWPaC 2012a). **Nearest BIA**: None overlap the Operational Area. Refer to **Table 4-5** for BIAs/habitat critical to the survival of marine turtles* within the EMBA. **Nearest habitat critical to the survival of green turtles** (Commonwealth of Australia, 2017): The Operational Area lies about 263 km from the 20 km internesting buffer around Muiron Islands.
Hawksbill turtle	**Breeding**: All year round. **Nesting**: All year round with peak in October to January.	Mainly sponges, also seagrasses, algae, soft corals and shellfish	**Preferred habitat**: Nearshore and offshore reef habitats. **Distribution**: Shark Bay north to Dampier Archipelago. **Major nesting sites**: The most significant rookery in WA is at Rosemary Island. Other rookeries include Varanus Island in the Lowendal group, some islands in the Montebello group and along the Ningaloo Coast (Limpus 2009). **Internesting habitat**: Limited data on Australian hawksbill turtles; however, literature indicates internesting habitat for this species is generally within 20 km of nesting beaches (DSEWPaC 2012a). **Nearest BIA:** None overlap the Operational Area. Refer to **Table 4-5** for BIAs/habitat critical to the survival of marine turtles* within the EMBA. **Nearest habitat critical to the survival of green turtles** (Commonwealth of Australia, 2017): The Operational Area lies about 53 km from the 20 km internesting buffer around Montebello Islands.
Flatback turtle	**Breeding**: September to January. **Nesting**: October to March with peak period in November to January.	Carnivorous, feeding mainly on soft bodied prey such as sea cucumbers, soft corals and jellyfish	**Preferred habitat**: Nearshore and offshore subtidal and soft-bottomed habitats of offshore islands. **Distribution**: Pilbara genetic stock: Shark Bay north to Dampier Archipelago. **Major nesting sites**: The largest nesting sites of the Pilbara region are Delambre Island, Barrow Island and the mainland coast (Mundabullangana Station near Cape Thouin and smaller nesting sites at Cemetery Beach in Port Hedland and Bell's Beach near Wickham).

Turtle Species	Key Seasons within the NWMR	Diet	Key Habitats
			Other significant rookeries include Thevenard Island, the Montebello Islands, Varanus Island, the Lowendal Islands and islands of the Dampier Archipelago. **Internesting habitat**: Up to 70 km from nesting beaches (Waayers et al. 2011, Whittock et al. 2014). Satellite tracking of flatback turtle nesting populations at Barrow Island indicates that this species travels east of Barrow Island, towards WA mainland coastal waters, between nesting events. **Nearest BIA**: An internesting BIA around the Montebello Islands overlaps the GWF-3 Operational Area. The boundary of the BIA is about 20 km from the LD Operational Area. Refer to **Table 4-5** for BIAs/habitat critical to the survival of marine turtles* within the EMBA. **Nearest habitat critical to the survival of green turtles** (Commonwealth of Australia, 2017): The Operational Area lies about 14 km from the 60 km internesting buffer around Montebello Islands.
Leatherback turtle	No confirmed nesting activity in WA.	Carnivorous, feeding mainly in the open ocean on jellyfish and other soft-bodied invertebrates	**Preferred habitat**: Nearshore, coastal tropical and temperate waters may be encountered within the NWMR but there are no known nesting sites within the NWMR. **Nearest BIA/Habitat Critical to the Survival of Marine Turtles**: No known BIAs for leatherback turtles in the Operational Area or EMBA.

** Habitat critical to the survival of a species identified in the Recovery Plan for Marine Turtles in Australia 2017–2027 (Commonwealth of Australia 2017) see **Section 4.5.2.3**.*

Sea snakes

Sea snakes occur throughout the tropical waters of Australia. There are three genera of sea snake; *Aipysurus* and *Emydocephalus*, which are typically found in coral reef habitats, and *Hydrophis*, which prefer inter-reef soft sediment habitats. Sea snakes typically occur in coastal, shallow water habitats (excluding the pelagic yellow-bellied sea snake) as they are air breathing animals (Udyawer et al., 2016). They occupy diverse habitats including coral reefs, turbid water habitats and deeper water (Guinea et al. 2004). Species exhibit habitat preferences depending on water depth, benthic habitat, turbidity and season (Heatwole and Cogger 1993). The majority of information on the occurrence of sea snakes has been sourced from by-catch logs maintained by the Northern Prawn Fishery (DEWHA 2008).

Udyawer et al. (2017) undertook a survey of sea snakes in the NWMR between 1999 and 2017, deploying over 2290 Baited Remote Underwater Video Stations (BRUVS). In total six hundred and eighty seven sea snakes were recorded, with the highest rates of sea snake sightings recorded in the Northern Oceanic Shoals. The majority of sea snakes were of the genus *Aipysurus* followed by *Emydocephalus* (Udywer et al., 2017). *Aipysurus* species were indicative of high coral cover and sea surface temperatures were significant to defining species assemblages in non-reef habitats (Udyawer et al., 2016). Sea snakes of the three genera described from the families *Hydrophiidae* and *Laticaudidae* distributions are widespread and include overlap with the shallower waters of the EMBA. The PMST identified 17 species of sea snake listed as Marine under the EPBC Act potentially occurring within the EMBA (**Appendix C**).

The short-nosed sea snake, listed as Critically Endangered under the EPBC Act, was identified by the PMST as potentially occurring within the EMBA (although not within the Operational Area). This species has been recorded on the Sahul Shelf, in particular, at Ashmore and Hibernia reefs, as well as Exmouth Gulf, and is strongly associated with shallow (<10 m deep) reef habitat.

Most sea snake species have depth distributions <50 m (Cook et al. 2016), however; recent ROV surveys in the Browse Basin have sighted sea snakes of the genus *Hydrophis* at depths >200 m (Crowe-Riddell, 2019). Given the water depths of the Operational Area and the lack of complex habitats, sea snakes are not expected but could be present in low numbers.

4.5.2.8 Fishes and Elasmobranchs

Seahorses and Pipefish

The Protected Matters Search identified 44 species of pipefish and seahorses listed as under the EPBC Act within the EMBA (**Appendix C**). By-catch data (Department of Fisheries 2010) indicates they are uncommon in deeper continental shelf waters (50–200 m), so are unlikely to occur within the Operational Area. This family (*Syngnathidae*) is commonly found in seagrass and sandy habitats around coastal islands and shallow reef areas along the NWS Province, and is likely to be found in coastal areas including the Ningaloo Coast. Within the EMBA, seahorses and pipefish may be encountered in a wide variety of shallow habitats, including seagrass meadows, reefs and sandy substrates.

Sawfish

<u>Narrow Sawfish</u>

The narrow sawfish was identified as potentially occurring within the Operational Area. The species is widely distributed throughout the Indo-Pacific region, with records spanning from the Arabian Gulf to Japan. In Australia, the species may have a broad tropical distribution from about North West Cape in WA to southern Queensland. Like other sawfish species, the narrow sawfish has experienced considerable decline in numbers due to human activities, including fishing and habitat loss/damage (Cavanagh et al. 2003). Interactions between prawn trawl fishing in coastal waters has been identified as a threat for narrow sawfish in Australia (Commonwealth of Australia 2015b).

Like other sawfish in the family *Pristidae*, the narrow sawfish prefers shallow coastal, estuarine and riverine habitats, although may occur in waters up to 100 m deep (D'Anastasi et al. 2013). Given the water depth of the Operational Area (between about 80 and 130 m) and distance from preferred habitats, narrow sawfish are not expected to occur within the Operational Area. However, the species may be found within the broader EMBA in shallow coastal waters and estuaries.

<u>Green Sawfish</u>

The green sawfish (*Pristis zijsron*) was identified as potentially occurring within the Operational Area (PMST report, Appendix C). The species was once widely distributed in coastal waters along the northern Indian Ocean, although it is believed northern Australia may be the last region where significant populations exist (Stevens et al. 2005). Within Australia, green sawfish are currently distributed from about the Whitsundays in Queensland across northern Australian waters to Shark Bay in WA (Commonwealth of Australia 2015b). Preferred habitat for green sawfish includes shallow coastal waters and tidal creeks (Chevron Australia 2014). Despite records of the species in deeper offshore waters, green sawfish typically occur in the inshore fringe with a strong association with mangroves and adjacent mudflat habitats (Commonwealth of Australia 2015b, Stevens et al. 2005). Movements within these preferred habitats correlate with tidal movements (Stevens et al. 2008).

The Multispecies Recovery Plan for Sawfish and River Sharks indicates 'known to occur' distribution includes offshore waters of the North West Shelf, with 'known' pupping areas in coastal waters north of Port Hedland to Roebuck Bay and pupping 'likely to occur' south of Port Hedland, Exmouth Gulf and North West Cape (Commonwealth of Australia 2015b). There are also identified BIAs at 80 Mile Beach, Roebuck Bay, Cape Leveque and Camden Sound for foraging, pupping and nursing. The Operational Area is not considered an important habitat area for the green sawfish based on depth and distance offshore and are not expected to occur within the Operational Area. However, the species has known distribution and presence within the broader EMBA, particularly, shallow water coastal area including mangrove habitat and tidal creeks.

Sharks

Whale Shark

The DAWE has defined a BIA for foraging whale sharks (post aggregation at Ningaloo) centred around the 200 m isobath. Furthermore, the 200 m isobath along the northern part of the West Australian coast is an important migration route, with migration occurring mainly between July to November (Commonwealth of Australia, 2015d; **Figure 4-12**). This BIA extends northward from the Ningaloo aggregation area and overlaps the Operational Area. Anecdotal evidence from sightings data collected from the Woodside offshore facilities on the NWS indicate whale sharks are present on the NWS in the months of April, July, August, September and October, corresponding with the whale shark's seasonal migration to and from the Ningaloo. However, the numbers of individual whale sharks that transit through the Operational Area is expected to be low, based on the number of whale sharks aggregating at Ningaloo, the preference for shallow, coastal waters (<200 m depth (Reynolds et al. 2017) and on the different migration paths that the whale sharks may follow (see below). Opportunistic sightings associated with an ROV survey of the Angel platform jacket during August and September of 2018 observed two male and two female whale sharks (McLean et al. 2019).

Whale sharks aggregate annually to feed in the waters off the Ningaloo Coast from March to July, with the largest numbers recorded in April and May (Sleeman et al. 2010). However, seasonal aggregation can be variable, with individual whale sharks recorded at other times of the year and year round (Reynolds et al. 2017). The population (comprising individuals that visit Ningaloo at some point during their lifetime) has been estimated to range between 300 and 500 individuals; the number visiting Ningaloo in any given year is expected to be somewhat smaller (Meekan et al. 2006). Timing of the whale shark migration to and from Ningaloo coincides with the coral mass spawning period, when there is an abundance of food (krill, planktonic larvae and schools of small fish) in the waters adjacent to Ningaloo. At Ningaloo, whale sharks stay within a few kilometres of the shore and in waters about 30–50 m deep (Wilson et al. 2006).

After the aggregation period, the distribution of the whale shark is largely unknown, particularly, outside Australian waters. Tagging, aerial and vessel surveys suggest the group disperses widely, up to several thousand kilometres away. Satellite tracking has shown that the sharks may follow three migration routes from Ningaloo (Meekan and Radford 2010, Wilson et al. 2006) (**Figure 4-12**):

- north-west, into the Indian Ocean
- directly north, towards Sumatra and Java
- north-east, passing through the NWS Province travelling along the shelf break and continental slope.

The tagging studies provided the justification for a foraging BIA for whale sharks and the Operational Area overlaps with this BIA, as shown in **Figure 4-12**. Though the BIA has been defined as a foraging area for whale sharks, it is more likely to be a migration pathway with whale sharks undertaking opportunistic foraging. It is expected that whale sharks may traverse through the Operational Area during their migrations to and from Ningaloo. However, whale shark presence within the area is expected to be of a relatively short duration and not in significant numbers, given the main aggregations are recorded in coastal waters, particularly the Ningaloo reef edge (Department of Conservation and Land Management 2005).

Anecdotal evidence from sightings made from Woodside's offshore platforms on the NWS indicate whale sharks are present in April, July, August, September and October, corresponding to the whale shark's migration to and from Ningaloo.

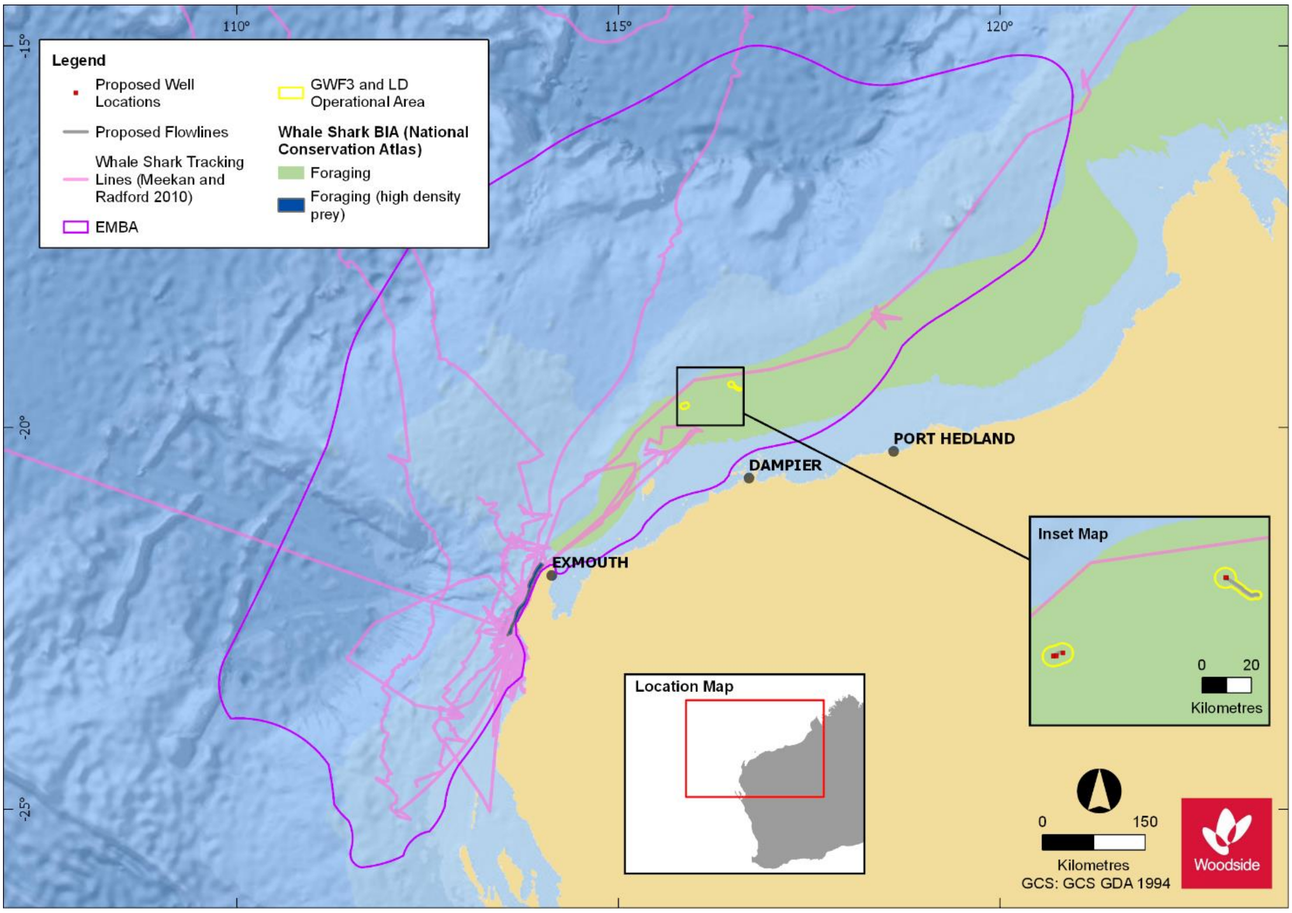


Figure 4-12: Satellite tracks of whale sharks tagged between 2005 and 2008

Source: Meekan and Radford (2010)

Grey Nurse Shark

The grey nurse shark was identified as potentially occurring within the Operational Area. The species has a broad distribution in inner continental shelf waters, primarily in sub-tropical to cool temperate waters. Off WA, the grey nurse shark occurs primarily in south-west coastal waters between 20 and 140 m depth (Chidlow et al. 2006). Grey nurse sharks have been documented as aggregating in specific areas (typically reefs), however no clear aggregation sites have been identified off WA (Chidlow et al. 2006). Given the species' preference for relatively shallow temperate waters, grey nurse sharks are unlikely to be present within the Operational Area but may occur within the EMBA.

Great White Shark

The great white shark was identified as potentially occurring within the Operational Area. The species typically occurs in temperate coastal waters between the shore and the 100 m depth contour; however, adults and juveniles have been recorded diving to depths of 1000 m (Bruce et al. 2006, Bruce 2008). They are also known to make open ocean excursions of several hundred kilometres and can cross ocean basins (Weng et al. 2007a, 2007b). Although great white sharks are not known to form and defend territories, they are known to return on a seasonal/regular basis to regions with high prey density, such as pinniped colonies (Bruce 2008).

Given the migratory nature of the species, its low abundance, broad distribution in temperate waters across southern Australia and absence of preferred prey (pinnipeds), great white sharks are likely to be infrequent within the Operational Area with only transiting individuals expected.

Shortfin Mako

The shortfin mako was identified as potentially occurring within the Operational Area and EMBA. The shortfin mako shark is a pelagic species with a circumglobal, wide-ranging oceanic distribution in tropical and temperate seas (Mollet et al. 2000). The shortfin mako is commonly found in water with temperatures greater than 16°C. The shortfin mako shark is an apex and generalist predator that feeds on a variety of prey, such as teleost fish, other sharks, marine mammals and marine turtles (Campana et al. 2005). Tagging studies indicate shortfin makos spend most of their time in water less than 50 m deep but with occasional dives up to 880 m (Abascal et al. 2011, Stevens et al. 2010). Little is known about the population size and distribution of shortfin mako sharks in WA; however, it is possible they will transit the Operational Area. It is expected that the number of individuals encountered are low due to their preference for shallow waters (<50 m) but it is likely they will be within the broader EMBA.

Longfin Mako

The longfin mako was identified as potentially occurring within the Operational Area and EMBA. The longfin mako is a widely distributed, but rarely encountered, oceanic shark species. The species can grow to just over 4 m long and is found in northern Australian waters, from Geraldton in WA at least to Port Stephens in NSW, and is uncommon in Australian waters relative to the shortfin mako (Bruce 2013, DEWHA 2010). There is very little information about these sharks in Australia, with no available population estimates or distribution trends. A study from southern California documented juvenile longfin mako sharks remaining near surface waters, while larger adults were frequently observed at greater maximum depths of about 200 m (Sepulveda et al. 2004). Longfin mako may occur in the Operational Area and broader EMBA, but given their widespread distribution and apparent low density, they are likely to be uncommon.

Scalloped Hammerhead

Scalloped hammerheads are relatively large sharks which are widely distributed in tropical and sub-tropical waters. The scalloped hammerhead is listed under the EPBC Act as Conservation Dependent and, as such, is not reported within the PMST. However, this species' known distribution indicates it may occur within the EMBA (DoEE, 2015).

In Australia, the species is found in both northern and temperate waters (Threatened Species Scientific Committee 2018). The scalloped hammerhead exhibits strong genetic population structuring as it exhibits a preference for shallow coastal shelf habitats, rarely transiting across deep oceanic waters (Australian Museum, 2018). Whilst this species is highly mobile and moves between inshore, coastal and offshore habitats throughout its life stages, it rarely ventures into deep offshore waters. Scalloped hammerheads are, therefore, likely to occur within the shallower waters of the EMBA and as infrequent visitors to the deeper waters of the Operational Area.

Rays

Reef Manta Ray

The reef manta ray was identified as potentially occurring within the Operational Area. The species is commonly sighted inshore, but also found around offshore coral reefs, rocky reefs and seamounts (Marshall et al. 2009). In contrast to the giant manta ray, long-term sighting records of the reef manta ray at established aggregation sites suggest this species is more resident in tropical waters, and may exhibit smaller home ranges, philopatric movement patterns and shorter seasonal migrations than the giant manta ray (Deakos et al. 2011, Marshall et al. 2009). A resident population of reef manta rays has been recorded at Ningaloo Reef, and the species has been shown to have both resident and migratory tendencies in eastern Australia (Couturier et al. 2011). The Operational Area is in offshore waters, so the area is not considered critical habitat; reef manta rays are considered highly unlikely to occur within the Operational Area. However, the reef manta ray may occur in continental shelf waters of the EMBA.

Giant Manta Ray

The giant manta ray is broadly distributed in tropical waters of Australia and was identified as potentially occurring within the Operational Area. The species primarily inhabits near-shore environments along productive coastlines with regular upwelling, but they appear to be seasonal visitors to coastal or offshore sites including offshore island groups, offshore pinnacles and seamounts (Marshall et al. 2011). The Operational Area is not located in or adjacent to any known key aggregation areas for the species (e.g. feeding or breeding). However, the Ningaloo Coast, about 284 km south-west of the Operational Area but within the EMBA, is an important area for giant manta rays in autumn and winter (Preen et al. 1997). Opportunistic sightings during an ROV survey at the Angel platform jacket included three observations of individual manta ray (McLean et al. 2019). The depth of this sighting was not specified. Occurrence of giant manta rays within the Operational Area is likely to be infrequent and restricted to individuals transiting the area.

Pelagic Fish

Southern Bluefin Tuna

The southern bluefin tuna is not currently included in the PMST; however, the species is Conservation Dependent under the EPBC Act. Southern bluefin tuna are highly migratory, occurring throughout waters 30–50° S but mainly in the eastern Indian Ocean and south-western Pacific Ocean. In Australian waters, the species ranges from northern WA, around the southern coast to northern NSW. Juveniles are known to inhabit inshore waters (Honda et al. 2010) and the species is thought to congregate at reefs, lumps and seamounts (Fujioka et al. 2010). Spawning occurs in warm waters south of Java from August–April with a peak during October–February (Honda et al. 2010). Following the spawning period juveniles migrate down the south coast of WA, with juveniles commonly found in the coastal waters of southern Australia during summer and in deeper, temperate oceanic waters during winter (Bestley et al., 2008; Phillips et al., 2009). Southern bluefin tuna are likely to occur within the Operational Area and EMBA, particularly during summer when juveniles migrate southwards.

4.5.2.9 Birds

Oceanic Seabirds and/or Migratory Shorebirds

Based on the results of two survey cruises and other unpublished records, Dunlop et al. (1988) recorded the occurrence of 18 species of seabirds over the NWS. These included a number of species of petrel, shearwater, tropicbird, frigatebird, booby and tern, as well as the silver gull. Of these, eight species occur year-round, and the remaining ten are seasonal visitors. From these surveys, it was noted that seabird distributions in tropical waters were generally patchy, except near islands. Migratory shorebirds may be present in or fly through the region between July and December and again between March and April as they complete migrations between Australia and offshore locations (Bamford et al. 2008, Commonwealth of Australia 2015d).

The Operational Area may be occasionally visited by migratory and oceanic birds but does not contain any emergent land that could be utilised as roosting or nesting habitat and contains no known critical habitats (including feeding) for any species. Eleven species of listed birds were identified by the EPBC Act Protected Matters search (**Appendix C**) for the Operational Area (**Table 4-2**).

One BIA for the migratory wedge-tailed shearwater overlaps the Operational Area, which relates to breeding (and a foraging buffer) and presence of these seabirds is typically between mid-August and April in the Pilbara; note the PMST report did not identify wedge-tailed shearwaters within the Operational Area.

Within the EMBA, there are numerous important habitats for seabirds and migratory shorebirds including key breeding/nesting areas, roosting areas and surrounding waters, important foraging and resting areas within the NWMR. These include (approximate distances from the Operational Area, at the closest point, shown in brackets):

- Muiron Islands (252 km south-west to Marine Management Area)
- Pilbara Islands (North, Middle and South groups – 119, 206, 237 km to closest State Nature Reserves, respectively)
- Shark Bay (614 km south-west).

These habitats are discussed further as key environmental sensitivities in **Section 4.7**.

<u>Australian Fairy Tern</u>

The Australian fairy tern has a coastal distribution from Sydney, south to Tasmania and around southern Western Australia up to Dampier. The Australian fairy tern feeds on small baitfish and roosts and nests on sandy beaches below vegetation (Higgins & Davies, 1996; Van de Kam et al., 2004). Although identified by the EPBC Act search as occurring within the Operational Area, due to the coastal distribution of the species the Australian fairy tern is unlikely to occur within the Operational Area. However, it is likely to occur in the coastal regions of the EMBA.

<u>Common Noddy</u>

The common noddy is the largest species of noddy found in Australian waters. The species is widespread in tropical and subtropical areas beyond Australia. This seabird typically forages in coastal waters around nesting sites, taking prey such as small fish, but may occur longer distances out to sea. Nesting occurs broadly across tropical and subtropical Australia in coastal areas, particularly on islands such as the Houtman Abrolhos island group (Burbidge and Fuller 1989). The common noddy is thought to undertake seasonal movements, with some nesting sites abandoned during the non-breeding season (which is protracted between spring and autumn). Based on the information above, the species may occur within the Operational Area (although the Operational Area does not constitute critical habitat for the species) and the EMBA, particularly around offshore and coastal islands.

Common Sandpiper

The common sandpiper is a small bird with a very large range through which it migrates annually between breeding grounds in the northern hemisphere (Europe and Asia) and non-breeding areas in the Asia-Pacific region (Bamford et al., 2008). In Australia, the species congregates in large flocks and forages in shallow waters and tidal flats between spring and autumn. Specific critical habitat in Australia has not been identified due to the species' broad distribution (Bamford et al., 2008). The common sandpiper may be present in coastal wetland and intertidal sand or mudflats throughout the EMBA, although is unlikely to occur in the Operational Area.

Pectoral Sandpiper

Similar to other species of sandpiper, the pectoral sandpiper breeds in the northern hemisphere during the boreal summer, before migrating long distances to feeding grounds in the southern hemisphere (DEWHA 2006). The species occurs throughout mainland Australia between spring and autumn. Given the species' preferred habitat, the pectoral sand piper is not expected to occur within the Operational Area but is expected to occur in suitable habitats within the EMBA.

Sharp-tailed Sandpiper

Like other species of sandpiper, the sharp-tailed sandpiper is a migratory, wading shorebird and undertakes long distance seasonal migrations between breeding grounds in the northern hemisphere and over-wintering areas in the southern hemisphere (Bamford et al., 2008). The species may occur in Australia between spring and autumn. The species is unlikely to occur within the Operational Area and only infrequently in the EMBA as they transit through, particularly near offshore islands.

Eastern Curlew

The eastern curlew was identified as potentially occurring within the Operational Area. The species is Australia's largest shorebird and a long-haul flyer (Department of Environment and Energy 2016). The eastern curlew takes an annual migratory flight to Russia and north-eastern China to breed, arriving back in Australia in August to feed in intertidal mud flats (Bamford et al. 2008). No BIAs or critical habitats for the eastern curlew have been identified in the Operational Area or EMBA.

Great Frigatebird

The greater frigatebird was identified as potentially occurring within the Operational Area. The species has a circumglobal distribution. The species breeds on offshore islands (generally March to November), and forages in waters surrounding breeding colonies, including Adele Island and Ashmore Reef (DSEWPaC 2012a), which lie beyond the EMBA.

Lesser Frigatebird

The lesser frigatebird was identified as potentially occurring within the Operational Area. It is usually seen in tropical or warmer waters around the coast of north Western Australia, the Northern Territory, Queensland and northern NSW (DSEWPaC 2012d). Within the North-west Marine Region, the lesser frigatebird is known to breed on Adele, Bedout and West Lacapede islands, Ashmore Reef and Cartier Island (DSEWPaC 2012d). The lesser frigatebird feeds mostly on fish and sometimes cephalopods and all food is taken while the bird is in flight. Lesser frigatebirds generally forage close to breeding colonies. A breeding BIA lies within the EMBA, about 156 km east of the Operational Area; the BIA is centred on Bedout Island.

Osprey

The osprey was identified as potentially occurring within the Operational Area. The osprey is a medium-sized raptor (length 50–65 cm; wingspan 145–170 cm) that is widely distributed around Australia in coastal and wetland habitats (Department of the Environment 2016b). The species also occurs throughout south-eastern Asia (Indonesia, Philippines, Palau Islands, New Guinea, Solomon Islands and New Caledonia) (Department of the Environment 2016b). Ospreys feed almost exclusively on fish, typically capturing prey observed while flying by plunging feet first into the water (Clancy 2005). Whilst listed as migratory, adults are generally restricted to a foraging area surrounding their nests (Department of the Environment 2016b). Egg laying in Australia is protracted between April and February (Olsen and Marples 1993), which may be due to the extended geographic range of the species within Australia and discrete genetic populations that may constitute subspecies (Olsen and Marples 1993, Wink et al. 2004). Given the species' preference for coastal and wetland environments, it is unlikely to occur within the Operational Area, but may occur within the EMBA in coastal waters.

Red Knot

The red knot migrates long distances from breeding grounds in high northern latitudes, where it breeds during the boreal summer, to the southern hemisphere during the austral summer. Both Australia and New Zealand host significant numbers of red knots during their non-breeding period (Bamford et al. 2008). The species is likely to occur in coastal wetland, intertidal sand or mudflats throughout the EMBA but unlikely to occur in the Operational Area due to the lack of suitable habitat.

Streaked Shearwater

The streaked shearwater is a migratory seabird with a broad distribution in the western Pacific Ocean. Within Australian waters, the species is commonly distributed from Exmouth, across northern Australia to Queensland, south to NSW (DSEWPaC, 2012). Its diet consists of invertebrates and epipelagic fishes (Atlas of Living Australia, 2019). The species breeds in temperate regions of east and south-east Asia before migrating to tropical regions near the equator; however, little is known about their movements during the non-breeding period (Yamamoto et al., 2010).

4.6 Socioeconomic Environment

4.6.1 Cultural and National Heritage

4.6.1.1 European and/or Indigenous Sites of Significance

There are no known sites of Indigenous or European cultural heritage significance within the vicinity of the Operational Area.

Within the EMBA, Ningaloo Reef, Exmouth, Barrow Island, Montebello Islands and the Dampier Archipelago and adjacent foreshores have a long history of occupancy by Aboriginal communities. Indigenous heritage places are protected under the *Aboriginal Heritage Act* 1972 (WA) or EPBC Act. A search of the Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Inquiry System was undertaken for the shoreline within the EMBA (**Appendix G**). The search indicated there are numerous registered sites, including middens, burial, ceremonial, artefacts, rock shelters, mythological and engraving sites recorded along the Ningaloo Coast, the Montebello Islands and the Dampier Archipelago (**Appendix G**). The exact location, access and traditional practices for a number of these sites are not disclosed and, if required such as in a major hydrocarbon release, would involve prioritising further consultation with key contacts within DPLH and local Aboriginal communities.

4.6.1.2 Historic Shipwrecks

In 2018 the Australian Parliament passed the *Underwater Cultural Heritage Act 2018* (Underwater Heritage Act). The Act came into effect on 1 July 2019, replacing the *Historic Shipwrecks Act 1976*. This new Underwater Heritage Act continues the protection of Australia's shipwrecks, but has also broadened to include protection to sunken aircraft and other types of underwater cultural heritage.

A search of the Australian National Shipwreck Database (Department of the Environment and Energy n.d.), which records all known Maritime Cultural Heritage (shipwrecks, aircraft, relics and other underwater cultural heritage) in Australian waters, indicated that there are no known Underwater Cultural Heritage sites within the Operational Area. However, a number of sites were identified within the EMBA; eleven of these (shipwrecks) were identified within 100 km of the Operational Area, at the closest point (**Table 4-8**).

Table 4-8: Recorded maritime cultural heritage sites in the vicinity of the Operational Area

Vessel name	Year wrecked	Wreck location*	Latitude (WGS84)	Longitude (WGS84)	Distance from closest point of the Operational Area (km)
McDermott Derrick Barge No 20	1989	North-east. tip of Eaglehawk Island, Dampier Archipelago	-20.14	115.95	43
McCormack	1989	North-east. tip of Eaglehawk Island West of Dampier	-20.14	115.95	43
Curlew	1911	At Onslow, Montebello Group	- 20.0	115.17	74
Marietta	1905	Montebello Islands	- 20.0	115.17	74
Vianen	1628	Barrow Island	- 20.0	115.17	74
Wild Wave (China)	1873	Montebello Islands	- 20.0	115.17	74
Trial	1622	Trial Rocks	- 20.29	115.38	76
Tanami	1622	Trial Rocks 16 km NW of Montebello Islands	- 20.28	115.37	76
Plym HMS	1952	Montebello Islands	-20.40	115.57	77
Tropic Queen	1975	Montebello Islands	-20.43	115.50	83
Parks Lugger	-	Hermite Island, Montebello Islands	-20.47	115.52	86
Dampier	-	Enderby Island, Dampier Archipelago	-20.52	116.23	93

** Wreck location as recorded in Australian National Shipwreck Database (DoEE n.d.)*

Source: DoEE (n.d.)

4.6.1.3 World, National, and Commonwealth Heritage Listed Places

There are no heritage listed sites within the Operational Area; however, there are a number of gazetted and proposed National and Commonwealth heritage places in the EMBA, including:

- World Heritage Places:
  - The Ningaloo Coast World Heritage Area (about 271 km south-west of the Operational Area, at the closest point) (see **Section 4.7.2.1**).
- National Heritage Places:
  - The Ningaloo Coast Natural Heritage Place (about 253 km south-west of the Operational Area, at the closest point)
  - Dampier Archipelago (including Burrup Peninsula) Indigenous Heritage Place (about 98 km south-west of the Operational Area, at the closest point)
  - Barrow Island and the Montebello-Barrow Islands Marine Conservation Reserves Nominated Heritage Place (about 68 km south-west of the Operational Area, at the closest point).
- Commonwealth Heritage Places:

- Mermaid Reef – Rowley Shoals Natural Heritage Place (about 409 km north-east of the Operational Area)
- Ningaloo Marine Area – Commonwealth Waters Natural Heritage Place (about 270 km south-west of the Operational Area, at the closest point).

4.6.2 Ramsar Wetlands

There are no Ramsar wetlands which overlap with or intersect the Operational Area or the EMBA.

4.6.3 Fisheries – Commercial

4.6.3.1 Commonwealth and State Fisheries

A number of Commonwealth and State fisheries are located within the Operational Area and EMBA. Fishcube data was requested to analyse the potential for interaction of fisheries with the Operational Area, which was used to determine consultation with State Fisheries who may be impacted by proposed petroleum activities (DPIRD, 2019). A review of the previous five years of the ABARES Fishery Status Report was undertaken to analyse the potential interaction of Commonwealth Fisheries with the Operational Area. **Table 4-9** provides further detail on the fisheries that have been identified through desk-based assessment and consultation (**Section 5**). **Figure 4-13**, provide the designated fisheries management areas where there is the potential for interaction within the Operational Area.

Table 4-9: Commonwealth and State fisheries of relevance to the Petroleum Activities Program

Fishery	Operational Areas		Within EMBA (including the socio-cultural EMBA)	Potential for interaction within Operational Area	Description
	GWF-3	LD			
Commonwealth Managed Fisheries					
Western Tuna and Billfish Fishery	✓	✓	✓	×	**Description**: The Western Tuna and Billfish Fishery zoning extends to the Australian EEZ boundary in the Indian Ocean, overlapping the Operational Area and EMBA. The key species that the fishery targets are four highly mobile pelagic species; swordfish (*Xiphias gladius*), bigeye tuna (*Thunnus obesus*), yellowfin tuna (*T. albacares*), striped marlin (*Kajikia audax*), some albacore tuna (*T. alalunga*) is also taken (ABARES, Williams et al., 2019). Over the last five years, fishing effort has been concentrated south of the Operational Area. Fishing effort from 2014 to 2018 has been recorded from offshore Point Cloates (Exmouth) south along the WA coast to Augusta in the south-west of WA (ABARES, Williams et al., 2019). **Licences/vessels**: Four vessels in 2017-2018 season (ABARES, Williams et al., 2019).
Southern Bluefin Tuna Fishery	✓	✓	✓	×	**Description**: The Southern Bluefin Tuna Fishery licence area overlaps the Operational Area and EMBA, however no current active fishing effort occurs in WA, only within southern and south-eastern Australia; within the Great Australian Bight (GAB), Tasmania and along the east coast of NSW (Patterson, et al., 2019). The fishery employs both longlining and purse seine net fishing methods, with the majority of fishing in Australia by purse seine in the GAB (Patterson, et al., 2019). Southern bluefin tuna (*Thunnus maccoyii*) are known to spawn in the north-eastern Indian Ocean (Davis et al., 1990, Matsuura et al., 1997). **Licences/vessels**: Seven purse seine vessels, 31 longline vessels active in 2017/18 season (Patterson, et al., 2019).
Western Skipjack Tuna Fishery	✓	✓	✓	×	**Description**: The combined Western Skipjack Tuna (*Katsuwonus pelamis*) Fishery encompasses the entire Australian EEZ, including the Operational Area and EMBA. The target species has historically been used for canning, and with the closure of canneries at Eden and Port Lincoln, effort in the fishery declined and there have been no active vessels operating since 2009 (Patterson and Mobsby, 2019). Should the fishery recommence efforts in the future, fishing effort in the Operational Area and EMBA will not occur as historical fishing effort was concentrated off southern Australia. **Licences/vessels**: Fishery inactive. No vessels active in 2017/18 season.

Fishery	Operational Areas		Within EMBA (including the socio-cultural EMBA)	Potential for interaction within Operational Area	Description
	GWF-3	LD			
North West Slope Trawl Fishery	×	×	✓	×	**Description**: The North West Slope Trawl Fishery licence area extends, from 114°E to 125°E, between the 200 m isobath and the outer boundary of the Australian Fishing Zone (AFZ) and the EEZ. The fishery traditionally targets scampi, deep water prawns and mixed snappers. Fishing for scampi occurs over soft, muddy sediments or sandy habitats, typically at depths of 350–600 m using demersal trawl gear on the continental slope focused in waters to the north-east of the Operational Area and EMBA, from offshore Barrow Island north to the south of Ashmore Reef (Mazloumi et al., 2019a). Activity in the fishery commenced in 1985, peaking at 21 active vessels in 1986-87. Operating from Point Samson and Darwin, fishing activity has been on a decline and stabilised at one or two active vessels each year since 2008-09, however, in 2017 activity increased and up to four vessels were operating (Mazloumi et al., 2019a). Fishing effort (number of trawl-hours) in the fishery is closely related to vessel activity, which increased during 2017/18 season. (Mazloumi et al., 2019a). **Licences/vessels**: Four vessels active in 2017/18 season (Mazloumi et al., 2019a).
Western Deepwater Trawl Fishery	×	×	✓	×	**Description**: The Western Deepwater Trawl Fishery is located in deep water (>200 m) off Western Australia, between longitude 115°08'E and the western boundary of the North West Slope Trawl Fishery (NWSTF) in the north (114°E), to the outer boundary of the AFZ. Recent changes to the boundary have occurred to align with the 200 m isobath (Mazloumi et al., 2019b). This fishery targets a number of deep water, demersal finfish and crustacean species. The nominated fishing grounds are extensive, however, fishing effort is to the south of the Operational Area, with areas of fishing activity located offshore of North West Cape along Ningaloo Reef, west of Shark Bay, and offshore Perth Metropolitan area, in water greater than the 200 m isobath. Fishing effort increased during the 2017/18 season compared to low effort in recent years after the early 2000's peak (Mazloumi et al., 2019b). **Licences/vessels**: three vessels active in 2017/18 season (Mazloumi et al., 2019b).
State Managed Fisheries					
Mackerel Managed Fishery	✓	✓	✓	✓	**Description**: The Mackerel Managed Fishery targets Spanish mackerel (*Scomberomorus commerson*) using near-surface trawling gear from small vessels in coastal areas around reefs, shoals and headlands. Jig fishing is also used to capture grey mackerel (*S. semifasciatus*), along with other species from the genera Scomberomorus (Molony et al., 2015). The commercial fishery extends from Geraldton to the Northern Territory border. There are three managed fishing areas: Kimberley (Area 1), Pilbara (Area 2), and Gascoyne and West

Fishery	Operational Areas		Within EMBA (including the socio-cultural EMBA)	Potential for interaction within Operational Area	Description
	GWF-3	LD			
					Coast (Area 3). Managed Fishing Areas 2 and 3 overlap the Operational Area. The catch is generally taken from the Pilbara and Kimberley coasts reflecting the tropical distribution of mackerel species (Molony et al., 2015). The fishing activity occurs around the coastal reefs of the Dampier Archipelago and Port Hedland area, with the seasonal appearance of mackerel in shallower coastal waters most likely associated with feeding and gonad development prior to spawning (Mackie et al., 2003). The catch effort in 2018/2019 was 214t (DPIRD, 2019a). Spanish mackerel spawn between August and November when inhabiting coastal reef areas of the Exmouth/Gascoyne region, with females exhibiting serial spawning behaviour (spawning every one to three days) over the spawning period. Outside the main fishing season (December – April), it is unclear which areas the mackerel populations inhabit. However, there is anecdotal evidence to suggest populations move into deeper offshore waters (Mackie et al., 2003). There have been at least three vessels that operate within a 60 NM block that cover part of both the GWF-3 and LD Operational Areas which have been in operation for the past five years (DPIRD, 2019b). No fishing activity has occurred within the 10 NM grid that overlaps the GWF-3 Operational Area. There has been some fishing activity within the 10 NM grid that overlaps the LD Operational Area in 2013 and 2016. **Licences/vessels**: 52 licences in 2017/18 season (DPIRD, 2019). 14 vessels in 2014 (Molony et al., 2015). Not stated from 2015 to 2018 (Lewis et al, 2018).
Pilbara Demersal Scalefish Fishery (Pilbara Trawl, Trap and Line)	✓	✓	✓	✓	**Description**: The Pilbara Demersal Scalefish Fishery (PDSF) overlaps the Operational Area, targeting a range of low and high value finfish species. The fishery includes the Pilbara Fish Trawl (Interim) Managed Fishery (PFTIMF), the Pilbara Trap Managed Fishery (PTMF) and the Pilbara Line Fishery (PLF) (Newman et al., 2017). The PDSF collectively use a combination of vessels, effort allocations (time), gear limits, plus spatial zones (including extensive trawl closures) as management measures (Newman et al., 2017). The Pilbara Demersal Scalefish Fishery is managed through area closures, gear restrictions and the use of individual effort allocations (Newman et al., 2017). The GWF-3 Operational Area overlaps a trap fishing area of the PDSF and the LD overlaps Areas 1 and 6 of the PFTIMF (Allen and Loneragan, 2010). <u>Pilbara Fish Trawl Interim Managed Fishery</u> The PFTIMF is divided into two zones, waters inside of the 50 m isobath are permanently closed to fish trawling, Zone 1 is closed to fish trawling, Zone 2 comprises six management areas and Area 3 is permanently closed to trawling, Area 6 has had no fish trawl effort

Fishery	Operational Areas		Within EMBA (including the socio-cultural EMBA)	Potential for interaction within Operational Area	Description
	GWF-3	LD			
					allocation since 1998 (Newman et al., 2017). The PFTIMF lands the largest component of the catch within the PDSF and operates in waters between 50 and 200 m water depth (Newman et al., 2015b; 2017). There have been up to three active PFTIMF vessels that operate within both the 10 and 60 NM blocks that cover just the LD Operational Area and have operated there for the past five years (DPIRD, 2019b). <u>Pilbara Trap Managed Fishery</u> The PTMF covers the area from Exmouth northwards and eastwards to the 120° line of longitude, and offshore as far as the 200 m isobath. Like the trawl fishery, the trap fishery is also managed by use of input controls in the form of individual transferable effort allocations monitored with a satellite-based vessel monitoring system (VMS). Waters inside of the 50 m isobath are permanently closed to trap fishing and Area 3 has also been closed to trapping since 1998 (Newman et al., 2015b). Traps are limited in number with the greatest effort in waters greater than 50 m depth. This fishery targets high value species such as red emperor and goldband snapper (*Pristipomoides spp*.) (Newman et al., 2019). There have been at least three active PTMF vessels that operate within a 60 NM block that cover both GWF-3 and LD Operational Areas and have operated there for the past five years. The fishing activity occurs in the 60 NM grid, therefore this fishing activity has potential to interact with the Operational Area (DPIRD, 2019b). <u>Pilbara Line Fishery</u> The PLF encompasses all of the 'Pilbara waters', extending from a line commencing at the intersection of 21°56'S latitude and the boundary of the Australian Fishing Zone and to longitude 120°E (Newman et al., 2014). The PLF targets tropical demersal scalefish and is the smallest scale fishery within the PDSF in terms of monetary value, attaining a commercial catch of 40t (Newman et al., 2015b). There are no stated depth limits and the western extent of the fishery is the boundary of the AFZ (Newman et al., 2015b). The PLF is managed under the Prohibition on Fishing by Line from Fishing Boats (Pilbara Waters) Order 2006 with the exemption of nine fishing vessels for any nominated five-month block period within the year. Fishing in Area 3 has also been a closed to line fishing since 1998 (Newman et al., 2015b). There have been up to four active PLF vessels that operate within a 60 NM block that cover the GWF-3 Operational Area, and up to five vessels that cover the LD Operational Area, which have operated there for the past five years (DPIRD, 2019b).

Fishery	Operational Areas		Within EMBA (including the socio-cultural EMBA)	Potential for interaction within Operational Area	Description
	GWF-3	LD			
					Licences/vessels: 11 permits in the PFTIMF, six licences in PTMF, 2017/18 season (DPIRD, 2019). 10 vessels active in 2017/18 season (two PFTIMF, three PTMF and five PLF; Newman et al., 2017).
South West Coast Salmon Managed Fishery	✓	✓	✓	×	**Description**: The South West Coast Salmon Managed Fishery operates on various beaches south of the metropolitan area and includes all Western Australian waters north of Cape Beaufort except Geographe Bay. This fishery uses beach seine nets to take western Australian salmon (*Arripis truttaceus*). No fishing takes place north of the Perth metropolitan area, despite the managed fishery boundary extending to the Western Australia/Northern Territory border. In 2017/18, the commercial catch for the South Coast Bioregion was 154 t, with 33% taken by the South West Coast Salmon Managed Fishery (Smith et al., 2019). The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019b). **Licences/vessels**: not applicable (shore-based).
West Coast Deep Sea Crustacean Managed Fishery	✓	✓	✓	×	**Description**: The West Coast Deep Sea Crustacean Managed Fishery extends north from Cape Leeuwin to the Western Australia/Northern Territory border in water depths great than 150 m within the AFZ, including the Operational Area. The fishery targets deep water crustaceans, including crystal (snow) crabs, giant (king) crabs and champagne (spiny) crabs, with the vast majority (>99%) of the catch landed in 2017 comprising crystal crabs (How and Orme 2018). Two vessels operated in the fishery in 2015, using baited pots operated in a longline formation in the shelf edge waters greater than 150 m water depths (How and Orme 2018). The catch effort in 2019/18 was 152.8 t (DPIRD, 2019) and was concentrated between Fremantle and Carnarvon. The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019). **Licences/vessels**: Seven licences in 2017/18 season (DPIRD, 2019). Six vessels active in 2017/18 season (How and Orme 2018).

Fishery	Operational Areas		Within EMBA (including the socio-cultural EMBA)	Potential for interaction within Operational Area	Description
	GWF-3	LD			
Pilbara Crab Managed Fishery	✓	✓	✓	×	**Description:** Blue Swimmer Crabs (*Portunus armatus*) are targeted by the Pilbara Crab Managed Fishery, which came into force in 2018. As there are no recent status reports, the Pilbara crab resource had been commercially accessed through the Pilbara Developing Crab Fishery (Developing Fishery) since it commenced in 2001 (DPIRD, 2018). The fishing effort occurs in Nickol Bay, near Dampier. Crab stocks in the Pilbara region are highly variable due to environmental fluctuations. Total commercial catch of blue swimmer crabs was 51 t and mud crabs was 9 t in the North Coast Bioregion for 2017/18 (Johnston et al., 2017). The fishery has not been active in the Operational Area since becoming active in 2018 (DPIRD, 2019). **Licences/vessels**: not available.
Marine Aquarium Fish Managed Fishery	✓	✓	✓	×	**Description**: The Marine Aquarium Managed Fishery operates within Western Australian waters. The managed fishery boundary overlaps the Operational Area. The fishery is primarily a dive-based fishery that uses hand-held nets to capture the desired target species and is restricted to safe diving depths (typically <30 m). The fishery is typically active from Esperance to Broome, with popular areas including the coastal waters of the Cape Leeuwin/Cape Naturaliste region, Dampier and Exmouth. The landed catch was predominantly ornamental fish but also included hermit crabs, seahorses, invertebrates, corals and live rock (Newman et al., 2014). The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019). **Licences/vessels**: 11 licences in 2017/18 (DPIRD, 2019; Newman et al. 2018).

Fishery	Operational Areas		Within EMBA (including the socio-cultural EMBA)	Potential for interaction within Operational Area	Description
	GWF-3	LD			
Specimen Shell Managed Fishery	✓	✓	✓	×	**Description**: The Specimen Shell Managed Fishery (SSF) can be conducted anywhere within Western Australia waters and targets the collection of specimen shells for display, collection, cataloguing and sale. The SSF encompasses the entire WA coastline and overlaps the Operational Area, effort also occurs in areas adjacent to the largest population centres such as: Broome, Karratha, Shark Bay, Mandurah, Exmouth, Capes area, Albany and Perth (Hart and Crowe 2015). Collection is predominately by hand when diving or wading in shallow coastal waters, though a deeper water collection aspect to the fishery has been initiated with the employment of ROVs operating at depths up to 300 m (Hart and Crowe 2015). The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019). **Licences/vessels**: 31 licences in 2017/18, with 23 of these being active in 2017 (Hart et al. 2018c).
Western Australian Abalone Managed Fishery	✓	✓	✓	×	**Description**: The Western Australian Abalone Managed Fishery includes all coastal waters from the Western Australian and South Australian border to the Western Australian and Northern Territory border. Shark Bay is considered the northern range limit for the commercial abalone species and the fishery also overlaps the Operational Area. Abalone are harvested by divers, limiting the fishery to shallow waters. The abalone fishery targets the greenlip abalone (*Haliotis laevigata*), brownlip abalone (*H. conicopora*) and Roe's abalone (*H. roei*). No commercial fishing for abalone north of Moore River (zone 8 of the managed fishery) took place in 2015 (Hart et al. 2015a). The commercial fishery reported a total commercial catch of 61 t in 2018/19 (DPIRD, 2019). The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019). **Licences/vessels**: 23 vessels active in Roe's abalone fishery in 2017 (Strain et al., 2018c).

Fishery	Operational Areas		Within EMBA (including the socio-cultural EMBA)	Potential for interaction within Operational Area	Description
	GWF-3	LD			
Pearl Oyster Managed Fishery	✓	✓	✓	×	**Description**: The Western Australian Pearl Oyster Fishery is the only remaining significant wild-stock fishery for pearl oysters in the world (Fletcher et al., 2006). The species targeted is the Indo-Pacific silver-lipped pearl oyster (*Pinctada maxima*), which are collected in shallow coastal waters along the north-west-shelf through the use of divers (restricted to safe diving depths), and are mainly for use in the culture of pearls (Hart et al., 2017). The fishery is separated into four zones. The Pearl Oyster Zone 1 lies within the vicinity of the Operational Area, extending from North West Cape (including Exmouth Gulf) to Cape Thouin. There are five licences in Zone 1, with fishing recently recommencing after a hiatus of several years (Hart et al., 2015b). The catch effort in 2018/19 was 614,002 oysters (DPIRD, 2019a). The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019b). **Licences/Vessels**: Five vessels and 15,637 diver hours in 2018/19 (DPIRD, 2019); Hart et al., 2019b).
Onslow Prawn Managed Fishery	✓	✓	✓	×	**Description**: The Onslow Prawn Managed Fishery encompasses a portion of the continental shelf off the Pilbara. The fishery targets a range of penaeids (primarily king prawns) which typically inhabit soft sediments <45 m water depth. Fishing is carried out using trawl gear over unconsolidated sediments (sand and mud). The catch was negligible in 2018/19, at <1 t. Only five days of fishing effort was undertaken (by one vessel) in 2017. (Kangas et al. 2017). The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019b). **Licences/vessels:** 30 licences in 2017/18 (DPIRD, 2019). One vessel in 2017 (Kangas et al., 2019).
Nickol Bay Prawn Managed Fishery	×	×	✓	×	**Description:** The Nickol Bay Prawn Managed Fishery is about 14 km from LD and 86 km from GWF-3 Operational Areas, and targets penaeid prawns (primarily banana prawns) using trawl gear. The target species typically inhabits sandy and muddy substrate in <45 m water depth. The catch effort in 2018/2019 was 81 t (DPIRD, 2019a). The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019b). **Licences/vessels:** The number of vessels is unreported. 14 licences in 2017/18 (DPIRD, 2019).

Fishery	Operational Areas		Within EMBA (including the socio-cultural EMBA)	Potential for interaction within Operational Area	Description
	GWF-3	LD			
West Australian Sea Cucumber Fishery	×	×	✓	×	**Description:** The sea cucumber or 'Beche-de-mer' fishery is a hand-harvested fishery that can be conducted within all Western Australian waters. The collection methods of this fishery are limited to shallow, coastal waters (methods principally by diving or wading). This nearshore fishery was predominantly a single-species fishery with 99% of the catch being sandfish (*Holothuria scabra*). A deepwater species redfish (*Actinopyga echinites*) has more recently emerged as a target species, but recent catch data indicates a rapid decline in the catch of this species (50% reduction in overall catch of the fishery from 2010 to 2011). The fishery was worth an estimated $400k in 2017 (Hart et al., 2018b) with a total catch of 135 t. There are specific areas closed to this fishery including the Dampier Archipelago and Rowley Shoals (DoF, 2012a). The catch effort in 2018/2019 for the Pilbara region (Sandfish) was 36 t, and 25 t of commercially caught redfish (DPIRD, 2019a). Fishing is usually concentrated in the northern half of the State from Exmouth Gulf to the Kimberley region (Hart et al., 2019c). The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019b). **Vessels:** Not applicable (hand collection – shallow water-based).
West Coast Rock Lobster Fishery	×	×	✓	×	**Description**: The West Coast Rock Lobster Fishery targets the western rock lobster (*Panulirus cygnus*) from Shark Bay south to Cape Leeuwin using baited traps (pots), about 242 km from GWF-3 and 302 km from LD Operational Areas. In 2008, it was determined that the allocated shares of the West Coast Rock Lobster resource would be 95% for the commercial sector, 5% to the recreational sector, and one tonne to customary fishers. The commercial fishery has been Australia's most valuable single-species wild capture fishery. In 2012/2013, the fishery moved to an individually transferable quota fishery. The fishery is managed using zones, seasons and total allowable catch. The fishing effort is off the central and southern west coast (de Lestang et al., 2018). The catch effort in 2018 was 6400 t (DPIRD, 2018). The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019b). **Licences/vessels**: 653 licences in 2017/18 (DPIRD, 2019). 234 vessels in 2017 (de Lestang et al. 2018).

Fishery	Operational Areas		Within EMBA (including the socio-cultural EMBA)	Potential for interaction within Operational Area	Description
	GWF-3	LD			
Gascoyne Demersal Scalefish Managed Fishery	×	×	✓	×	**Description**: The Gascoyne Demersal Scalefish Fishery (GDSF) comprises commercial and recreational fishing for demersal scalefish in the continental waters of the Gascoyne Coast Bioregion, about 428 km from GWF-3 and 490 km from LD Operational Areas. The GDSF is located between the southern Ningaloo Coast to south of Shark Bay with a closure area from Point Maud to Tantabiddi. Commercial vessels have historically targeted the oceanic stocks of pink snapper (*Pagrus auratus*) during the winter months, with the main component caught within Shark Bay, accounting for 80% of the total commercial catch. The GDSF continues operating throughout the year targeting additional demersal species including the goldband snapper (*Pristipomoides spp.*), red emperor (*Lutjanus sebae*), emperors and cod (family Serranidae) (Jackson et al., 2015). The catch effort in 2019 was 45.1 t of snapper, and 164 t of other demersals (DPIRD, 2019). The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019b). **Licences/vessels**: 58 licences in 2017/18 (DPIRD, 2019). 16 vessels (Jackson et al. 2018; Gaughan and Santoro, 2018).
Exmouth Gulf Prawn Managed Fishery	×	×	✓	×	**Description**: The Exmouth Gulf Managed Fishery targets penaeid prawns (primarily banana prawns) using trawl gear within Exmouth Gulf, about 237 km from the GWF-3 Operational Area and 301 km from LD. The target species typically inhabits sandy and muddy substrate in <45 m water depth. The catch effort in 2018/19 was 880 t (DPIRD, 2019). The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019b). **Licences/vessels:** 15 licences in 2017/18 (DPIRD, 2019); Six vessels in 2015 (Sporer et al., 2015a), not provided in 2017/18 report.

Fishery	Operational Areas		Within EMBA (including the socio-cultural EMBA)	Potential for interaction within Operational Area	Description
	GWF-3	LD			
Shark Bay Prawn and Scallop Managed Fisheries	×	×	✓	×	**Description**: The Shark Bay Prawn Managed Fishery lies about 476 km from the GWF-3 Operational Area and 536 km from LD, and is the highest producing Western Australian fishery for prawns. It targets the western king prawn (*Penaeus latisulcatus*) and brown tiger prawn (*Penaeus esculentus*) and takes a variety of smaller prawn species including endeavour prawns (*Metapenaeus spp*.) and coral prawns (various species). In 2018, The Shark Bay Prawn Managed Fishery reported a catch effort of 1608 t (DPIRD, 2018). The Shark Bay Scallop Managed Fishery targets the saucer scallop (*Amusium balloti*) and was usually Western Australia's most productive scallop fishery until it was closed due to the results from the pre-season survey of stock abundance (Sporer et al., 2015). The stock is currently recovering after sustained recruitment (Kangas et al., 2017b). In 2018, the Shark Bay Scallop Managed Fishery reported a catch effort of 1632 t (DPIRD, 2018). The fishery has not been active in the Operational Area within the last five years (DPIRD, 2019b). **Licences/vessels**: 18 vessels in 2017 (Kangas et al., 2018). 18 (Prawn) and 29 (Scallop) licences in 2019 (DPIRD, 2019).

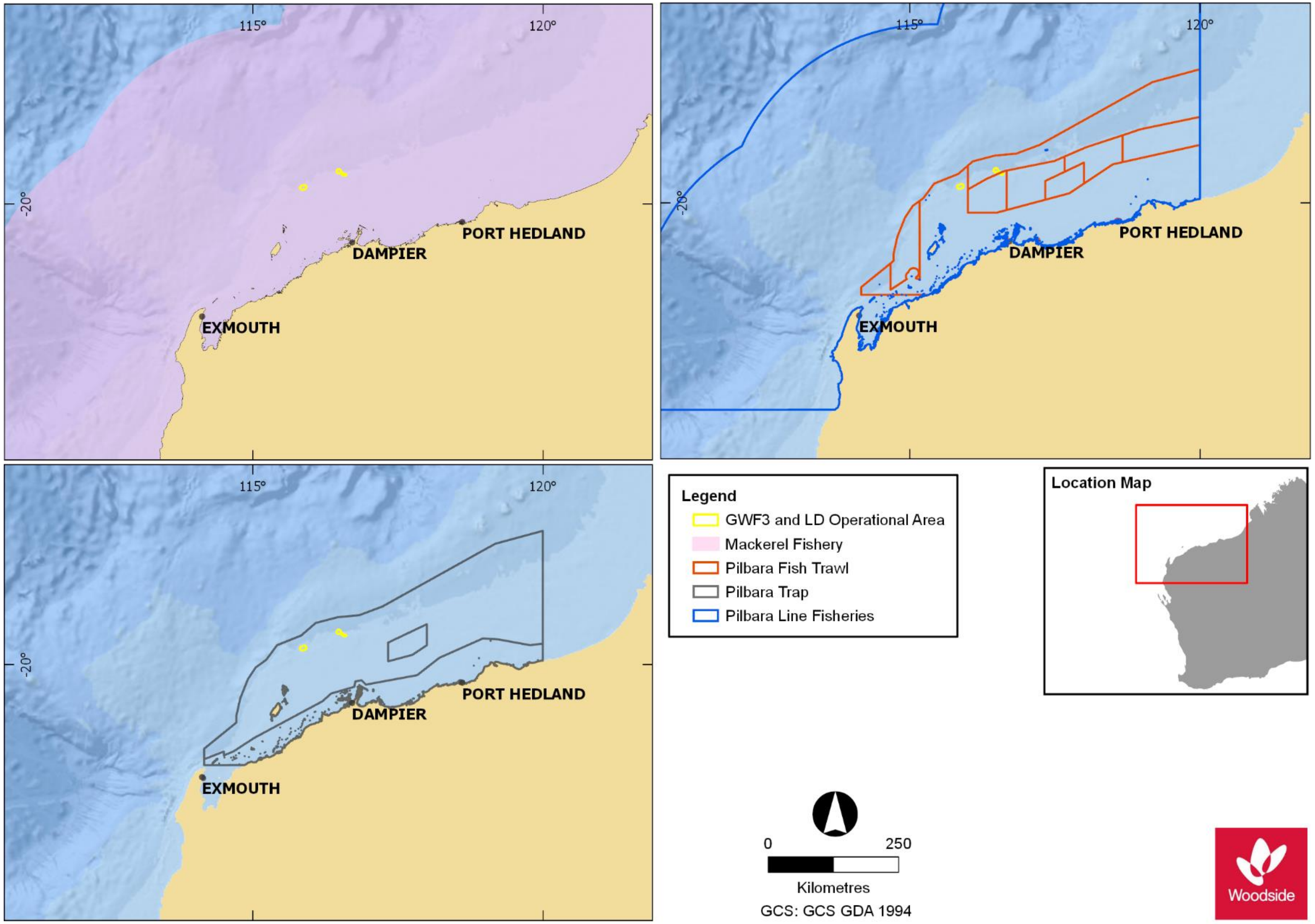


Figure 4-13: Location of commercial fisheries with the potential for interaction within the Operational Area

4.6.3.2 Aquaculture

There are no aquaculture operations within the Operational Area as these operations are typically restricted to shallow coastal waters. Aquaculture in the region consists primarily of culturing hatchery-reared and wild-caught oysters (*Pinctada maxima*) for pearl production, which is primarily centred around Broome and the Dampier Peninsula. Leases typically occur in shallow coastal waters at depths of less than 20 m (Fletcher et al. 2006). There are existing pearl aquaculture leases at the Montebello Islands (within EMBA), although they are not active at the time of writing (Fletcher et al. 2017). Primary spawning of the pearl oyster occurs from mid-October to December. A smaller secondary spawning occurs in February and March (Fletcher et al. 2006).

4.6.4 Fisheries – Traditional

There are no traditional or customary fisheries within the Operational Area, as these are typically restricted to shallow coastal waters and/or areas with structures such as reefs. However, it is recognised that Barrow Island, Montebello Islands and Ningaloo Reef, all within the EMBA, have a known history of fishing when areas were occupied (as from historical records) (Department of Conservation and Land Management 2005, Department of Environment and Conservation 2007).

Traditional fishing still occurs within coastal areas of the Pilbara, particularly within the Dampier Archipelago where there are extensive embayments and islands close to shore. The EMBA overlaps a number of small islands along the offshore extent of the Dampier Archipelago, near Rosemary Island, where there is a potential for traditional fishing to occur, as well as a number of the Pilbara Islands (Southern Island Group) (e.g. Thevenard Island, Serrurier Island and Murion Islands). Although historically traditional fishing occurred on these islands, given their distance from shore it is unlikely to occur today. The EMBA does not overlap any area of mainland within the Pilbara.

4.6.5 Tourism and Recreation

No tourism activities take place specifically within the Operational Area, but it is acknowledged that there are growing tourism and recreational sectors in WA which have expanded over the last couple of decades. Growth and the potential for further expansion in tourism and recreational activities is recognised for the Pilbara and Gascoyne regions, with the development of regional centres and a workforce associated with the resources sector (SGS Economics & Planning 2012).

FishCube data indicates no charter operator vessels have been active in the waters within or adjacent to the Operational Area in the past five years (DPIRD, 2019; **Table 4-9**). The Montebello Islands (74 km from the Operational Area) are the next closest location for tourism, with some charter boat operators taking visitors to these remote islands (DEC 2013). Occasional recreational fishing occurs at Rankin Bank and Glomar Shoal (located about 19 km west and 1 km south-east of the Operational Area, respectively), however consultation with Recfishwest has indicated that this is not likely due to the distance offshore (**Section 5**).

Within the EMBA, tourism is one of the major industries of the Gascoyne region and contributes significantly to the local economy in terms of both income and employment. The main marine nature-based tourist activities are concentrated around and within the Ningaloo World Heritage Area (about 271 km south-west of the Operational Area at the closest point) and North West Cape area, including recreational fishing, snorkelling and scuba diving, whale shark (April to August) and manta ray (year round) encounters, whale watching (July to October), whale encounters (August and November) and turtle watching (all year round) (Schianetz et al. 2009). Recreational fishing and diving charters also visit some offshore islands within the socio-cultural EMBA (e.g. Montebello Islands, Thevenard Island, Murion Islands, and islands within the Dampier Archipelago) with permanent accommodation located on Thevenard Island.

4.6.6 Shipping

The NWMR supports significant commercial shipping activity, the majority of which is associated with the mining and oil and gas industries (**Figure 4-14**).

The Australian Maritime Safety Authority (AMSA) has introduced a network of marine fairways across the NWMR of WA to reduce the risk of vessel collisions with offshore infrastructure. The fairways are not mandatory but AMSA strongly recommends commercial vessels remain within the fairway when transiting the region. It is noted that one of the shipping fairways intersects with the Operational Area (**Figure 4-14**). Vessel tracking data suggests shipping is concentrated to the east of the Operational Area, which is likely associated with Woodside oil and gas facilities.

Ports in the region are nodes of increased vessel activities; active ports in the vicinity of the Operational Area, at the closest point, include:

- Dampier Port (about 128 km south of the Operational Area)
- Barrow Island Port (about 121 km south-west of the Operational Area)
- Port of Port Hedland (about 224 km south-east of the Operational Area)
- Port of Ashburton, Onslow (about 231 km south-west of the Operational Area).

Additional shipping routes are located within the wider region and it is expected that local vessel traffic will pass through the area. Shipping activities in the region may include:

- international bulk freighters/tankers including mineral ore, hydrocarbons (LNG, liquefied petroleum gas, condensate) and salt carriers
- domestic support/supply vessels servicing offshore facilities
- construction vessels/barges/dredges
- offshore survey vessels
- commercial and recreational fishing vessels.

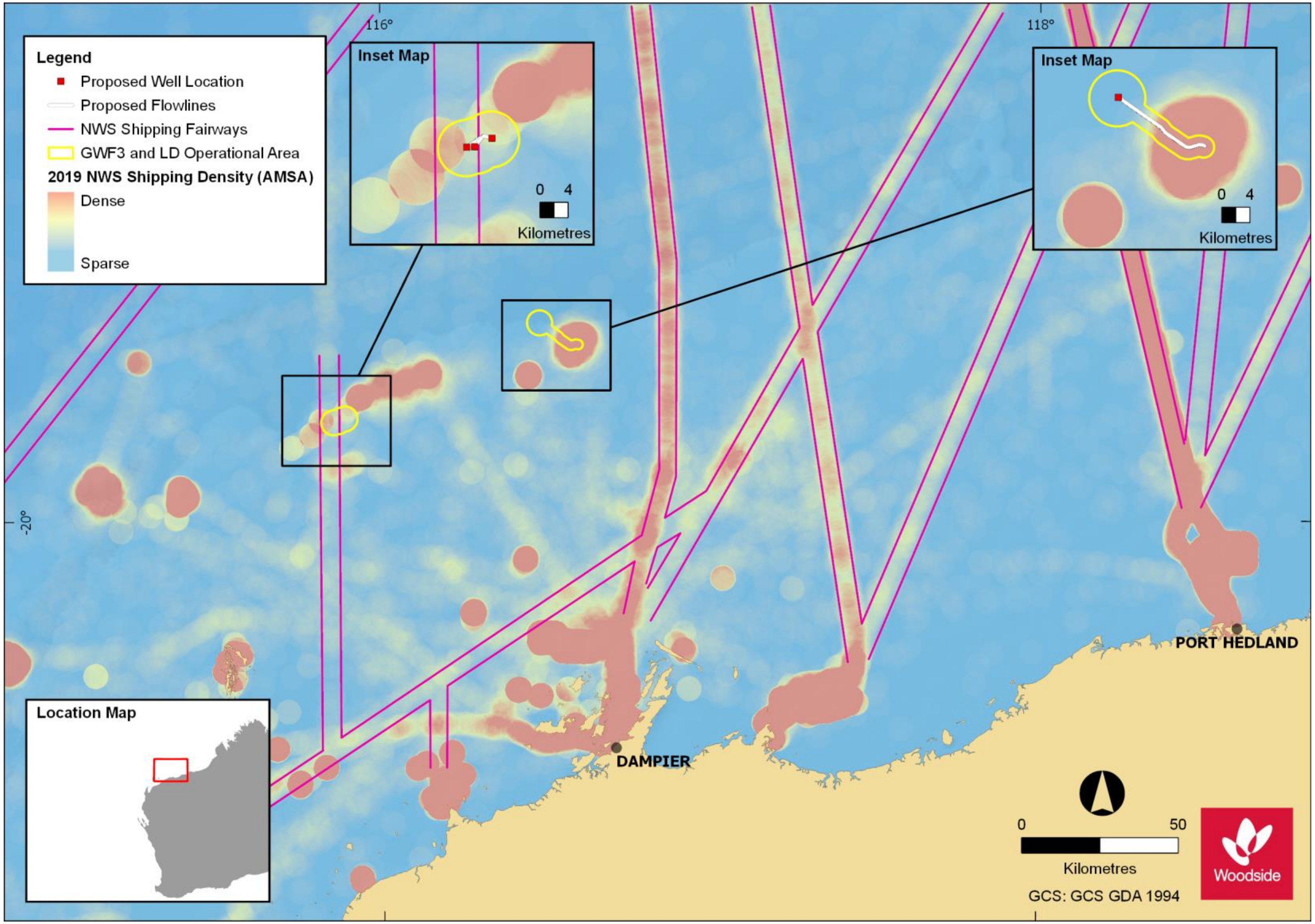


Figure 4-14: Vessel density map in the vicinity of Operational Area from 2016, derived from AMSA satellite tracking system data (vessels include cargo, LNG tanker, passenger, support and other vessels)

4.6.7 Oil and Gas Infrastructure

The Operational Area is located within an area of established oil and gas operations in the broader NWMR. **Table 4-10** lists other facilities (FPSOs and platforms) currently in operation in the vicinity of the Operational Area (as shown in **Figure 4-15**). The existing infrastructure in the vicinity of the Operational Area includes the components of the broader GWF development including manifold, xmas trees, umbilical and pipeline and the components of the broader LD development including the Angel Platform, export pipeline, flowlines, tie-in spools, umbilicals, SSIV, mattresses and the CWLH infrastructure (**Section 3.9.1**)

Table 4-10: Other oil and gas facilities in the vicinity of the Operational Area

Facility name (Operator)	Approximate distance and direction from GWF-3 Operational Area (km)	Approximate distance and direction from LD Operational Area (km)
Angel	74 km north-east	Overlapping
Goodwyn Alpha (GWA) platform	4 km north-east	59 km south-west
Okha FPSO	56 km north-east	13km south-west
North Rankin Complex	27 km north-east	36 km south-west
Wheatstone Platform (Chevron)	51 km south-west	124 km south-west
Reindeer (Quadrant/Santos)	52 km south-east	62 km south-west
Pluto	55 km south-west	128 km south-west
Stag (Quadrant/Santos)	71 km south-east	92 km south-west

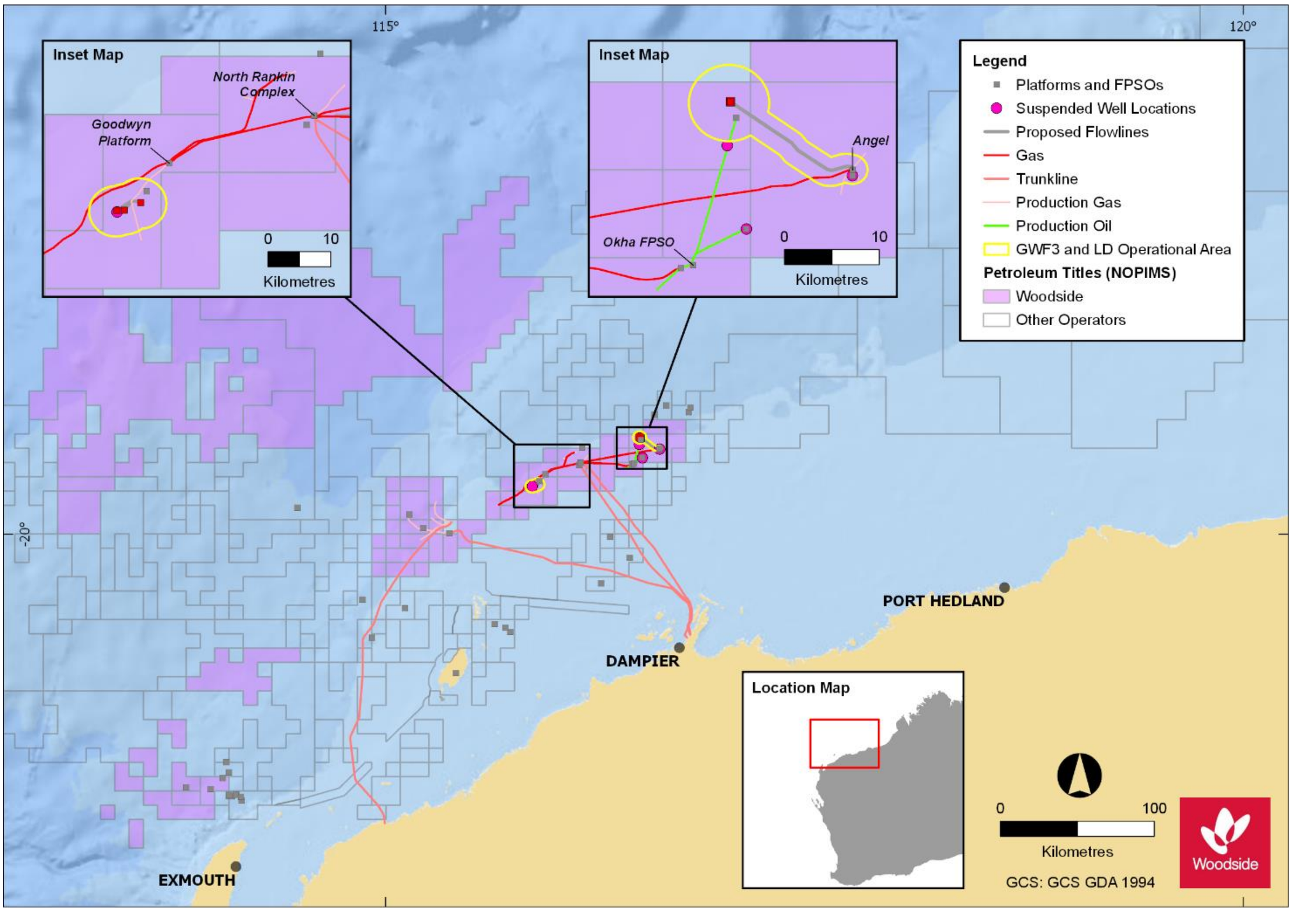


Figure 4-15: Oil and gas titles and infrastructure

4.6.8 Defence

There are designated defence practice areas in the offshore marine waters off Ningaloo and North West Cape, beyond the Operational Area but within the EMBA (**Figure 4-16**). A Royal Australian Air Force base at Learmonth, on North West Cape, is 327 km from the Operational Area, at the closest point.

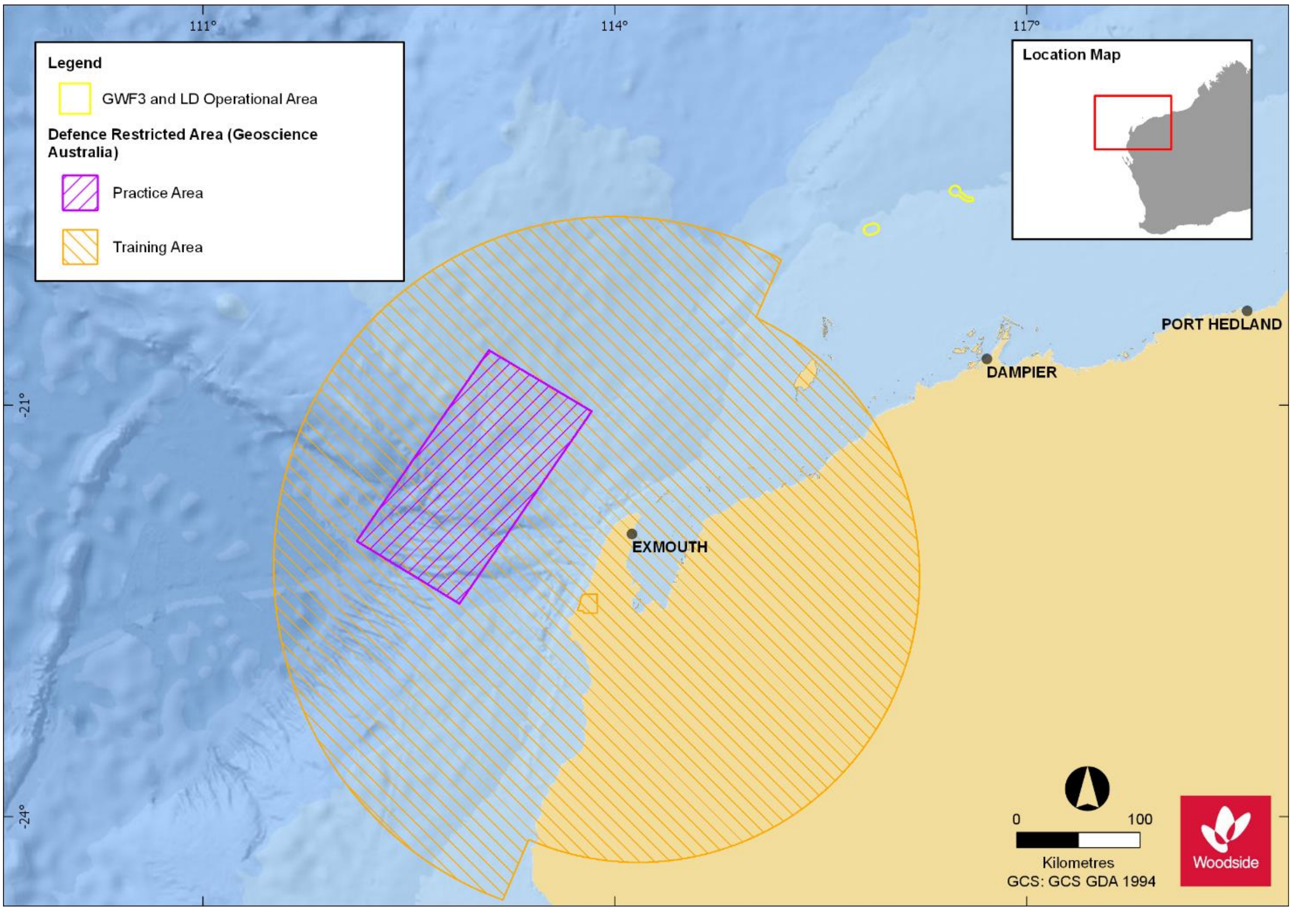


Figure 4-16: Department of Defence demarcated marine offshore areas for military and defence practice with reference to the location of the Operational Area

4.7 Values and Sensitivities

The values and sensitivities of the Operational Area and EMBA are presented in this subsection of the existing environment description. The offshore environment of the NWMR contains environmental assets (such as habitat and species) of high value or sensitivity including the Commonwealth marine environment (offshore waters), as well as the wider regional context including coastal waters and habitats such as the Montebello/Barrow/Lowendal Island Group and the Ningaloo WHA, and the associated resident, seasonal and migratory marine life including species such as marine mammals, turtles and birds (**Section 4.5.2**).

Many sensitive receptor locations are protected as part of Commonwealth and State managed areas and have been allocated conservation objectives (IUCN Protected Area Category) based on the Australian IUCN reserve management principles in *Schedule 8 of the EPBC Regulations 2000*. These principles determine what activities are acceptable within a protected area under the EPBC Act. As all planned petroleum activities will take place within the Operational Area, and no protected areas overlap this, the planned activities associated with the Petroleum Activities Program are conducted in a manner consistent with the Australian IUCN reserve management principles for the IUCN categories that have been identified (**Table 4-11**).

The North-west Marine Parks Network Management Plan (DNP 2018) provides for the protection and conservation of biodiversity and values of marine parks in the North-west Region that extends from the WA–NT border to Kalbarri, south of Shark Bay. The North-west Marine Parks Network covers 335,341 km^2 and includes 13 marine parks (DNP 2018).

Key natural values in the North-west Marine Parks Network Management Plan (DNP 2018) include:

- KEFs (Ashmore Reef, Cartier Island, Canyons linking the Argo Abyssal Plain with the Scott Plateau, Mermaid Reef and the Commonwealth Waters Surrounding the Rowley Shoals, Exmouth Plateau, Canyons linking the Cuvier Abyssal Plain with the Cape Range Peninsula, the Commonwealth Waters adjacent to Ningaloo Reef, Continental Slope Demersal Fish Communities, and the Ancient Coastline at 125 m Depth Contour)
- BIAs where aggregations of individuals of protected species breed, forage and rest during migration.

The North-west Marine Parks Network includes two WHAs, these being the Ningaloo Coast WHA and the Shark Bay WHA. The plan also supports a range of uses such as shipping, ports, commercial fishing, pearling and aquaculture, as well as offshore mining operations.

A number of high-value or sensitive environments were identified and are located within the EMBA. A number of these are within established Australian Marine Parks (AMPs) (North-west Marine Parks Network) and management of the AMPs is governed by the North-west Marine Parks Network Management Plan (DNP 2018).

The following subsections outline the values and sensitivities of the established and proposed Marine Protected Areas (MPAs) and other sensitive areas in the EMBA (listed in **Table 4-11**, shown in **Figure 4-17**). In addition, these areas are also considered in the environmental risk evaluation of planned and unplanned activities associated with the Petroleum Activities Program.

Table 4-11: Summary of established and proposed MPAs and other sensitive locations within the EMBA

	Distance from Operational Area to Values/Sensitivity boundaries (km)	IUCN Protected Area Category[1]
Australian Marine Parks (AMPs)		
Montebello	31	VI
Argo-Rowley Terrace	183	II, VI
Gascoyne	242	II, IV, VI
Ningaloo	270	II, IV
Mermaid Reef	399	II
Shark Bay	577	IV
Carnarvon Canyon	605	IV
State Marine Parks and Nature Reserves		
Marine Parks		
Montebello Islands	68	IA, II, IV, VI
Ningaloo	271	IA, II, IV
Barrow Island	119	IA, IV, VI
Rowley Shoals	312	II
Marine Management Areas		
Barrow Island	87	IA, IV, VI
Murion Islands	252	IA, VI
Fish Habitat Protection Areas		
None identified within the Operational Area or EMBA.		
Nature Reserves		

	Distance from Operational Area to Values/Sensitivity boundaries (km)	IUCN Protected Area Category[1]
Lowendal Islands Nature Reserve	101	IA
Barrow Island Nature Reserve	109	IA
Boodie, Double and Middle Islands Nature Reserve	114	IA
Great Sandy Island Nature Reserve	119	IA
Round Island Nature Reserve	135	IA
Airlie Island Nature Reserve	187	IA
Thevenard Island Nature Reserve	207	IA
Bessieres Island Nature Reserve	225	IA
Serrurier Island Nature Reserve	237	IA
Murion Islands Nature Reserve	256	IA
Heritage		
World Heritage Areas		
The Ningaloo Coast	271	Not applicable
National Heritage Areas		
Barrow Island and the Montebello-Barrow Islands Marine Conservation Reserves	68	Not applicable
The Ningaloo Coast	253	Not applicable
Commonwealth Heritage Areas		
Ningaloo Marine Area – Commonwealth Waters	270	Not applicable
Mermaid Reef – Rowley Shoals	409	Not applicable
Key Ecological Features		
Ancient coastline at 125 m depth contour	Overlapping	Not applicable
Glomar Shoal	1	Not applicable
Continental Slope Demersal Fish Communities	35	Not applicable
Exmouth Plateau	149	Not applicable
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	225	Not applicable
Commonwealth Waters adjacent to Ningaloo Reef	270	Not applicable
Mermaid Reef and Commonwealth Waters Surrounding Rowley Shoals	303	Not applicable
Western demersal slope and associated fish communities	736	Not applicable

[1] *Conservation objectives for IUCN categories in **Table 4-11** include:*

- *IA: Strict nature reserve – protected from all but light human use*
- *II: National park – protects ecosystems and natural values, but facilitates human visitation*
- *IV: Habitat/species management area – conservation of a particular species, taxonomic group or habitat*
- *VI: Protected area with sustainable use of natural resources – allows human use but prohibits large scale development.*

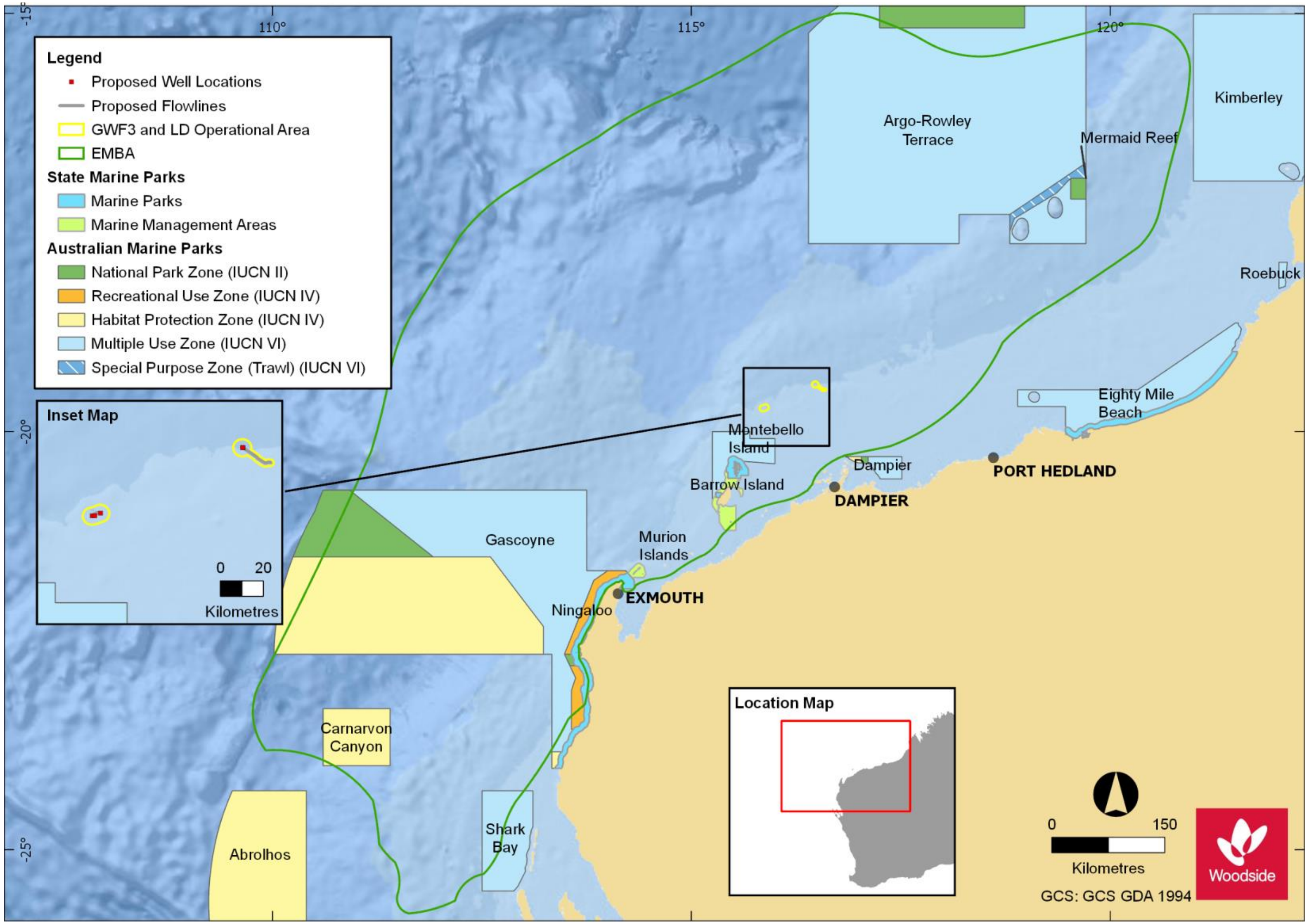


Figure 4-17: Commonwealth and State Marine Protected Areas in relation to the Operational Area and EMBA for GWF-3 and Lambert Deep

4.7.1 Montebello/Barrow/Lowendal Islands

The marine and coastal environments of the Montebello/Barrow/Lowendal Islands group represent a unique combination of offshore islands, intertidal and subtidal coral reefs, mangroves, macroalgal communities and sheltered lagoons, and are considered a distinct coastal type with very significant conservation values (DEC 2007).

4.7.1.1 Montebello AMP

The Montebello AMP is adjacent to the Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area, providing a contiguous marine park covering both State and Commonwealth Waters. Major natural values within the Montebello AMP include (DoEE n.d., DNP 2018):

- significant habitats, species and ecological communities associated with the NWS Province
- BIAs for a range of MNES, including breeding habitat for seabirds and foraging habitat for whale sharks. (**Section 4.5.2**)
- two historic shipwrecks, the *Trial* and the *Tanami* (both >100 km from the Operational Area)
- diverse social values including tourism, fishing, mining and recreation
- foraging areas adjacent to important nesting sites for marine turtles
- part of the migratory pathway of the protected humpback whale
- shallow shelf environments with depths ranging from 15 m to 150 m, providing protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features
- examples of the seafloor habitats and communities of the NWS Province bioregion as well as the Pilbara (offshore) mesoscale bioregion (Heap et al. 2005)
- one KEF for the region, the Ancient Coastline at 125 m Depth Contour (**Section 4.7.5**).

The entire Montebello AMP, an area of 341,300 ha, is designated a multiple use zone (IUCN Category IV), allowing for long-term protection and maintenance of the AMP in conjunction with sustainable use, including oil and gas exploration activities. The Montebello AMP is 31 km from the Operational Area, at the closest point.

The Montebello AMP contains two known shipwrecks; these have been in Australian waters for at least 75 years, and are therefore protected under the Commonwealth *Underwater Cultural Heritage Act 2018*:

- the *Trial*, which was wrecked in 1622, is the earliest known shipwreck in Australian waters
- the *Tanami*, which was wrecked in a cyclone in 1935.

Tourism, commercial fishing, mining and recreation are important activities in the AMP (DNP 2018.

4.7.1.2 Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area

The Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area are jointly managed, cover a combined area of 1770 km^2, and are about 68 km from the Operational Area, at the closest point. A sanctuary zone covers the entire

4100 ha Barrow Island Marine Park. The Barrow Island Marine Management Area covers 114,500 ha and includes most of the waters surrounding Barrow Island and Lowendal Islands, except for the port areas around Barrow and Varanus Islands. Key conservation and environmental values within the reserves include (DEC 2007):

- a complex seabed and island topography consisting of subtidal and intertidal reefs, sheltered lagoons, channels, beaches, cliffs and rocky shores
- pristine sediment and water quality, supporting a healthy marine ecosystem
- undisturbed intertidal and subtidal coral reefs and bommies with a high diversity of hard corals
- important mangroves, particularly along the Montebello Islands, which are considered globally unique as they occur in offshore lagoons
- extensive subtidal macroalgal and seagrass communities
- important habitat for cetaceans and dugongs
- nesting habitat for marine turtles
- important feeding, staging and nesting areas for seabirds and migratory shorebirds
- rich finfish fauna with at least 456 species
- historical culture of the pearl oyster (*Pinctada maxima*), which produced some of the highest quality pearls in the world.

These islands support significant colonies of wedge-tailed shearwaters and bridled terns. The Montebello Islands support the biggest breeding population of roseate terns in WA. Ospreys, white-bellied sea-eagles, eastern reef egrets, Caspian terns, and lesser crested terns also breed in this area. Observations suggest an area to the west of the Montebello Islands may be a minor zone of upwelling in the NWMR, supporting large feeding aggregations of terns. There is also some evidence that the area is an important feeding ground for Hutton’s shearwaters and soft-plumaged petrels. Barrow Island is ranked equal tenth among 147 sites in Australia that are important for migratory shorebirds. Barrow, Lowendal and Montebello islands are internationally significant sites for six species of migratory shorebirds, supporting more than 1% of the East Asian-Australasian Flyway population of these species (DSEWPaC 2012c).

The Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area is contiguous with the Montebello Australian Marine Park. The intertidal habitats of the Montebello/Barrow/Lowendal Islands group are influenced by the passage of tropical cyclones that shape sandy beaches (RPS Bowman Bishaw Gorham 2007). The dominant habitats on the exposed west coasts of islands in the area are sandy beaches, rocky shores and cliffs. The predominant physical habitats of the sheltered east coasts of islands are sand flats, mudflats, rocky pavements and platforms (RPS Bowman Bishaw Gorham 2007).

4.7.1.3 Barrow Island Nature Reserve

The Barrow Island Nature Reserve is a Class A Nature Reserve covering around 235 km^2 and extending to the low water mark adjacent to the Montebello Islands/ Barrow Island Marine Parks. The islands surrounding Barrow Island including Boodie, Double and Middle Islands make up the Boodie, Double and Middle Islands Nature Reserve, covering 587 ha (Department of Parks and Wildlife [DPaW] 2015). Together, these two nature reserves are commonly referred to as the Barrow Group Nature Reserves (DPaW 2015).

The Barrow Island coastline comprises dry creek beds, beaches, clay and salt flats, mangroves, intertidal flats and reefs and is bordered by high cliffs on the western side. Key conservation values are considered for threats that may impact the area. The reserve consists of (DPaW 2015):

- the second largest island off the WA coast
- an important biological refuge site, because of isolation from certain threatening processes on the mainland
- flora that are restricted in distribution and at or near the limit of their range
- a high number of fauna species with high conservation value
- an extensive hydrogeological karst system that supports a subterranean community of high conservation significance
- regionally and nationally significant rookeries for green and flatback turtles
- important habitat for migratory shorebirds, also used by these species as a staging and destination terminus
- significant habitat, such as intertidal mudflats, rock platforms, mangroves, rock piles and cliffs, clay pans and caves
- a significant fossil record that indicates local historical biodiversity and evolution
- a history of Indigenous and other European use including 13 registered Indigenous cultural heritage sites.

4.7.1.4 Lowendal Islands Nature Reserve

The Lowendal Islands Nature Reserve incorporates the islands of the Lowendal Archipelago, around 101 km from the Operational Area at the closest point, inside the EMBA.

The Lowendal Islands group is made up of 34 islands and islets, with the largest being Varanus Island at 83 ha. The islands are limestone rocks that extend a few metres above the sea level and have sparse vegetation (DSEWPaC 2012a).

Key conservation values within the reserve include:

- feeding and breeding habitat for the shorebirds including the common greenshank, common sandpiper and the red-necked stint
- foraging habitat for hawksbill turtles
- resident populations of common bottlenose dolphins and Indo-Pacific humpback dolphins
- critical nesting and internesting habitat for hawksbill turtles (Varanus Island), and supports an important flatback turtle rookery
- seabird colonies for species such as the wedge-tailed shearwaters and bridled terns
- foraging and staging areas for migratory shorebirds and internationally significant site for six species of migratory shorebirds, supporting more than 1% of the East Asian-Australasian Flyway population for these species
- seagrass habitat for dugongs.

4.7.2 Ningaloo Coast and Gascoyne

4.7.2.1 Ningaloo Coast World Heritage Area

The Ningaloo Coast WHA includes North West Cape and the Muiron Islands, and was inscribed under criterion (vii) and criterion (x) by the World Heritage Committee onto the World Heritage Register in June 2011. The statement of Outstanding Universal Value for the Ningaloo Coast was based on the natural criteria and recognised the following:

- Criterion (vii): The landscapes and seascapes are mostly intact and comprise large-scale marine, coastal and terrestrial environments. The lush and colourful underwater scenery provides a stark and spectacular contrast with the arid and rugged land. Large aggregations of whale sharks and important aggregations of other fish species and marine mammals occur in the Ningaloo Coast WHA. Mass coral spawning and seasonal nutrient upwelling cause a peak in productivity that leads to groups of 300–500 whale sharks, making this the largest documented aggregation in the world.
- Criterion (x): The Ningaloo Reef harbours a high marine diversity of >300 documented coral species, >700 reef fish species, around 650 mollusc species, as well as around 600 crustacean species and >1000 species of marine algae. The high numbers of 155 sponge species and 25 new species of echinoderms add to the significance of the area. In the transition zone between tropical and temperate waters, the Ningaloo Coast hosts an unusual diversity of marine turtle species with an estimated 10,000 nests along the coast annually.

The Ningaloo Coast WHA is recognised as being of outstanding conservation value, supporting a rich array of habitats and diverse and abundant marine life (DoEE n.d.). The region has a high diversity of marine habitats including coastal mangroves, lagoons, coral reef, open ocean, continental slope and the continental shelf (CALM 2005). The dominant feature of the Ningaloo Coast WHA is Ningaloo Reef, the largest fringing reef in Australia. Ningaloo Reef supports both tropical and temperate species of marine fauna and flora, and >300 species of coral (CALM 2005).

The Ningaloo Coast WHA provides important nesting habitat for four species of marine turtle found in WA. The North West Cape and Muiron Islands are major nesting sites for loggerhead turtles, with between 400 and 600 females nesting annually on the Ningaloo Coast (particularly, North West Cape area) and Muiron Islands, respectively. The North West Cape is also a major nesting habitat for hawksbill and green turtles, with 1000–1500 green turtles nesting in the area annually (DEC 2007). The Muiron Islands are minor nesting sites for flatback and hawksbill turtles (DEC 2007).

Each year, the largest congregation of whale sharks anywhere in the world takes place off the coast of the Ningaloo WHA. It is estimated that between 300 and 500 whale sharks visit each year between March and July, coinciding with the annual mass coral spawning events.

It is these natural heritage values, iconic wilderness, seascapes, wildlife and biodiversity which are major attractions of the WHA and therefore the main driver for tourism on the North West Cape. All properties inscribed on the World Heritage List must have adequate management to ensure their protection, thus the Ningaloo WHA is managed via the Australian Marine Park and State Marine Park (see subsections below).

4.7.2.2 Ningaloo AMP

The Ningaloo AMP covers 2326 km^2, lies 270 km from the Operational Area (at the closest point) and is about 1200 km north of Perth. It is contiguous with the WA Ningaloo Marine Park. Ningaloo Reef, which is located in State Waters within the State-managed Marine Park, is further protected by the Ningaloo AMP. Water depths range from shallow water of 30 m to oceanic waters at 1000 m deep. Major natural values of the park include ecosystems representative of (DoEE n.d., DNP 2018):

- three KEFs (**Section 4.7.5**):
  - Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula
  - Commonwealth Waters adjacent to Ningaloo Reef
  - Continental Slope Demersal Fish Communities.
- foraging areas adjacent to important breeding areas for migratory seabirds, whale sharks and marine turtles
- important nesting sites for marine turtles
- part of the migratory pathway of the humpback whale
- shallow shelf environments with depths ranging from 15 m to 150 m, providing protection for the shelf and slope habitats, as well as pinnacle and terrace seafloor features
- examples of the seafloor habitats and communities of the Central Western Shelf Transition.

The park has international and national significance due to its diverse range of marine species and unique geomorphic features. It provides essential biological and ecological links that sustain the biodiversity and ecological processes, including the supply of nutrients to reef communities from deeper waters further offshore, to the Ningaloo Reef ecosystem.

4.7.2.3 Ningaloo Marine Park and Muiron Islands Marine Management Plan

The Ningaloo Marine Park (State Waters) was established in 1987 and stretches 300 km from the North West Cape to Red Bluff, and is 271 km from the Operational Area, at the closest point. It encompasses the State Waters covering the Ningaloo Reef system and a 40 m strip along the upper shore. The Muiron Islands Marine Management Area is 252 km south-west of the Operational Area and is managed under the same management plan as for the Ningaloo State Marine Park (CALM 2005). The Ningaloo Marine Park is part of the Ningaloo Coast WHA. Ecological and conservation values of the Ningaloo Marine Park and Muiron Islands are summarised below.

Generally, all ecological values are presumed to be in an undisturbed condition except for some localised high-use areas (CALM 2005). The ecological and conservation values include:

- Unique geomorphology, which has resulted in a high habitat and species diversity.
- High sediment and water quality.
- Subtidal and intertidal coral reef communities providing food, settlement substrate and shelter for marine flora and fauna.
- Filter feeding communities (sponge gardens) in the northern part of the North West Cape and the Muiron and Sunday Islands.
- Shoreline intertidal reef communities providing feeding habitat for larger fish and other marine animals during high tide.
- Soft sediment communities found in deeper waters, characterised by a surface film of microorganisms that provide a rich source of food for invertebrates.

- Macroalgae and seagrass communities, which are an important primary producer providing habitat for vertebrate and invertebrate fauna.
- Mangroves occurring only in the northern part of the Ningaloo Marine Park, important for reef fish communities (Cassata and Collins 2008) and supporting a high diversity of infauna, particularly molluscs (600 mollusc species).
- Diverse fish fauna (around 460 species).
- Foreshores and nearshore reefs of the Ningaloo Coast and Muiron/Sunday islands providing internesting, nesting and hatchling habitat for several species of marine turtles including the loggerhead, green, flatback and hawksbill turtles.
- Whale sharks aggregating annually to feed in the waters around Ningaloo Reef, from March to July, with the largest numbers being recorded around April and May (Sleeman et al. 2010). The season can be variable, with individual whale sharks being recorded at other times of the year. Timing of the whale sharks' migration to and from Ningaloo coincides with the mass coral spawning period when there is an abundance of food (krill, planktonic larvae and schools of small fish) in the waters adjacent to Ningaloo Reef.
- Seasonal shark aggregations and manta rays are commonly found in the area with a permanent population of manta rays (*Manta alfredi*) inhabiting the Ningaloo Reef. Numbers are boosted periodically by roaming and seasonal animals. Small aggregations coincide with small pulses of target prey and the spawning events of many reef inhabitants, while larger aggregations coincide with major seasonal spawning events. The number of species in the Ningaloo Reef area peaks during autumn, which corresponds to coral spawning, and during spring which corresponds with the crab spawning event (McGregor n.d.).
- Annual mass coral spawning on Ningaloo Reef. Synchronous, multi-species spawning of tropical reef corals occurs during a brief predictable period in late summer/early autumn generally seven to nine nights after a full moon on neap, nocturnal ebb tides March/April each year (Rosser and Gilmour 2008, Taylor and Pearce 1999).
- Large coral slicks generally forming over shallow reef areas in calm conditions. Note: Minor spawning activities occur on the same nights after the February and April full moons, and in some years the mass spawning event occurs after the April full moon (Simpson et al. 1993).
- Marine mammals such as dugong and small cetacean populations frequenting or residing in nearshore waters. Dugong numbers in Ningaloo Marine Park are considered to be around 1000 individuals, with a similar number in Exmouth Gulf (CALM 2005). The Ningaloo/Exmouth Gulf region supports a significant population of dugongs, which is interconnected with the Shark Bay resident population.
- Nesting and foraging habitat for seabirds and shorebirds. About 33 species of seabirds are recorded in the Ningaloo Marine Park (13 resident and 20 migratory), with five known rookeries as well as isolated rookeries on the Muiron and Sunday Islands.

In addition to the ecological and conservation values, the Ningaloo Marine Park has a number of social values including culture heritage (both Indigenous and maritime; **Section 4.6.1**) and marine-based tourism and recreation (water-sports and fishing) (**Section 4.6.5**). The Ningaloo Marine Park (State Waters) is contiguous with the Ningaloo AMP (**Figure 4-17**) and The Ningaloo Coast was listed as a National Heritage Place on 6 January 2010 due to its extraordinary natural qualities and Indigenous Significance (DoEE 2019b).

Ningaloo Shoreline, Shallow Subtidal Reef and Intertidal Habitats

The Ningaloo Marine Park reef and lagoonal systems comprise a variety of shallow subtidal and intertidal communities that contain shallow outer reef slope (spur and groove habitat), reef crest (emergent at low tide), reef flat (coralline algae and high cover tabular *Acropora* spp. coral communities), back reef lagoon (coral, soft sediment and macroalgal communities), sublittoral limestone platform (turf algae/molluscs/echinoderm community), and intertidal mangrove, mudflat and salt marsh communities (Cassata and Collins 2008).

The area seaward of the reef crest is characterised by a coralline algae/coral community (spur and groove reef slope). The area has a series of perpendicular spur and grooves from 5 to 40 m depth range, comprising narrow, deep channels filled with sand and coral rubble and rock spurs with diverse hard coral communities (with dominant tabular *Acropora* spp. growing in small, compact colonies), together with soft corals, *Millepora* spp. (fire coral), sponges and macroalgae. Coralline algae encrust dead corals, rocks and coral rubble. Coral growth is most prolific between 5 and 10 m depth.

On the landward side of the reef crest is a reef flat habitat and back reef lagoon, with various subtidal and intertidal habitats (Cassata and Collins 2008):

- Outer reef flat (very shallow, <1 m depth) at the back of the reef crest: Coralline algae/coral community (spur and groove). Similar morphology to the reef slope.
- Rocky middle/inner reef flat (~1 m depth): Tabular *Acropora* spp. Community.
- Back reef lagoon (>2 m depth): Patchy staghorn, massive and sub-massive coral community.
- Lagoonal sand flat (1–2 m depth): Sparse corals and algae community. This habitat is characterised by sheltered areas of limestone pavement with a veneer of sand and small outcrops of corals (Porites spp., Acropora spp.) with scattered patches of macroalgae (Sargassum spp., Halimeda spp., Caulerpa spp.) or seagrass (Halophila spp.).
- Lagoonal and inter-reef sandy depressions (3–15 m depth): Coral ‘bommies’ and algal patch community; a distinctive habitat type composed of sandy depressions either found as large deep regions within the lagoon or small depressions/channels inside the reef flat.
- Lagoon, shoreward reef channels (shallow): Macroalgal community. Fleshy algae colonising subtidal limestone pavement that is covered in sand with Sargassum spp. up to 0.5 m high and other red and green algal species. There are also small patches of hard and soft corals, sponges and ascidians.
- Sublittoral limestone platform: Turf algae/mollusc/echinoderm community. This habitat is composed of a flat limestone pavement often contiguous with the rocky shoreline, and supports intertidal and subtidal fauna comprising molluscs (limpets, chitons, small mussels, cowries and giant clams) and echinoderms (sea cucumbers, starfish and sea urchins) with isolated hard and soft coral colonies. The limestone pavement also has a ubiquitous coverage of turf algae.
- Mangroves: Although not a common habitat type within Ningaloo Marine Park, there are mangroves in the upper intertidal zone on a muddy substrate of carbonate silt and lay. The mangroves are located within the mangrove sanctuary zone (where they occupy a large section of coast between Low Point and Mangrove Bay) and sporadically within the osprey sanctuary zone on the Yardie Creek banks. There are three species of mangrove: *Avicennia marina*, *Rhizophora stylosa* and *Bruguiera exaristata*. *A. marina* is most common and widespread. This habitat supports a diverse community of invertebrate fauna

including gastropods, crabs and burrowing worms, and is also a nursery area for the juveniles of many species of reef fish.

- Intertidal mudflats: Mudflats occur in the lower intertidal zone of the lagoon, formed from the deposition of mud in the sheltered tidal waters.
- Salt marshes: The salt marsh habitat is seaward of the mangroves and is represented by salt-tolerant vegetation and sandy patches.

Muiron Islands: Shallow Subtidal, Intertidal and Shoreline Habitats

Coastal sensitivity mapping identified the onshore sensitivities to be turtle rookeries and turtle nesting, which occurs from October to April (Joint Carnarvon Basin Operators 2012). Most of the western coast comprises limestone coastal cliffs interspersed with sandy beaches and intertidal rock platforms. The nearshore sensitivities include the intertidal/nearshore reef (Joint Carnarvon Basin Operators 2012). Soft coral communities dominate the reefs on the western side of the Muiron Islands. Habitats on the eastern side are more sheltered, comprising sandy beaches and shallow lagoons with diverse soft and hard coral communities (Cassata and Collins 2008, Kobryn et al. 2013).

4.7.2.4 Gascoyne AMP

The Gascoyne AMP covers around 81,766 km^2, is 242 km from the Operational Area (at the closest point) and includes waters from <15 m to 6000 m deep. Conservation values identified within the park include ecosystems representative of (DoEE n.d., DNP 2018):

- foraging areas for migratory seabirds (including the wedge-tailed shearwater), hawksbill and flatback turtles and whale sharks
- a continuous connectivity corridor
- seafloor features including canyon, terrace, ridge, knolls, deep hole/valley and continental rise
- sponge gardens in the south of the park adjacent to WA coastal waters
- examples of the ecosystems of the Central Western Shelf Transition, the Central Western Transition and the NWS Province bioregions as well as the Ningaloo mesoscale bioregion.

The AMP contains four KEFs for the region:

- canyons on the slope between the Cuvier Abyssal Plain and the Cape Range Peninsula (associated enhanced productivity, aggregations of marine life and unique seafloor feature)
- Exmouth Plateau (unique seafloor feature associated with internal wave generation)
- continental slope demersal fish communities (high species diversity and endemism; this is the most diverse slope bioregion in Australia, with >500 species recorded, of which 76 are endemic to the area)
- Commonwealth waters adjacent to Ningaloo Reef – an area where the Leeuwin and Ningaloo currents interact resulting in enhanced productivity and aggregations of marine life.

The park boundary is adjacent to the existing Commonwealth portion of the Ningaloo AMP.

4.7.3 Pilbara Coast and Islands

4.7.3.1 Pilbara Islands (Northern, Middle and Southern Island Groups)

Within the nearshore waters between the Muiron Islands and the Dampier Archipelago are a series of islands collectively termed the Northern, Middle and Southern Island Groups. This area has been defined as the Pilbara offshore region (greater than 10 m water depth) and includes islands, shoals and rocky outcrops.

The Northern Island Group includes more than 30 islands that range from east of Cape Preston south to the mouth of the Robe River, 10–35 km offshore, including the Great Sandy Islands Nature Reserve and the Passage Islands. The Northern Island Group is located about 119 km south south-west of the Operational Area, at the closest point.

The Middle Island Group includes the Mary Anne Reefs and neighbouring small islands. The Southern Island Group includes Serrurier, Bessieres and Thevenard Islands Nature Reserves and is located about 206 km south-west of the Operational Area, at the closest point. The nearshore habitats of these islands generally consist of fringing reefs on the seaward side and wide intertidal sand flats on the leeward side. Despite generally high turbidity in the area and relatively low abundance, hard coral biodiversity is high (Chevron Australia 2010). The coral community structure within this area, and others within the region, is highly temporally variable due to cyclonic activity.

The large islands of the groups provide important nesting habitat for seabirds and marine turtles (Chevron Australia 2010). In the Southern Island Group, a number of seabirds, including Caspian terns, little terns, wedge-tailed shearwaters and ospreys breed on Serrurier Island and nearby Airlie Island. Wedge-tailed shearwaters also have breeding populations on islands from the Northern Island Group. Hawksbill turtle feeding grounds occur in the Mary Anne and Great Sandy Island groups. Mary Anne Island also includes a breeding population of roseate terns. Serrurier Island also is a major nesting area for green turtles and may be a foraging area for this species. Thevenard Island supports a significant flatback turtle rookery along with small numbers of green turtles and is a known feeding area for green turtles.

Chevron Australia (2010) documented the key subtidal habitats of the Pilbara offshore region as:

- limestone pavement supporting dense macroalgae
- biogenic fringing coral reefs
- coral communities associated with hard substrate (shoals and rocky outcrops)
- filter feeding communities (sponges and ascidians) on sand veneered pavement
- sand/gravel plains and shoals supporting sparse foliose macroalgae.

4.7.4 Rowley Shoals

4.7.4.1 Rowley Shoals Marine Park

The Rowley Shoals Marine Park protects two of the three oceanic shoals (Clerke Reef and Imperieuse Reef) that constitute the Rowley Shoals. The third shoal (Mermaid Reef) is protected by the Argo-Rowley Terrace Australian Marine Park (see below). The Rowley Shoals Marine Park is characterised by intertidal and subtidal coral reefs, with rich and diverse marine fauna and high water quality. The reefs within the park may act as a source of recruits for habitats further south, via the Leeuwin Current, and hence are considered to be regionally significant (MPRA 2007) (MPRA 2007). Environmental values within the Rowley Shoals Marine Park include (MPRA 2007):

- geology and geomorphology: the best geological examples of shelf-edge atolls on the Australian continental shelf, with the three reefs representing three distinct stages in formation
- water quality: high water quality due to the relatively low seasonal human usage and the surrounding pristine oceanic waters
- intertidal coral reef communities: extensive relatively undisturbed intertidal coral reef communities with a high diversity of marine fauna
- subtidal coral reef communities: coral communities dominated by a rich diversity of hard corals
- invertebrates (excluding corals): a diverse marine invertebrate community that includes a number of endemic species
- finfish: a rich finfish fauna that includes many species unique to Australia
- turtles: turtles occur within the park, but no known significant breeding sites
- seabirds: Bedwell Island within Clerke Reef is the site of the second-largest breeding colony of red-tailed tropicbirds, an uncommon species in WA
- cetaceans: based on known distributions, it is likely that at least 13 species of cetaceans regularly visit the park
- scientific research: the undisturbed nature and rich diversity of marine communities provide researchers with access to a reference area with which to compare the health of intensively used reefs in the Indo-West Pacific region
- scuba diving, snorkelling and other water sports: the relatively undisturbed nature and diversity of the natural environment provides world-class opportunities for scuba diving and snorkelling
- seascapes: ‘wilderness’ seascapes of turquoise lagoon waters, low sandy islands, intertidal reefs, breaking surf and the oceanic waters beyond the reef rim are major attractions
- nature-based tourism: natural values of the area ensure significant tourism potential and opportunity for a variety of marine nature-based tourism activities
- recreational fishing: a popular offshore fishing destination, with fishers primarily targeting pelagic and, to a lesser degree, demersal finfish species
- petroleum exploration and production: the Rowley sub-basin of the Canning Basin (over which the Rowley Shoals are located) is considered to be prospective for petroleum
- wilderness: a remote and isolated location with minimal infrastructure and low visitor levels provides a wilderness experience for visitors.

The marine park is located in the headwaters of the Leeuwin Current and is thought to provide a source of invertebrate and fish recruitment for reefs further south and thus is considered regionally important (MPRA, 2007). Marine turtles are known to visit Mermaid Reef, and isolated instances of turtles nesting in the Rowley Shoals Marine Park have been recorded (DEWHA, 2008).

The Rowley Shoals are also identified as breeding grounds for red-tailed tropicbirds, white-tailed tropicbirds and little terns, however numbers are generally low. For example, only a single pair of white-tailed tropicbirds nest on Bedwell Island on Clerke Reef (DSEWPaC 2012b).

4.7.4.2 Argo-Rowley Terrace AMP

The Argo-Rowley Terrace AMP covers 146,099 km^2 of the MPA network, including the Commonwealth Waters surrounding the Rowley Shoals (each reef managed as separate State and Australian marine parks). The Argo-Rowley Terrace AMP encompasses water depths from about 220–6000 m.

The natural values include ecosystems representative of (DoEE n.d., Director of National Parks 2018):

- important foraging areas for migratory seabirds and, reportedly, the loggerhead turtle
- support for relatively large populations of sharks (compared with other areas in the region)
- a range of seafloor features such as canyons, continental rise and the terrace, among others
- connectivity between the reefs of the Rowley Shoals
- linkage of the Argo Abyssal Plain with the Scott Plateau through canyons
- two KEFs (**Section 4.7.5**):
  - canyons linking the Argo Abyssal Plain with the Scott Plateau
  - Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals
- resting and breeding BIAs for seabirds and a migratory BIA for the pygmy blue whale.

4.7.4.3 Mermaid Reef AMP

Mermaid Reef AMP covers an area of approximately 540 km2 which is zoned entirely as a National Park Zone (IUCN II). The AMP is near the edge of Australia’s continental slope and is surrounded by waters that extend to a depth of over 500 m. The AMP contains Mermaid Reef, the most north-easterly of three reef systems forming the Rowley Shoals. Mermaid Reef is totally submerged at high tide and therefore falls under Australian Government jurisdiction. The other two reefs of the Rowley Shoals (Clerke Reef and Imperieuse Reef) are managed by the Western Australian Government as part of the Rowley Shoals Marine Park. Mermaid Reef–Rowley Shoals is listed on the Commonwealth Heritage List. Ecological and conservation values of the AMP include (Director of National Parks, 2018):

- contains habitats, species and ecological communities associated with the Northwest Transition
- ecosystems of the Marine Park are associated with emergent reef flat, deep reef flat, lagoon, and submerged sand habitats
- supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act
- biologically important areas within the Marine Park include breeding habitat for seabirds and a migratory pathway for the pygmy blue whale
- the reefs of the Rowley Shoals are thought to provide ecological stepping stones for reef species originating in Indonesian/Western Pacific waters
- contains the Mermaid Reef and Commonwealth waters surrounding Rowley Shoals KEF, valued for its high species richness, high productivity and aggregations of marine life.

4.7.5 Carnarvon Canyon AMP

The Carnarvon Canyon AMP lies about 513 km from the Operational Area, partially within the EMBA. The AMP covers 6177 km² and includes water depths in the range of 1500–6000 m (Director of National Parks, 2018). The reserve contains a number of conservation values, including (Director of National Parks, 2018):

- deep water ecosystems associated with the Carnarvon Canyon, a single-channel canyon covering the entire depth range of the canyon
- examples of ecosystems representative of the Central Western Transition
- support for a range of species protect.

4.7.6 Shark Bay AMP

The Shark Bay AMP lies about 577 km from the Operational Area, partially iwthin the EMBA. The AMP covers approximately 7443 km^2 and includes waters in the depth range of approximately 15–220 m (DoEE n.d.). The marine park encompasses offshore waters that buffer the state waters of Shark Bay and the barrier islands of Dirk Hartog, Dorre and Bernier. The park contains a number of natural values (as listed below) and social values relating to marine nature-based tourism and recreation (water-sports and fishing) including (Director of National Parks, 2018a):

- foraging area adjacent to important breeding areas for several species of migratory birds
- part of the migratory pathway of protected humpback whales
- adjacent to the largest nesting area for loggerhead turtles (the largest in Australia)
- provides protection to shelf and slope habitats as well as terrace features
- connectivity between the inshore waters of the Shark Bay WHA and deeper Commonwealth waters
- examples of shallower ecosystems of the Central Western Shelf and Central Western Transition provincial bioregions including the Zuytdorp meso-scale bioregion
- provides connectivity between inshore waters of the Shark Bay WHA and deeper waters offshore.

4.7.7 Key Ecological Features

KEFs are the parts of the marine ecosystem that are considered to be important for a marine region's biodiversity or ecosystem function and integrity. KEFs have been identified by the Commonwealth Government on the basis of advice from scientists about the ecological processes and characteristics of the area.

KEFs meet one or more of the following criteria:

- a species, group of species or a community with a regionally important ecological role (e.g. a predator, prey that affects a large biomass or number of other marine species)
- a species, group of species or a community that is nationally or regionally important for biodiversity
- an area or habitat that is nationally or regionally important for:
  - enhanced or high productivity (such as predictable upwellings – an upwelling occurs when cold nutrient-rich waters from the bottom of the ocean rise to the surface)

- aggregations of marine life (such as feeding, resting, breeding or nursery areas)
- biodiversity and endemism (species which only occur in a specific area)
- a unique seafloor feature, with known or presumed ecological properties of regional significance.

One KEF, Ancient Coastline at 125 m depth contour, overlaps the Operational Area, with an additional eight KEFs within or intersecting the EMBA (**Figure 4-18**). The key values of these KEFs are described below.

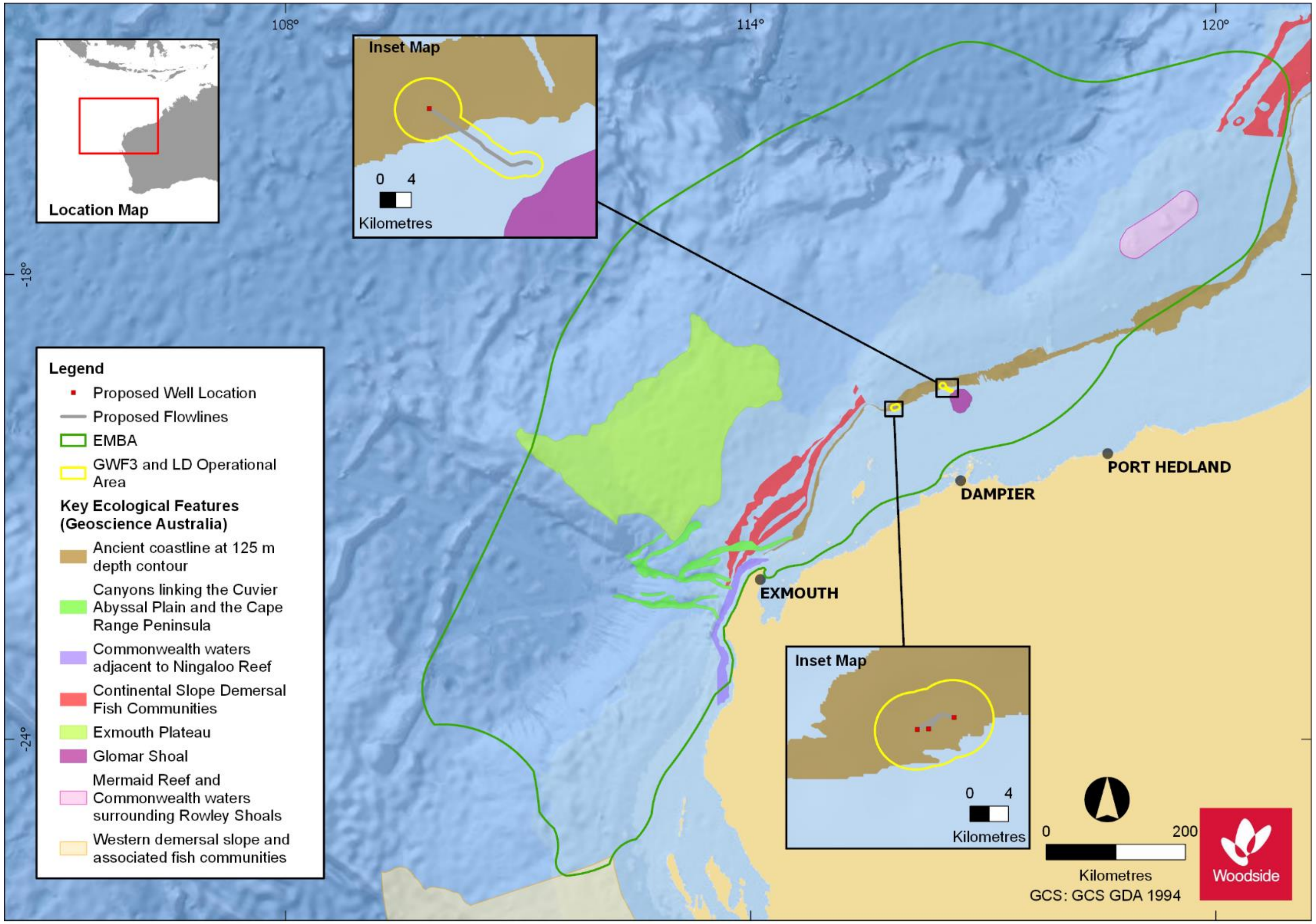


Figure 4-18: Key ecological features relevant to the Operational Area and EMBA

4.7.7.1 Ancient Coastline at 125 m Depth Contour

Several steps and terraces as a result of Holocene sea level changes occur in the NWMR, the most prominent of these features occurring as an escarpment along the NWMR and Sahul Shelf at a water depth of 125 m. This feature is known as the Ancient Coastline at 125 m depth contour KEF. This KEF overlaps the Operational Area, extending along a line approximated by the 125 m isobath (**Figure 4-18**). The KEF is not continuous throughout the NWMR, and coincides with a well-documented eustatic stillstand at around 130 m worldwide (Falkner et al. 2009).

Where the Ancient Coastline at 125 m depth contour provides areas of hard substrate, it may contribute to higher diversity and enhanced species richness relative to soft sediment habitat (Falkner et al. 2009). Parts of the KEF, represented as rocky escarpment, are considered to provide biologically important habitat in areas otherwise predominantly comprising soft sediments.

This escarpment type feature may also facilitate mixing within the water column due to upwelling, providing a nutrient-rich environment. Although this KEF adds additional habitat types to a representative system, these habitat types are not unique to the coastline as they are widespread on the upper shelf (Falkner et al. 2009).

4.7.7.2 Glomar Shoal

Glomar Shoal is about 1 km south-east of the Operational Area, at the closest point. Comprising three submerged shoals, this is a large (215 km^2) complex bathymetrical feature on the outer continental shelf off the Pilbara. Glomar Shoal rises gently on the south-west side of the reef from 80 m depth to a single plateau at 40 m depth. The north-eastern side of the reef rises steeply from 70 m to 40 m depth. The shoal is relatively shallow, with water depths reaching 22–28 m at its shallowest point (AIMS 2014a). Together with Rankin Bank (see **Section 4.7.8.1**) this remote shallow-water area represents regionally unique habitats and is likely to play an important role in the productivity of the Pilbara region (AIMS 2014b, Wahab et al. 2018).

Glomar Shoal has been identified as a KEF of the continental shelf within the NWMR based on its regionally important habitat supporting high biological diversity and high localised productivity (Falkner et al. 2009). On a regional level, Glomar Shoal is also known to be an important area for a number of commercial and recreational fish species.

Benthic habitats of Glomar Shoal vary with depth and are characterised by coarse unconsolidated sediment at depths greater than 60 m, to hard substrate supporting benthic communities comprising spare hard and soft corals, sponges and macroalgae at depths <40 m. Total cover of benthic taxa (hard coral, soft coral, sponges and other benthic biota) is highest at depths <40 m and decreases with depth (Wahub et al., 2018). At depths of 60--80 m benthic cover is low and about 2% and at depths greater than 80 m benthic cover is barely present with baseline survey data indicating 0.1% cover of benthic biota. Structurally complex biodiverse benthic habitats are mainly found within the north-eastern portion of Glomar Shoal (AIMS 2014a, Wahab et al., 2018).

In 2013, Woodside engaged AIMS to conduct a biodiversity survey of Glomar Shoal and Rankin Bank (AIMS 2014a, Wahab et al., 2018) using underwater towed cameras. The survey observed widespread filter feeder habitat, generally at low to moderate densities. Filter feeding communities included bryozoans, sponges, gorgonians and hydroids attached to consolidated substrate; these were interspersed with sand which hosted few filter feeders (Wahab et al., 2018).

Sponges and mixed sponge benthic groups were the dominant benthic group at Glomar Shoal, with hard corals, algae, soft corals and mixed benthos only making up 10% of the study area (AIMS 2014a). In contrast, Rankin Bank has almost equal areas of hard corals, soft corals and sponges (AIMS 2014b). The study indicated that both Rankin Bank and Glomar Shoal had characteristic transitions in habitat types with depth, from shallow hard coral and associated algae groups, to deeper soft coral areas with sponges (AIMS 2014b). A study by Wahab et al. (2018) also observed filter feeders being twice as abundant as hard corals at Glomar Shoal, and to be the dominant non-algal taxa in waters below 80 m depth at Rankin Bank.

Further surveys were undertaken of an area south-east of Rankin Bank (AIMS 2014b). The study focused on an area covering about 100 km^2 of seabed, extending from the outer flank of Rankin Bank across the adjacent shelf at depths of 60 to 100 m. Filter-feeding communities were more predominant in the shallower depths (60-80 m) and included bryozoans, sponges, gorgonians and hydroids attached to consolidated substrate; these were interspersed with sand which hosted few filter feeders (AIMS 2014b).

Overall, the benthic habitats of Glomar Shoal are considered pristine and hosts regionally distinct ecological communities. The fish abundance and diversity of the demersal fish communities of Glomar Shoal are influenced by the seabed habitat type, with genera associated with sandy habitats common, including threadfin breams (*Nemipterus* spp.) and triggerfish (*Abalistes* spp.). Species richness and abundance are influenced by habitat depth and the degree of coral cover. In general, the fish abundance and diversity of Glomar Shoal are considered comparable with other reefs and the submerged shoals and banks in the region, although less diverse and abundant than fish assemblages at Rankin Bank (Wahab et al. 2018).

4.7.7.3 Continental Slope Demersal Fish Communities

The continental slope demersal fish communities in the region have been identified as a KEF of the NWS Province (DSEWPaC 2012a) and lie about 35 km west of the Operational Area, at the closest point. The continental slope between North West Cape and the Montebello Trough has been identified as one of the most diverse slope assemblages in Australian waters, with >508 fish species and the highest number of endemic species (76) of any Australian slope habitat (DEWHA 2008). Additional features relating to the fish populations of this area are:

- Continental slope demersal fish communities have been identified as a KEF of the NWMR due to the notable diversity of the demersal fish assemblages and high levels of endemism (DSEWPaC 2012a).
- The North West Cape region is a transition area for demersal shelf and slope fish communities between the tropical-dominated communities to the north and temperate communities to the south (Last et al. 2005). The benthic shelf and slope communities off the North West Cape comprise both tropical and temperate fish species with a north–south gradient (DEWHA 2008).
- The fish fauna of the North West Cape region, like the ichthyofauna of many regions, exhibit decreasing species richness with depth (Last et al. 2005). Fish species diversity has been shown to be positively correlated with habitat complexity, with more complex habitats (e.g. coral reefs) typically hosting higher species richness than simpler habitats such as bare, unconsolidated muddy sediments (Gratwicke and Speight 2005). A total of 500 finfish species from 234 genera and 86 families have been recorded within the Ningaloo Marine Park, and 393 species were identified at study sites of the Muiron Islands (CALM 2005). The offshore sediment habitats of the Operational Area are expected to support lower fish species richness than other shallower, more complex habitats in the coastal areas of the region.

4.7.7.4 Exmouth Plateau

The Exmouth Plateau is a large, mid-slope, continental margin plateau that lies off the north-west coast of Australia, located about 149 km west of the Operational Area, at the closest point. It ranges in depth from about 800 to 3500 m and is a major structural element of the Carnarvon Basin. The plateau is bordered by the Rankin Platform and the Exmouth sub-basin of the Northern Carnarvon Basin to the east, the Argo Abyssal Plain to the north, and the Gascoyne and Cuvier Abyssal Plains to the north-west and south-west. The plateau is recognised as a KEF because it is an area of enhanced biological productivity that supports a range of species (TGS, 2011).

The Exmouth Plateau has a relatively uneven seabed, which includes pinnacles and canyon systems in the northern section. The canyon systems are recognised as a distinct feature and are localised areas of high biological productivity (TGS, 2011). Biological productivity on the top of the Exmouth Plateau is comparatively low due to tropical oligotrophic waters, with increased productivity identified around the plateau boundaries as a result of internal waves and upwelling (TGS, 2011). The sediments of the plateau are assumed to consist of abyssal red clays, which indicate that benthic communities are likely to include filter feeders and epifauna, including sea cucumbers, polychaetes and sea pens (TGS, 2011). Pelagic species are likely to include nekton, small pelagic fish and large predators such as billfish, sharks and dolphins (TGS, 2011). Protected and migratory species are also known to pass through the region including whale sharks, cetaceans and marine turtles.

Only a portion of the full Exmouth Plateau geological feature is considered a KEF under Australian legislation. The listed Exmouth Plateau KEF covers mainly the shallower region of the plateau (i.e. the plateau’s surface). Most actions in or adjacent to the NWMR are considered unlikely to adversely impact the integrity or ecosystem function of the Exmouth Plateau; ocean acidification resulting from climate change is the only potential pressure identified in the relevant bioregional plan (DSEWPaC, 2012a). Further explanation on the bathymetry and expected habitat of the Exmouth KEF is included in **Section 4.4**.

4.7.7.5 Canyons Linking the Cuvier Abyssal Plain and the Cape Range Peninsula

The canyons that link the Cuvier Abyssal Plain with the Cape Range Peninsula lie off the north-west coast of Australia, over 225 km south-west of the Operational Area, at the closest point, but within the EMBA. The canyons are believed to support the productivity and species richness of Ningaloo Reef. Interactions with the Leeuwin current and strong internal tides are thought to result in upwelling at the canyon heads, thus creating conditions for enhanced productivity in the region (Brewer et al., 2007). Aggregations of whale sharks, manta rays, humpback whales, sea snakes, sharks, predatory fish and seabirds are known to occur in the area due to the enhanced productivity (Sleeman et al., 2007).

4.7.7.6 Commonwealth Waters Adjacent to Ningaloo Reef

The Commonwealth waters adjacent to Ningaloo Reef KEF lies adjacent to the 3 NM State waters limit along Ningaloo Reef and include the Ningaloo Australian Marine Park. See **Section 4.7.2** for further information for the values and sensitivities associated with this KEF.

4.7.7.7 Mermaid Reef and Commonwealth Waters Surrounding Rowley Shoals

The Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals KEF are located about 303 km from the Operational Area (at the closest point), adjacent to the three nautical mile State waters limit surrounding Clerke and Imperieuse reefs, and include the Mermaid Reef National Nature Park (**Section 4.7.4**).

4.7.7.8 Western Demersal Slops and Associated Fish Communities of the Central Western Province

The 'western demersal slope and associated fish communities of the Central Western Province' KEF covers 669 km² between Perth and the northern boundary of the South-west Marine Region (north-south) and from the shelf edge to the boundary of the Exclusive Economic Zone (east-west). At least 480 species of demersal fish inhabit the central western slope, 31 of which are considered endemic to the bioregion. Unlike other slope fish communities in Australia, many of these species do not appear to migrate vertically in the water column as part of their daily feeding habits (Williams et al., 2001). The KEF has therefore been defined for its high levels of biodiversity and endemism.

4.7.8 Other Sensitive Areas

4.7.8.1 Rankin Bank

Rankin Bank is on the continental shelf, about 19 km west of the GWF-3 Operational Area at the closest point. While Rankin Bank is not a KEF, it is, along with Glomar Shoal, the only large complex bathymetrical feature on the outer western shelf of the west Pilbara, and represents habitats that are likely to play an important role in the productivity and biodiversity of the Pilbara region (AIMS 2014a, Wahab et al. 2018). Rankin Bank comprises three submerged shoals delineated by the 50 m depth contour with water depths of around 18 – 30.5 m (Wahab et al. 2018).

Rankin Bank represents a diverse marine environment, predominantly comprising consolidated reef and algae habitat (around 55% cover), followed by hard corals (around 25% cover), unconsolidated sand/silt habitat (around 16% cover), and benthic communities composed of macroalgae, soft corals, sponges and other invertebrates (around 3% cover) (Wahab et al. 2018). Hard corals are a significant component of the benthic community of some parts of the bank, with abundance in the upper end of the range observed elsewhere on the submerged shoals and banks of north-west Australia, and have been shown to be more diverse and productive than those at Glomar Shoal (Heyward et al. 2012, Wahab et al. 2018).

Rankin Bank has been shown to support a diverse fish assemblage (Wahab et al. 2018). Wahab et al. (2018) suggested Rankin Bank is a refuge for fish species on the largely homogeneous benthic habitat in the middle to outer continental shelf in the NWS Province. Rankin Bank has been shown to host more abundant and species-rich fish assemblages than Glomar Shoal, although differences in some measures of taxonomic diversity and distinctness were not significantly different (Wahab et al. 2018). This is consistent with studies showing a strong correlation between habitat diversity and fish assemblage species richness (Gratwicke and Speight 2005, Last et al. 2005).

The habitat surrounding Rankin Bank (<50 m deep) was mapped by AIMS on behalf of Woodside (2014b) and hosts filter-feeding communities in areas of consolidated substrate interspersed by sand (see **Section 4.7.7.2** for discussion). Refer to **Section 4.5.1.3** for information on filter feeding communities.

5. STAKEHOLDER CONSULTATION

5.1 Summary

Woodside is committed to consulting relevant stakeholders to ensure stakeholder feedback informs its decision making and planning for proposed petroleum activities and builds upon Woodside's extensive and ongoing stakeholder consultation for its offshore petroleum activities in the region.

5.2 Stakeholder Consultation Guidance

Woodside has followed the requirements of sub-regulation 11A (1) of the Environment Regulations to identify relevant stakeholders, these being:

- each Department or agency of the Commonwealth Government to which the activities to be carried out under the Environment Plan, or the revision of the Plan, may be relevant
- each Department or agency of a State or the NT Government to which the activities to be carried out under the Environment Plan, or the revision of the Plan, may be relevant
- the Department of the responsible State Minister, or the responsible NT Minister
- a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the Environment Plan, or the revision of the Plan
- any other person or organisation that the Titleholder considers relevant.

Woodside's assessment of stakeholder relevance is outlined in Table **5**-**1**.

5.3 Stakeholder Consultation Objectives

In support of this EP, Woodside has sought to:

- ensure all relevant stakeholders are identified and engaged in a timely and effective manner
- develop and make available communications material to stakeholders that is relevant to their interests and information needs
- incorporate stakeholder feedback into the management of the proposed activity where practicable
- provide feedback to stakeholders on Woodside's assessment of their feedback and keep a record of all engagements
- make available opportunities to provide feedback during the life of this EP.

5.4 Stakeholder Expectations for Consultation

Stakeholder consultation for this activity has also been guided by stakeholder organisation expectations for consultation on planned activities. This guidance includes:

NOPSEMA:

- *GL1721 - Environment plan decision making - Rev 5 - June 2018*
- *GN1847 - Responding to public comment on environment plans - Rev 0 - April 2019*
- *GN1344 - Environment plan content requirements - Rev 4 - April 2019*
- *GN1488 - Oil pollution risk management - Rev 2 - February 2018*

- *Consultation with Commonwealth agencies with responsibilities in the marine area*

AFMA:

- *Petroleum industry consultation with the commercial fishing industry*

Commonwealth Department of Agriculture and Water Resources:

- *Fisheries and the Environment – Offshore Petroleum and Greenhouse Gas Act 2006*
- *Offshore Installations Biosecurity Guide*

WA Department of Primary Industries and Regional Development:

- *Guidance statement for oil and gas industry consultation with the Department of Fisheries*

WA Department of Transport

- *Offshore Petroleum Industry Guidance Note*

Woodside acknowledges that additional relevant stakeholders may be identified prior to or during the proposed activity. These stakeholders will be contacted, provided relevant information to their interests and invited to provide feedback about the proposed activity. Woodside will assess their feedback, respond to the stakeholder and incorporate feedback into the management of the proposed activity where practicable.

Woodside consultation arrangements typically provide stakeholders up to 30 days (unless otherwise agreed) to review and respond to proposed activities where stakeholders are potentially affected. Woodside considers this consultation period an adequate timeframe in which stakeholders can assess potential impacts of the proposed activity and provide feedback.

Table 5-1: Assessment of relevant stakeholders for the proposed activity

Stakeholder	Relevant to activity	Reasoning
Commonwealth Government department or agency		
Australian Border Force (ABF)	Yes	Responsible for coordinating maritime security.
Australian Fisheries Management Authority (AFMA)	No	Responsible for the management of Commonwealth fisheries. No potential for interaction with Commonwealth fisheries in the Operational Area based on an assessment of the last five years of ABARES Fishery Status Reports and previous engagement with AFMA.
Australian Hydrographic Office (AHO)	Yes	Response for maritime safety and Notice to Mariners.
Australian Maritime Safety Authority (AMSA)	Yes	Statutory agency for vessel safety and navigation and legislated responsibility for oil pollution response in Commonwealth waters. Proposed activity has a hydrocarbon spill risk, which may require AMSA assistance for pollution response.
Department of Agriculture and Water Resources (DAWR)	Yes	Responsible for implementing Commonwealth policies and programmes to support the agriculture, fisheries, food and forestry industries. The proposed activity has the potential impact to DAWR's interests in the prevention of introduced marine species. There is no potential impact to DAWRs interests in Commonwealth Fisheries based on an assessment of the last five years of ABARES Fishery Status Reports and previous engagement with AFMA.
Department of Defence	No	Responsible for defending Australia and its national interests. The proposed Operational Area does not overlap the Defence training area.
Department of Agriculture, Water and the Environment (DAWE)	No	Responsible for designing and implementing Australian Government policy and programs to protect and conserve the environment, water and heritage, promote climate action, and provide adequate, reliable and affordable energy. The proposed activity does not trigger any of the DAWE's functions, interests or activities.
Department of Industry, Innovation and Science (DIIS)	Yes	Department of the relevant Commonwealth Minister and is required to be consulted under the Regulations.
Director of National Parks (DNP)	Yes	Responsible for the management of Commonwealth parks and conservation zones. Whilst planned activities do not affect the functions, interests or activities of the DNP, Woodside has chosen to provide information on arrangements for unplanned events, such as an oil spill, which have potential to impact the values within a Commonwealth marine park.
WA Government department or agency		
Department of Biodiversity, Conservation and Attractions (DBCA), Parks and Wildlife Service	No	Responsible for the management of Western Australia's parks, forests and reserves. Planned activities do not impact DBCA's functions, interests or activities.

Stakeholder	Relevant to activity	Reasoning
Department of Mines, Industry Regulation and Safety (DMIRS)	Yes	Department of relevant State Minister and is required to be consulted under the Regulations.
Department of Primary Industries and Regional Development (DPIRD)	Yes	Responsible for the management of State fisheries. Potential for interaction with State fisheries in the Operational Area.
Department of Transport (DoT)	Yes	Legislated responsibility for oil pollution response in State waters. Proposed activity has a hydrocarbon spill risk, which may require DoT response in State waters.
Commonwealth fisheries*		
Western Tuna and Billfish Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area based on an assessment of the last five years of ABARES Fishery Status Reports and previous engagement with AFMA.
Southern Bluefin Tuna Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area based on an assessment of the last five years of ABARES Fishery Status Reports and previous engagement with AFMA.
Western Skipjack Tuna Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area based on an assessment of the last five years of ABARES Fishery Status Reports and previous engagement with AFMA.
State fisheries*		
Mackerel Managed Fishery – Pilbara (Area 2)	Yes	The fishery overlaps with the Operational Area and DPIRD data indicates active fishing within the Operational Area.
Pilbara Demersal Scalefish Fishery - Pilbara Trawl Fishery	Yes	The fishery overlaps with the Operational Area and DPIRD data indicates active fishing within the Operational Area.
Pilbara Demersal Scalefish Fishery - Pilbara Trap Fishery	Yes	The fishery overlaps with the Operational Area and DPIRD data indicates active fishing within the Operational Area.
Pilbara Demersal Scalefish Fishery - Pilbara Line Fishery	Yes	The fishery overlaps with the Operational Area and DPIRD data indicates active fishing within the Operational Area.
South West Coast Salmon Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
West Coast Deep Sea Crustacean Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Pilbara Crab Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area since it was established in 2018.

Stakeholder	Relevant to activity	Reasoning
Marine Aquarium Fish Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Specimen Shell Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Western Australian Abalone Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Pearl Oyster Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Onslow Prawn Managed Fishery	No	Whilst the fishery overlaps the Operational Area, the fishery has not been active in the Operational Area within the last five years.
Industry		
Santos	Yes	Adjacent titleholder
KUFPEC	Yes	Adjacent titleholder
Lightmark Enterprises	Yes	Adjacent titleholder
Sapura Energy	Yes	Adjacent titleholder
Finder	Yes	Adjacent titleholder
BP	Yes	Adjacent titleholder
JX Nippon	Yes	Adjacent titleholder
Industry representative organisations		
Australian Petroleum Production and Exploration Association (APPEA)	Yes	Represents the interests of oil and gas explorers and producers in Australia.
Commonwealth Fisheries Association	No	Represents the interests of commercial fishers with licences in Commonwealth waters. There is no potential for interaction with Commonwealth fisheries in the Operational Area based on an assessment of the last five years of ABARES Fishery Status Reports and previous engagement with AFMA.
Pearl Producers Association (PPA)	Yes	Although interactions with licence holders in the Pearl Oyster Managed Fishery are unlikely, PPA has requested to be informed of Woodside's planned activities.

Stakeholder	Relevant to activity	Reasoning
Recfishwest	No	Represents the interests of recreational fishers in Western Australia. Recfishwest have advised that activities will not impact any charter operators and/or recreational fishers.
Western Australian Fishing Industry Council (WAFIC)	Yes	Represents the interests of commercial fishers with licences in State Waters. There is potential for interaction with commercial fishers in the Mackerel Managed Fishery (Area 2) and Pilbara Demersal Scalefish Fishery.
Other Stakeholders		
Charter boat, tourism and dive operators	No	Recfishwest have advised that activities will not impact any charter operators and/or recreational fishers.

** Fisheries has been identified as being relevant on the basis of fishing licence overlap with the proposed Operational Area, as well as consideration of fishing effort data, fishing methods and water depth.* ***Table 4-9*** *provides a detailed assessment of Commonwealth and State fisheries within or adjacent to the Operational Area.*

** We note that a redistribution of responsibilities amongst Commonwealth Government Departments was enacted in February 2020, including the transfer of agriculture functions to the renamed Department of Agriculture, Water and the Environment, and the transfer of energy functions to the renamed Department of Industry, Science, Energy and Resources.*

5.5 Stakeholder Consultation

Consultation activities undertaken for the proposed activity are outlined in **Table 5-2.**

The Consultation Information Sheet (**Appendix F**, ref 1.2) is published on the Woodside website and includes a toll-free 1800 phone number.

Table 5-2: Stakeholder consultation plan activities

Stakeholder	Information provided	Stakeholder response	Woodside response
Commonwealth Government department or agency			
ABF	On 13 December 2019 Woodside emailed ABF advising of the proposed activity (**Appendix F**, reference 1.1) and provided a consultation information sheet (**Appendix F**, reference 1.2). On 16 December 2019 Woodside emailed ABF to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F**, reference 1.15). A revised consultation information sheet was provided (**Appendix F**, reference 1.16).	No feedback received.	Email and consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
AHO	On 13 December 2019 Woodside emailed AHO advising of the proposed activity (**Appendix F**, reference 1.3), provided a shipping fairways map (**Appendix F**, reference 1.4), and a consultation information sheet (**Appendix F**, reference 1.2). On 16 December 2019 Woodside emailed AHO to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F**, reference 1.15). A revised consultation information sheet was provided (**Appendix F**, reference 1.16).	On 16 December 2019 AHO emailed Woodside acknowledging receipt of its consultation information, and that the information supplied would be registered, assessed, prioritised and validated in preparation for updating its navigational charting products. On 17 December 2019 AHO emailed Woodside acknowledging it had received its updated consultation information.	Woodside will notify the AHO no less than four working weeks before operations commence.
AMSA – Marine Safety	On 13 December 2019 Woodside emailed AMSA advising of the proposed activity (**Appendix F**, reference 1.3), provided a shipping fairways map (**Appendix F**, reference 1.4.), and a consultation information sheet (**Appendix F**, reference 1.2). On 16 December 2019 Woodside emailed AMSA to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F**, reference 1.15). A revised consultation information sheet was provided (**Appendix F**, reference 1.16).	On 16 December 2019 AMSA emailed Woodside requesting the Master to email AMSA's Joint Rescue Coordination Centre at least 24–48 hours before operations commence and provided details of information required by the Centre in that communication. AMSA requested that the Australian Hydrographic Office (AHO) be contacted through datacentre@hydro.gov.au no less than four working weeks before operations commence for the promulgation of related notices to mariners. AMSA provided advice on obtaining vessel traffic plots, including digital data sets and maps. On 18 December AMSA emailed Woodside acknowledging it had received its updated consultation information.	Woodside will notify AMSA's Joint Rescue Coordination Centre at least 24–48 hours before operations commence for each activity.

Stakeholder	Information provided	Stakeholder response	Woodside response
AMSA – Marine Pollution	On 13 December 2019 Woodside emailed AMSA advising on its consultation approach for the Oil Pollution First Strike Plan (**Appendix F**, reference 1.11), and a consultation information sheet (**Appendix F**, reference 1.2). On 16 December 2019 Woodside emailed AMSA to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F**, reference 1.15). A revised consultation information sheet was provided (**Appendix F**, reference 1.16). On 3 February 2020 Woodside emailed a copy of Woodside's Oil Pollution First Strike Plan for the activity was shared (**Appendix F**, reference 1.20).	No feedback received.	Email, consultation Information Sheet and Oil Pollution First Strike Plan provided. Woodside considers the level of consultation to be adequate.
DAWR	On 13 December 2019 Woodside emailed DAWR advising of the proposed activity and provided information on invasive marine species (**Appendix F**, reference 1.8), a Commonwealth fisheries map (**Appendix F**, reference 1.9) and a consultation information sheet (**Appendix F**, reference 1.2). On 16 December 2019 Woodside emailed DAWR to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F**, reference 1.15). A revised consultation information sheet was provided (**Appendix F**, reference 1.16).	No feedback received.	Woodside has addressed maritime biosecurity and Commonwealth fishing-related issues in **Section 6** of this EP based on previous offshore activities. Woodside considers the level of consultation to be adequate.
DIIS	On 13 December 2019 Woodside emailed DIIS advising of the proposed activity (**Appendix F**, reference 1.1) and provided a consultation information sheet (**Appendix F**, reference 1.2). On 16 December 2019 Woodside emailed DIIS to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F,** reference 1.15). A revised consultation information sheet was provided (**Appendix F**, reference 1.16).	No feedback received.	Email and Consultation Information Sheet provided. Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
DNP	On 14 January 2020 Woodside emailed DNP advising of the proposed activity (**Appendix F**, reference 1.17) and provided a consultation information sheet (**Appendix F**, reference 1.16). On 29 January 2020 Woodside emailed DNP as a follow-up to check whether DNP had any feedback on the activity.	On 7 February 2020 DNP emailed Woodside acknowledging receipt of the consultation information and advised that no further information was required in relation to the activity unless details regarding the activity change and result in an overlap with, or new impact to a marine park, or for emergency responses.	Notice will be provided to the DNP if details regarding the activity change and result in an overlap with, or new impact to a marine park, or for emergency responses.
Western Australian Government department, agency or advisory body			
DMIRS	On 13 December 2019 Woodside emailed DMIRS advising of the proposed activity (**Appendix F**, reference 1.1) and provided a consultation information sheet (**Appendix F**, reference 1.2). On 16 December 2019 Woodside emailed DMIRS to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F**, reference 1.15). A revised consultation information sheet was provided (**Appendix F**, reference 1.16).	On 24 December 2019 DMIRS emailed Woodside acknowledging receipt of the consultation information and advised that no further information was required at this stage. DMIRS requested that it continue to be informed by sending any further updates to petroleum. environment@dmirs.wa.gov.au	Woodside notes DMIRS advice that no further information is required.
DPIRD	On 14 December 2019 Woodside emailed DPIRD advising of the proposed activity (**Appendix F**, reference 1.12) and provided a State fisheries map relevant to the proposed activity (**Appendix F**, reference 1.13) and a consultation information sheet (**Appendix F**, reference 1.16). On 24 January 2020 Woodside emailed DPIRD as a follow-up to check whether DPIRD had any feedback on the activity. On 29 January 2020 Woodside called and left a voice message with DPIRD to check whether DPIRD had any feedback on the activity.	No feedback received.	Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
DoT	On 13 December Woodside emailed DoT advising on its consultation approach for the Oil Pollution First Strike Plan (**Appendix F**, reference 1.10) consultation information sheet. On 16 December 2019 Woodside emailed DoT to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F**, reference 1.15). A revised consultation information sheet was provided (**Appendix F**, reference 1.16).	On 13 and 16 December 2019 Woodside received an automated response from DoT in response to its consultation information. On 10 January 2020 DoT emailed Woodside advising that it be consulted as outlined in the Department of Transport Offshore Petroleum Industry Guidance Note – Marine Oil Pollution, if there was risk of a spill impacting State waters from the activity. On 20 February 2020 DoT thanked Woodside for providing its Oil Pollution First Strike Plan for the activity and advised it had no comments. DoT requested a final version once accepted.	On 22 January 2020 Woodside emailed DoT, advising that modelling indicated hydrocarbons could impact State waters in the unlikely event of an oil spill. A copy of Woodside's Oil Pollution First Strike Plan for the activity was shared (**Appendix F**, reference 1.20).
State fisheries			
Mackerel Managed Fishery – Pilbara (Area 2)	On 23 December 2019 Woodside sent a letter to licence holders in the Mackerel Managed Fishery (Area 2) advising of the proposed activity (**Appendix F**, reference 11.1) and provided a State fisheries map relevant to proposed activity (**Appendix F,** reference 1.13) and a consultation information sheet (**Appendix F**, reference 1.16).	No feedback received.	Woodside considers the level of consultation to be adequate.
Pilbara Demersal Scalefish Fishery - Pilbara Trawl Fishery	On 23 December 2019 Woodside emailed licence holders in the Pilbara Trawl Fishery advising of the proposed activity (**Appendix F**, reference 11.1) and provided a State fisheries map relevant to proposed activity (**Appendix F**, reference 1.13) and a consultation information sheet (**Appendix F**, reference 1.16).	No feedback received.	Woodside considers the level of consultation to be adequate.
Pilbara Demersal Scalefish Fishery - Pilbara Trap Fishery	On 23 December 2019 Woodside emailed licence holders in the Pilbara Trap Fishery advising of the proposed activity (**Appendix F**, reference 11.1) and provided a State fisheries map relevant to proposed activity (**Appendix F**, reference 1.13) and a consultation information sheet (**Appendix F**, reference 1.16).	No feedback received.	Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
Pilbara Demersal Scalefish Fishery - Pilbara Line Fishery	On 23 December 2019 Woodside emailed licence holders in the Pilbara Line Fishery advising of the proposed activity (**Appendix F**, reference 11.1) and provided a State fisheries map relevant to proposed activity (**Appendix F**, reference 1.13) and a consultation information sheet (**Appendix F**, reference 1.16)	No feedback received.	Woodside considers the level of consultation to be adequate.
Industry			
Santos	On 13 December Woodside emailed Santos advising of the proposed activity (**Appendix F**, reference 1.5) and provided a titles map relevant to the proposed activity (**Appendix F**, reference 1.6) and a consultation information sheet (**Appendix F**, reference 1.2). On 16 December 2019 Woodside emailed Santos to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F**, reference 1.2). A revised consultation information sheet was provided (**Appendix F**, reference 1.16). On 17 January 2020 Woodside emailed Santos to advise of a minor revision to the participants to titles WA-26-L and WA-27-L (**Appendix F**, reference 1.18). A revised titles map was provided (**Appendix F**, reference 1.19).	No feedback received.	Woodside considers the level of consultation to be adequate.
KUFPEC	On 16 December 2019 Woodside emailed KUFPEC advising of the proposed activity (**Appendix F**, reference 10.1) and provided a titles map relevant to the proposed activity (**Appendix F**, ref 10.1.1) and a consultation information sheet (**Appendix F**, reference 1.16).	On 15 January 2020 KUFPEC advised that Woodside was incorrectly listed as a participant in WA-26-L and WA-27-L in the titles map (**Appendix F**, ref 10.1.1). KUFPEC requested that the map be corrected. KUFPEC advised they had no further comments on the activity.	On 17 January 2020 Woodside emailed KUFPEC acknowledging the discrepancy in the original titles map and advised that the participants to titles WA-26-L and WA-27-L had been amended. A revised titles map was provided (**Appendix F**, reference 10.1.2).

Stakeholder	Information provided	Stakeholder response	Woodside response
Lightmark Enterprises	On 13 December 2019 Woodside emailed Lightmark Enterprises advising of the proposed activity (**Appendix F**, reference 1.5) and provided a titles map relevant to the proposed activity (**Appendix F**, reference 1.6) and a consultation information sheet (**Appendix F**, reference 1.2). On 16 December 2019 Woodside emailed Lightmark Enterprises to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F**, reference 1.15). A revised consultation information sheet was provided (**Appendix F**, reference 1.16). On 17 January 2020 Woodside emailed Lightmark Enterprises to advise of a minor revision to the participants to titles WA-26-L and WA-27-L (**Appendix F**, reference 1.18). A revised titles map was provided (**Appendix F**, reference 1.19).	No feedback received.	Woodside considers the level of consultation to be adequate.
Sapura Energy	On 13 December 2019 Woodside emailed Sapura Energy advising of the proposed activity (**Appendix F**, reference 1.5) and provided a titles map relevant to the proposed activity (**Appendix F**, reference 1.6) and a consultation information sheet (**Appendix F**, reference 1.2). On 16 December 2019 Woodside emailed Sapura Energy to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F**, reference 1.15). A revised consultation information sheet was provided (**Appendix F**, reference 1.16). On 17 January 2020 Woodside emailed Sapura Energy to advise of a minor revision to the participants to titles WA-26-L and WA-27-L (**Appendix F**, reference 1.18). A revised titles map was provided (**Appendix F**, reference 1.19).	On 20 March Sapura Energy thanked Woodside for the information and asked to be kept updated with Woodside's ongoing developments.	Woodside notes the request and considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
Finder	On 26 February 2020 Woodside emailed Finder advising of the proposed activity (**Appendix F**, reference 1.23) and provided a titles map relevant to the proposed activity (**Appendix F**, reference 1.19) and a consultation information sheet (**Appendix F**, reference 1.16).	No feedback received.	Woodside considers the level of consultation to be adequate.
BP	On 13 December 2019 Woodside emailed BP advising of the proposed activity (**Appendix F**, reference 1.5) and provided a titles map relevant to the proposed activity (**Appendix F**, reference 1.6) and a consultation information sheet (**Appendix F**, reference 1.2). On 16 December 2019 Woodside emailed BP to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F**, reference 1.15). A revised consultation information sheet was provided (**Appendix F**, reference 1.16). On 17 January 2020 Woodside emailed BP to advise of a minor revision to the participants to titles WA-26-L and WA-27-L (**Appendix F**, reference 1.18). A revised titles map was provided (**Appendix F**, reference 1.19).	No feedback received.	Woodside considers the level of consultation to be adequate.
JX Nippon	On 22 January 2020 Woodside emailed JX Nippon advising of the proposed activity (**Appendix F**, reference 1.21) and provided a titles map relevant to the proposed activity (**Appendix F**, ref 1.19) and a consultation information sheet (**Appendix F**, reference 1.16).	On 22 January 2020 JX Nippon emailed Woodside acknowledging receipt of the consultation information and advised that the information received would be passed on to the relevant department. On 29 January 2020 JX Nippon advised they had no comments on the activity.	Woodside considers the level of consultation to be adequate.

Stakeholder	Information provided	Stakeholder response	Woodside response
Industry representative organisations			
APPEA	On 13 December 2019 Woodside emailed APPEA advising of the proposed activity (**Appendix F**, reference 1.1) and provided a consultation information sheet (**Appendix F**, reference 1.2). On 16 December 2019 Woodside emailed APPEA to advise of a minor revision to the approximate water depth of the proposed activity (**Appendix F**, reference 1.15). A revised consultation information sheet was provided (**Appendix F**, reference 1.16).	No feedback received.	Woodside considers the level of consultation to be adequate.
PPA	On 14 December 2019 Woodside emailed PPA advising of the proposed activity (**Appendix F**, reference 1.12) and provided a State Fisheries map relevant to the proposed activity (**Appendix F**, reference 1.13) and a consultation information sheet (**Appendix F**, reference 1.16).	No feedback received.	Woodside considers the level of consultation to be adequate.
WAFIC	On 14 December 2019 Woodside emailed PPA advising of the proposed activity (**Appendix F**, reference 1.14) and provided a State Fisheries map relevant to the proposed activity (**Appendix F**, reference 1.13) and a consultation information sheet (**Appendix F**, reference 1.16).	On 20 December 2019 WAFIC emailed Woodside advising only Mackerel Area 2 licence holders should be consulted. WAFIC thanked Woodside for clarifying exclusion areas and cautionary areas in its consultation materials.	Woodside thanked WAFIC for its advice and has consulted Mackerel Fishery Area 2 licence holders.
Recfishwest	On 18 December Woodside emailed Recfishwest advising of the proposed activity (**Appendix F**, reference 1.22) and provided a consultation information sheet (**Appendix F**, reference 1.2).	On 19 December Recfishwest emailed Woodside advising that, given the distance from shore, it did not foresee the activity impacting charter or recreational fishers.	Woodside notes the Recfishwest advice that there will be no impact to charter or recreational fishers.

5.6 Ongoing Stakeholder Consultation

Woodside is committed to the engagements listed in **Table 5-3**, based on stakeholder feedback.

Table 5-3: Assessment ongoing stakeholder consultation

Stakeholder	Activity
AMSA	Woodside will notify AMSA's Joint Rescue Coordination Centre at least 24 – 48 hours before operations commence.
AHO	Woodside will notify the AHO no less than four working weeks before operations commence.
DNP	Woodside will notify the DNP if details regarding the activity change and result in an overlap with or new impact to a marine park, or for emergency responses.

6. ENVIRONMENTAL IMPACT AND RISK ASSESSMENT, PERFORMANCE OUTCOMES, STANDARDS AND MEASUREMENT CRITERIA

6.1 Overview

This section presents the impact and risk analysis and evaluation, EPOs, EPSs and MC for the Petroleum Activities Program, using the methodology described in **Section 2**.

6.2 Analysis and Evaluation

As required by Regulation 13(5) and 13(6) of the Environment Regulations, the analysis and evaluation demonstrate that the identified risks and impacts associated with the Petroleum Activities Program are reduced to ALARP, are of an acceptable level and consider all operations of the activity, including potential emergency conditions.

The risks identified during the ENVID (including decision type, current risk level, acceptability of risk and tools used to demonstrate acceptability and ALARP) have been divided into two broad categories:

- planned (routine and non-routine) activities
- unplanned events (accidents, incidents or emergency situations).

Within these categories, impact assessment groupings are based on stressor type, e.g. emissions, physical presence, etc. In all cases, the worst credible consequence was assumed.

The ENVID identified nine impacts and 10 risks associated with the Petroleum Activities Program. Planned activities and unplanned events are summarised in **Table 6-1** and **Table 6-2**.

The analysis and evaluation for the Petroleum Activities Program indicate that all the current environmental risks and impacts associated with the activity are reduced to ALARP and are of an acceptable level, as discussed further in **Sections 6.6** and **6.7**.

Table 6-1: Environmental impact analysis summary of planned activities

Aspect	EP section	Risk rating				Acceptability of Impact/Risk
		Impact/ consequence	Potential impact/consequence level	Likelihood	Current risk rating	
Physical presence: interference with or displacement of third-party vessels	**6.6.1**	F	Social and cultural – no lasting effect (less than one month), localised impact not significant to areas/items of cultural significance.	-	-	Broadly acceptable
Physical presence: disturbance to benthic habitat from MODU anchoring, drilling operations, subsea infrastructure installation and ROV operations	**6.6.2**	E	Environment – slight, short-term local impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	-	-	Broadly acceptable
Routine acoustic emissions: generation of noise from project vessels, MODU, positioning equipment, helicopter transfers & flaring	**6.6.3**	F	Environment – no lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. protected species).	-	-	Broadly acceptable
Routine and non-routine discharges to the marine environment: MODU and project vessels	**6.6.4**	F	Environment – no lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. water quality).	-	-	Broadly acceptable
Routine and non-routine discharges to the marine environment: drill cuttings and drilling fluids (WBM and NWBM)	**6.6.5**	D	Environment – minor, short-term impact (one to two years) on species, habitat (but not affecting ecosystems), physical or biological attributes.	-	-	Broadly acceptable
Routine and non-routine discharges to the marine environment: cement, cementing fluids, grout, subsea well fluids, produced water and unused bulk products	**6.6.6**	E	Environment – slight, short term local impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	-	-	Broadly acceptable
Routine and non-routine discharges to the marine environment: flowline and subsea installation fluids	**6.6.7**	E	Environment – slight, short term local impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	-	-	Broadly acceptable
Routine atmospheric emissions: fuel combustion, flaring, incineration and venting	**6.6.8**	F	Environment – no lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. air quality).	-	-	Broadly acceptable
Routine light emissions: external lighting on MODU and project vessels	**6.6.9**	F	Environment – no lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. species).	-	-	Broadly acceptable

Table 6-2: Environmental risk analysis summary of unplanned events

Aspect	EP section	Risk rating				Acceptability of Impact/Risk
		Impact/ consequence	Potential impact/consequence level	Likelihood	Current Risk Rating	
Accidental hydrocarbon release: Loss of well integrity	**6.7.2**	B	Environment – Major, long term impact (10–50 years) on highly valued ecosystems, species, habitat, physical or biological attributes. Reputation/brand – National concern and/or international interest. Medium to long-term impact (5–20 years) to reputation and brand. Venture and/or asset operations restricted.	1	M	Acceptable if ALARP
Accidental hydrocarbon release: Vessel collision	**6.7.3**	D	Environment – Minor, short-term impact (one to two years) on species, habitat (but not affecting ecosystems), physical or biological attributes.	1	M	Broadly acceptable
Accidental hydrocarbon release: Bunkering	**6.7.4**	E	Environment – Slight, short-term impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	2	M	Broadly acceptable
Unplanned discharges: Drilling fluids	**6.7.5**	E	Environment – Slight, short-term impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	1	L	Broadly acceptable
Unplanned discharges: Deck and subsea spills	**6.7.6**	E	Environment – Slight, short-term impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	1	L	Broadly acceptable
Unplanned discharges: Loss of solid hazardous and non-hazardous wastes/equipment	**6.7.7**	F	Environment – No lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. water quality).	2	L	Broadly acceptable
Physical presence: Vessel collision with marine fauna	**6.7.8**	E	Environment – Slight, short-term local impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	1	L	Broadly acceptable
Physical presence: Disturbance to seabed from loss of station keeping	**6.7.9**	E	Environment – Slight, short-term local impact (less than one year) on species, habitat (but not affecting ecosystems function), physical or biological attributes.	1	L	Broadly acceptable
Physical presence: Dropped object resulting in seabed disturbance	**6.7.10**	F	Environment – No lasting effect (less than one month); localised impact not significant to environmental receptors (e.g. benthic habitats).	2	L	Broadly acceptable
Physical presence: Accidental introduction and establishment of IMS	**6.7.11**	B	Environment – No credible risk identified. Reputation and Brand – Minor, short-term impact (one to two years) to reputation and brand. Close scrutiny of asset level operations or future proposals.	0	M	Broadly acceptable

6.2.1 Cumulative Impacts

Woodside has assessed the cumulative impacts of the Petroleum Activities Program in relation to other relevant petroleum activities which could realistically result in overlapping temporal and spatial extents.

The Angel facility lies at the eastern end of the LD Flowline within the Operational Area, with tie-in of the LD flowline into an existing J-tube on the Angel facility. Other facilities located in close proximity to the Operational Area consist of the GWA facility which lies 4 km south-west, and the Okha FPSO which lies about 13 km south-west. Given the sources of environmental risks and impacts from the Petroleum Activities Program are primarily concentrated around the new wells, the potential for cumulative impacts is considered to be low. The release of fluid from the existing Angel J-tube is addressed in **Section 6.6.7** and due to its limited volumes, does not substantially increase the discharges at the Angel facility.

Woodside is not aware of any other petroleum activities within Permit Areas WA-3 L, WA-5-L and WA-16-L within the proposed time of the Petroleum Activities Program. While Woodside may be undertaking plugging and abandonment activities in WA-23-L there will be no temporal (activities will not occur concurrently) and spatial (over 10 km West of the GDA wells) overlap and therefore no cumulative impacts are predicted from these activities.

Additionally, concurrent drilling operations are not planned under this EP.

6.3 Environmental Performance Outcomes, Standards and Measurement Criteria

Regulation 13(7) of the Environment Regulations requires that an EP includes EPOs, EPSs and MC that address legislative and other controls to manage the environmental risks and impacts of the activity to ALARP and Acceptable levels.

EPOs, EPSs and MC for the Petroleum Activities Program have been identified to allow Woodside's environmental performance to be measured and through the implementation of this EP, to determine whether the EPOs and EPSs have been met.

The EPOs, EPSs and MC specified are consistent with legislative requirements and Woodside's standards and procedures. They have been developed based on the legislation, codes and standards, good industry practices and professional judgement outlined in **Sections 2.6.1.4** and **Section 2.7**, as part of the acceptability and ALARP justification process.

The EPOs, EPSs and MC are presented throughout this section and in **Appendix D**. A breach of these EPOs or EPSs constitutes a 'Recordable Incident' under the Environment Regulations (refer to **Section 7.7.4**).

6.4 Presentation

The analysis and evaluation (ALARP and acceptability), EPOs, EPSs and MC are presented in tabular form throughout this section, as shown in the sample below. Italicised text in this example table denotes the purpose of each part of the table, with reference to the relevant sections of the Regulations and/or this EP.

<table>
<tr><th colspan="15">Context
Description of the context for the impact/risk. Regulation 13(1, 13(2) and 13(3)</th></tr>
<tr><td colspan="4">*Description of the Activity – Regulation 13(1)*</td><td colspan="6">*Description of the Environment – Regulations 13(2)(3)*</td><td colspan="5">*Consultation – Regulation 11A*</td></tr>
<tr><th colspan="15">Impacts and Risks Evaluation Summary
Summary of ENVID outcomes</th></tr>
<tr><td rowspan="2">***Source of Risk***
Regulation 13(1)</td><td colspan="7">***Environmental Value Potentially Impacted***
Regulations 13(2)(3)</td><td colspan="7">***Evaluation***
Section 2</td></tr>
<tr><td>***Soil and groundwater***</td><td>***Marine sediment***</td><td>***Water quality***</td><td>***Air quality (incl odour)***</td><td>***Ecosystems/habitat***</td><td>***Species***</td><td>***Socioeconomic***</td><td>***Decision type***</td><td>***Consequence/impact***</td><td>***Likelihood***</td><td>***Risk rating***</td><td>***ALARP tools***</td><td>***Acceptability***</td><td>***Outcome***</td></tr>
<tr><td>Summary of source of risk/impact</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="15">***Description of Source of Risk or Impact***</td></tr>
<tr><td colspan="15">Description of the identified risk/impact including sources or threats that may lead to the impact/risk or identified event. Regulation 13(1).</td></tr>
<tr><th colspan="15">Impact or Consequence Assessment</th></tr>
<tr><td colspan="15">***Environmental Value/s Potentially Impacted***</td></tr>
<tr><td colspan="15">Discussion and assessment of the potential impacts to the identified environment value/s. Regulation 13(5) (6).
Description of potential impacts to environmental values aligned to Woodside Risk Matrix consequence descriptors.</td></tr>
</table>

<table>
<tr><th colspan="5">Demonstration of ALARP</th></tr>
<tr><td>***Control considered***</td><td>***Control Feasibility (F) and Cost/Sacrifice (CS)[6]***</td><td>***Benefit in impact/risk reduction***</td><td>***Proportionality***</td><td>***Control adopted***</td></tr>
<tr><td colspan="5">***ALARP/Hierarchy of Control Tools Used - Section 2.6.2***</td></tr>
<tr><td>*Summary of control considered to ensure the impacts and risks are continuously reduced to ALARP.*
Regulation 13(5)(c).</td><td>*Technical/logistical feasibility of the control.*
Cost/sacrifice required to implement the control (qualitative measure).</td><td>*Qualitative commentary of impact/risk that could be averted/ environmental benefit gained if the cost/ sacrifice is made and the control is adopted.*</td><td>*Proportionality of cost/sacrifice vs environmental benefit. If proportionate (benefits outweigh costs), the control will be adopted. If disproportionate (costs outweigh benefits), the control will not be adopted.*</td><td>*If control is adopted, reference to Control No. provided.*</td></tr>
<tr><td colspan="5">***ALARP Statement***
Made on the basis of the environmental risk/impact assessment outcomes, use of the relevant tools appropriate to the decision type (**Section 2.7** and Figure 2-4) and a proportionality assessment. Regulation 10A (b).</td></tr>
</table>

[6] Qualitative measure

Demonstration of Acceptability
Acceptability Statement Made on the basis of applying the process described in **Section 2.7** taking into account internal and external expectations, risk/impact to environmental thresholds and use of environment decision principles. Regulation 10A(c)

EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO No. **S**: *Specific performance that addresses the legislative and other controls that manage the activity, and against which performance by Woodside in protecting the environment will be measured.* **M**: *Performance against the outcome will be measured through implementation of the controls via the MC.* **A**: *Achievability/feasibility of the outcome demonstrated via discussion of feasibility of controls in ALARP demonstration. Controls are directly linked to the outcome.* **R**: *The outcome will be relevant to the source of risk/impact and the potentially impacted environmental value*[7] **T**: *The outcome will state the timeframe during which the outcome will apply or by which it will be achieved.*	**C No.** *Identified control adopted to ensure that the impacts and risks are continuously reduced to ALARP.* *Regulation 13(5) (c).*	**PS No.** *Statement of the performance required of a control measure. Regulation 13(7)(a).*	**MC No.** *Measurement criteria for determining whether the outcomes and standards have been met. Regulation 13(7)(c).*

6.5 Potential Environmental Risks Not Included Within the Scope of the Environment Plan

The ENVID identified a number of environmental risks that were assessed as not being applicable (not credible) (refer **Section 2.5**) within or outside the Operational Area as a result of the Petroleum Activities Program. Therefore, they were determined to not form part of this EP. These are described in the following sections for information only.

6.5.1 Shallow/Near-shore Activities

The Petroleum Activities Program is located in water depths of about 80-130 m and at a distance of about 74 km from the nearest landfall (this being the Montebello Islands). Consequently, risks associated with shallow/near-shore activities such as vessel grounding were assessed as not credible.

6.5.2 Helicopter Interference with Other Users

Aerial interference with other users is not considered credible as the Operational Area is more than 115 km from mainland Australia and there are no other identified users of the airspace over the Operational Area, e.g. Royal Australian Air Force.

[7] Where impact/consequence descriptors are capitalised and presented within EPOs in **Section 6**; performance level corresponds with those aligned with the Woodside Risk Matrix (refer **Section 2.6**).

6.5.3 Collision with Angel Platform

Due to the close proximity of the activities during tie-in, a collision between the PIV and the Angel Platform is possible. The Angel Operations Environment Plan considers the risk of a loss of marine vessel separation between a vessel and the riser platform which may result in a loss of hydrocarbon containment from the Angel facility and/or the release of fuel from the vessel.

The in force Angel Operations EP provides a full description and assessment of impacts and risks. Management controls and response capabilities are also detailed in that EP. Additional controls for operating the PIV are provided throughout **Section 6.6 and 6.7**.

6.5.4 Loss of Containment of Existing Subsea Infrastructure

As described in **Section 4.6.7** existing subsea infrastructure is present in the Operational Area as part of the GWA, Angel and Okha Field Production Systems (see **Figure 3-4** and **Figure 3-5**).

A subsea loss of containment from a rupture of live infrastructure within the Operational Area could occur, in the event of dropped objects or should loss of station keeping of the MODU from mooring failure result in anchor drag across infrastructure.

The Lambert 4 well and flowline (Okha subsea infrastructure) along with the Angel Export Pipeline occur within the Operational Area around the LDA-01 well and flowline.

The GWF-1 infrastructure including GDA-01 and GDA-02 wells and production flowlines (GWA Infrastructure) occur within the Operational Area around the GWF-3 wells, with the proposed wells tying into the existing GDA manifold, outboard of the GWA SSIV.

This existing infrastructure (wells, flowlines and other infrastructure) could credibly be ruptured, resulting in loss of inventory as described in the next sections.

6.5.4.1 Angel Export Pipeline

A worst-case credible hydrocarbon release scenario has been defined in the Angel Operations EP as the rupture of the subsea export pipeline. This could result in a release to the environment of up to 9000 m^3 of Angel condensate.

The in force Angel Operations EP provides a description and assessment of impacts and risks. Management controls and response capabilities are also detailed in that EP. Additional controls for operating the MODU are provided throughout **Sections 6.6 and 6.7**.

6.5.4.2 Goodwyn Alpha (GWA) Subsea Infrastructure

A worst-case credible hydrocarbon release scenario has been defined in the GWA Facility Operations EP as a well blow-out at seabed of the highest flowing well, resulting in a 77-day loss of containment. This could result in a release of up to 185,141 m^3 of GWF-1 condensate.

Another worst-case credible hydrocarbon release scenario has been defined in the GWA Facility Operations EP as the rupture of the 16-inch flowline upstream of the SSIV. This could result in a release of up to 237 m^3 of GWF-1 condensate.

The in force GWA Facility Operations EP provides a description and assessment of impacts and risks. Management controls and response capabilities are detailed in that EP. Additional controls for operating the MODU are provided throughout **Section 6.6 and 6.7**.

6.5.4.3 Okha Subsea Infrastructure

A worst-case credible hydrocarbon release scenario has been defined in the Okha FPSO Operations EP as the rupture of the eight-inch production flowline which holds the largest liquid hydrocarbon inventory within the Okha subsea system. This could result in a release of up to 414 m^3 of Cossack light crude.

The in force Okha Facility Operations EP provides a full description and assessment of impacts and risks. Management controls and response capabilities are also detailed in that EP. Additional controls for operating the MODU are provided throughout **Section 6.6 and 6.7**.

6.5.5 Loss of Containment from Suspended Wellheads

Several existing wellheads occur in the Operational Area for this EP that have been suspended in accordance with applicable legislation at the time of the activity (**Figure 4-15** above). Barriers are in place down the wells, so if a wellhead was inadvertently damaged or removed through dropped objects or anchor drag, no loss of containment would occur. Therefore, the scenario of loss of containment from existing wellheads is not considered credible and is not assessed further.

6.6 Planned Activities (Routine and Non-routine)

6.6.1 Physical Presence: Interference with or Displacement of Third-Party Vessels

Context		
Project Vessels – **Section 3.5** Project Vessel-based Activities – **Section 3.7** Drilling Activities – **Section 3.8** Subsea Installation and Pre-commissioning Activities – **Section 3.9** Wellhead Assembly Left In-situ – **Section 3.11.8**	Socioeconomic Environment – **Section 4.6**	Stakeholder Consultation – **Section 5**

Impact Evaluation Summary

Source of impact	***Environmental value potentially impacted***							***Evaluation***				
	Soil and groundwater	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence***	***ALARP tools***	***Acceptability***	***Outcome***
Displacement of other users – proximity of MODU and primary project vessels interfering with or displacing third-party vessels (commercial fishing and commercial shipping)							X	A	F	GP PJ	Broadly acceptable	EPO 1
Presence of subsea infrastructure (including wellhead left in-situ) interfering with or displacing third-party vessels (commercial/ recreational fishing)							X	A	F	GP PJ		EPO 2

Description of Source of Impact

Presence of MODU and Vessels and Subsea Infrastructure

Woodside proposes to drill four production wells (listed in **Table 3-2**) and drilling activities are expected to take about 70 days per well to complete. Only one well will be drilled at a time, therefore, a MODU and support vessels may be present within the Operational Area for up to about one year (**Section 3.4**).

Subsea installation vessels will be used to install and pre-commission the flowlines and subsea infrastructure (**Section 3.5**). This is expected to take a cumulative duration of about 100 days (including mobilisation, demobilisation and contingency).

The Petroleum Activities Program is planned to be executed as a single campaign, notwithstanding the constraints described above. However, should the need require, multiple campaigns may be undertaken.

Support vessels will assist the MODU and installation vessels. As required, one of the vessels will be at the MODU to perform standby duties as stipulated in the One Marine Charterers Instructions, and others will transit in and out of the Operational Area to port for routine, non-routine and emergency operations.

The presence of the MODU, primary installation vessels and other project vessel movements could present a navigational hazard to shipping and commercial fishing activities in the Operational Area. When underway, activities are conducted up to 24 hours per day, seven days per week.

As outlined in **Section 3.10**, wells may need to be abandoned if a respud is required. This is considered a contingent activity and if a well is abandoned due to respud, routine techniques will be used to remove the wellhead(s). Wellhead assemblies may be left in-situ if these routine removal techniques are unsuccessful. If a wellhead is left in-situ, it could potentially interfere with third-party activities (particularly fishing activities).

Impact Assessment

Potential Impacts to Socioeconomic Environment

Displacement or Interference with Commercial Fishing Activities

A number of Commonwealth and State managed fisheries overlap the Operational Area. The proposed wells are situated within three Commonwealth and ten State managed fisheries areas, however, only two fisheries (the Mackerel Managed Fishery and Pilbara Demersal Scalefish Fishery (trawl, trap and line)), are considered to be active in the vicinity of the Operational Area (**Section 4.6.3.1, Table 5-1**).

The Operational Area is located in water depths ranging from 80 – 130 m, with all wells being drilled in water depths of greater than 125 m, which is beyond the upper depth limit where typical Mackerel Managed Fishery effort occurs (up to about 70 m). Therefore, interactions with participants in the commercial fishery are unlikely during drilling activities. The Angel Platform is located in water depths of about 80 m, so there is potential for interaction during the tieback of the LD well to the facility, however impacts are expected to be minimal given the existing 500 m petroleum safety zone around the Angel facility.

The Operational Area overlaps Zone 1 and Zone 2 of the Pilbara Trap Managed Fishery (PTMF), and Area 1 and Area 6 of Pilbara Fish Trawl Interim Managed Fishery (Allen and Loneragan, 2010). The presence of commercial fishing vessels in the Operational Area would likely be short term, potentially resulting in a minor interference (navigational hazard) and localised displacement/avoidance by commercial fishing vessels within the immediate vicinity of the MODU and project vessels. In observance of good seamanship all support vessels avoid close and or disruptive engagement with any commercial fishing activity. Fishcube data shows that there has been a maximum of three trap, three trawl vessels and five line vessels within the 60 NM blocks that intersect the Operational Area in the last five years and there was no direct response from commercial fisheries during the stakeholder consultation period (refer **Table 5-2**). The potential impact is considered to be isolated and temporary.

Potential impacts to commercial fishing if a well is abandoned and the wellhead remains in-situ (**Sections 3.11.7** and **3.11.8**), are snag hazards to fishing equipment such as trawl nets that operate along the seabed. Zone 1 of the Pilbara Trawl Fishery is closed to trawl fishing and therefore impacts are unlikely.

Displacement of Recreational Fishing

Stakeholder consultation did not identify any key recreational fishing activity within the Operational Area. Recreational fishing in the region is concentrated around the coastal waters and islands of the NWMR such as the Montebello Islands (approximately 74 km south-west of the Operational Area, at the closest point). Due to the distance offshore and water depths, recreational fishing is unlikely to occur in the Operational Area. If recreational fishing effort occurred within the Operational Areas while drilling or subsea installation is being performed, displacement as a result of the Petroleum Activities Program would be minimal and relate only to the 500 m petroleum safety zone, around the MODU and primary installation vessels. Additionally, fishing activity may be excluded from the immediate area around primary installation vessels. Therefore, the potential impacts would be isolated to temporary impacts.

Given the distance of the Operational Area offshore and water depths between 80 and 130 m, with all wells being drilled in greater than 125 m water depth, snagging hazards to recreational fishing equipment as a result of a wellhead remaining in-situ are highly unlikely.

Displacement to Commercial Shipping

The presence of the MODU and project vessels could potentially cause temporary disruption to commercial shipping. The GWF-3 Operational Area overlaps a shipping fairway and the LD Operational Area is about 24 km away from shipping fairways (**Figure 4-14**). AMSA did not raise specific concerns about the Petroleum Activities Program (**Section 5.5**) and noted that some heavy vessels traverse through Permit Areas WA-3-L, WA-5-L and WA-16-L. Shipping in the area is mainly related to the resources industry, and particularly associated with the Woodside-operated North Rankin Complex. Potential impacts to commercial shipping activities associated with this Petroleum Activities Program may include displacement of vessels as they make slight course alterations to avoid project vessels such as the MODU, subsea installation vessels or subsea support vessels. The project vessels are present for the duration of the activities specified in this EP (i.e. temporary) and, therefore, the potential impact to commercial shipping is considered to be isolated and temporary.Given the water depth of the proposed wells (>125 m), impacts to commercial shipping as a result of the wellhead remaining in-situ are not considered credible.

Cumulative Impacts

There are no cumulative impacts from drilling activities, as no wells are to be drilled concurrently. However, there may be cumulative impacts to commercial fisheries from concurrent drilling and subsea installation activities. Of the fisheries considered active in the vicinity of the Operational Area, potential cumulative impacts to vessels that overlap the Operational Area would be localised with no lasting effect.

Summary of Potential Impacts to Environment Value(s)

Given the adopted controls, it is considered that physical presence of the MODU, primary installation vessels, support vessels and the potential presence of a wellhead left in-situ (if required) will not result in a potential impact greater than a localised impact with no lasting effect to shipping and commercial/recreational fishing interests (i.e. Social and Cultural Impacts – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[8]	***Benefit/Reduction in Impact***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No controls identified.				
Good Practice				
AHO will be notified of activities and movements no less than four working weeks prior to scheduled activity commencement date.	F: Yes. CS: Minimal cost. Standard practice.	Notification to AHO will enable them to generate navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including AUSCOAST warnings where relevant)).	Benefits outweigh cost/sacrifice. Control is also Standard practice.	Yes **C 1.1**
Notify DPIRD (Western Australia) (formerly the WA Department of Fisheries) of activities within three months of drilling.	F: Yes. CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard practice.	Yes **C 1.2**
Notify AMSA Joint Rescue Coordination Centre (JRCC) of activities and movements 24-48 hours before operations commence.	F: Yes. CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard practice.	Yes **C 1.3**
Undertake consultation with relevant stakeholders for activities and movements that commence more than a year after EP acceptance.	F: Yes. CS: Minimal cost. Standard practice.	Communicating the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard practice.	Yes **C 1.4**
Routine removal of wellheads will be attempted in the event of a respud.	F: Yes. CS: Additional cost. Standard practice.	Routine removal of wellheads may reduce the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also Standard practice.	Yes **C 2.1**

1 Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[8]***	***Benefit/Reduction in Impact***	***Proportionality***	***Control Adopted***
Professional Judgement – Eliminate				
Limit drilling activities to avoid peak shipping and commercial fishing activities.	F: No. Shipping occurs year-round and cannot be avoided. SIMOPS with fishing seasons cannot be eliminated as exact timings for all activities are not confirmed. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
Over-trawl protection on subsea infrastructure.	F: Yes. Over-trawl protection could mitigate the potential for commercial fishing trawl gear to damage subsea infrastructure and/or result in loss of trawl gear. CS: Significant additional cost.	Reduces the potential for snagging trawl nets if a wellhead is left in-situ following abandonment during drilling. However, given the low level of trawling activity occurring in the Operational Area and that the infrastructure is marked on nautical charts, the benefit is low.	Disproportionate. Significant additional costs.	No
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts of the physical presence of the MODU, project vessels, subsea infrastructure and potentially a wellhead left in-situ (if required) on other users, such as commercial fisheries, recreational fishing and shipping. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				
Demonstration of Acceptability				
Acceptability Statement The impact assessment has determined that, given the adopted controls, physical presence of the MODU, project vessels, subsea infrastructure and potentially a wellhead left in-situ (if required) is unlikely to result in potential impact greater than isolated impacts with no lasting effect to commercial fishing, recreational fishing and shipping. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil and gas industry practice and meet the expectations of AMSA and AHO provided in consultation with stakeholders. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of physical presence of the Petroleum Activities Program to a level that is broadly acceptable.				

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 1 Marine users aware of the Petroleum Activities Program.	**C 1.1** Notify AHO of activities and movements no less than four working weeks prior to the scheduled	**PS 1.1** Notification to AHO of activities and movements to allow generation of navigation warnings	**MC 1.1.1** Consultation records demonstrate that AHO has been notified prior to commencement of an

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	activity commencement date.	(Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including AUSCOAST warnings where relevant).	activity to allow generation of navigation warnings (MSIN and NTM (including AUSCOAST warnings where relevant)).
	C 1.2 Notify DPIRD (Western Australia) (formally the WA Department of Fisheries) of activities within three months of drilling.	**PS 1.2** Notification to Department of Primary Industries and Regional Development in order to inform other marine users of the activities to reduce activities interfering with other marine users for longer than necessary.	**MC 1.2.1** Consultation records demonstrate that Department of Primary Industries and Regional Development has been notified prior to commencement of drilling.
	C 1.3 Notify AMSA JRCC of activities and movements 24–48 hours before operations commence.	**PS 1.3** Notification to AMSA JRCC to prevent activities interfering with other marine users. AMSA JRCC will require the MODU's details (including name, callsign and Maritime Mobile Service Identity), satellite communications details (including INMARSAT-C and satellite telephone), area of operation, requested clearance from other vessels and need to be advised when operations start and end.	**MC 1.3.1** Consultation records demonstrate that AMSA JRCC has been notified prior to commencement of the activity within required timeframes.
	C 1.4 Undertake consultation with relevant stakeholders for activities and movements that commence more than a year after EP acceptance.	**PS 1.4** In order to prevent activities interfering with other marine users, relevant stakeholders consulted no less than four working weeks prior to scheduled activity commencement date.	**MC 1.4.1** Consultation records demonstrate relevant stakeholders have been consulted.
EPO 2 Routine removal of wellheads will be attempted during Petroleum Activities Program if required following respud.	**C 2.1** Routine removal of wellheads will be attempted in the event of a respud.	**PS 2.1** Removal of wellheads attempted during the Petroleum Activities Program in the event of a respud.	**MC 2.1.1** Records demonstrate routine removal of wellheads was attempted.

6.6.2 Physical Presence: Disturbance to Benthic Habitat from MODU Anchoring, Drilling Operations, Subsea Infrastructure Installation and ROV Operations

Context	
Project vessel-based activities – **Section 3.5** Drilling activities – **Section 3.8** Subsea Installation and Pre-commissioning Activities – **Section 3.9** Wellhead assembly left in-situ – **Section 3.11.8**	Biological Environment – **Section 4.5** Values and Sensitivities – **Section 4.7**

Impact Evaluation Summary

Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***				
	Soil and groundwater	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence/impact***	***ALARP tools***	***Acceptability***	***Outcome***
Disturbance to seabed from drilling operations					X			A	F	GP PJ	Broadly acceptable	EPO 3
Disturbance to seabed from ROV operation (including localised sediment relocation from sediment mobilisation techniques)					X			A	F			
Disturbance to seabed from MODU station keeping (MODU mooring, including anchor holding testing)					X			A	E			
Disturbance to seabed from subsea installation of infrastructure (initiation anchor deployment, clump weights, flowlines, manifolds and umbilicals, installation aids and stabilisation systems (concrete mattresses and sandbags)					X			A	F			
Disturbance to seabed from wellhead remaining in-situ					X			A	F			EPO 2

Description of Source of Impact

Drilling

Drilling activities may result in intermittent or discontinuous direct physical or mechanical disturbance to the seabed up to an approximate 100 m radial distance around each new well location due to the installation of the BOP and conductor.

Please note that the generation and discharge of cuttings and drilling fluids are not considered in this section; refer to ***Section 6.6.5*** *for an assessment of drill cuttings and drilling fluids.*

MODU Anchoring and Anchor Holding Testing

Seabed disturbance may result from the anchor holding testing and MODU anchor mooring system, including placement of anchors and chain/wire on the seabed; potential dragging during tensioning; and recovery of anchors. Suction piling may be required for installing the anchors. Overall, the mooring of the MODU and anchor holding testing activities may result in localised, small-scale seabed disturbance to the benthic habitats described in **Section 4.5.1**. Mooring may require a 12-point pre-laid mooring system at each well location depending on the time of year; however, for drilling activities outside of cyclone season, a standard eight-point system is more likely.

There are four proposed production well locations for the Petroleum Activities Program (**Table 3-2**), equating to the need for a maximum of 48 anchor installations, assuming all implement the 12 point mooring system.

The planned anchoring activities are to be within the parameters defined in the Anchoring of Vessels and Floating Facilities Environment Plan Reference Case (Department of Industry, Innovation and Science, undated) for all anchoring activities performed by vessels and floating facilities (excluding FPSOs and Floating LNG vessels) during the Petroleum Activities Program, including:

- installation of moorings, buoys, equipment or other infrastructure for a period of up to two years
- wet storage on seabed of anchor chains, etc. during activities up to two years
- activities with total areas of seabed disturbance less than 13,000 m^2
- locations of water depth greater than 70 m. This boundary is set to exclude areas of sensitive primary producer habitats (e.g. corals, seagrass) that occur in shallower waters.

Subsea Installation Activities

Subsea installation of the infrastructure components for the Petroleum Activities Program are described in Table 3-7 and may result in temporary disturbance and suspension of sediment causing increased turbidity, and impacts to benthic habitats during the installation process.

The installation of subsea infrastructure (including placement of materials/equipment on the seabed), supporting structures (including wellheads, flowlines, umbilicals, umbilical termination assemblies, flying leads, manifold, concrete mattresses) and installation aids (clump weights, concrete mattresses, sandbags, bulkabags and rigging) may result in localised disturbance to benthic habitats in the form of loss of habitat and a scour around the subsea infrastructure during the lifespan of the equipment.

Commencement of the flowline installation generally requires tension to the flowline as it transitions from the installation vessel to the seabed. Therefore, commencement of the flowline Installation may start with landing the end of flowline termination head into the manifold connection system or on the seabed attached to the initiation anchor (clump weight). This will cause small, localised and temporary impacts to water quality in the vicinity of flowline landout.

When using the existing manifold, when the termination end is fully landed, the flexible flowline is to be continuously laid using vertical lay system and at the same time, the ROV monitors the touch-down point on the seabed as well as the flexible lay back radius. In the event, the flexible flowline needs to make a turn, a temporary small bulkabag filled with individual sandbags are deployed to act as the turning bollard. Turning bollards (if required) would have their contents (sand locally sourced) left on the seabed and the bags recovered to the installation vessel.

A project specific, basis of design has been developed for subsea infrastructure, using high resolution bathymetry data, to identify and avoid, where possible, any seabed features. This reduces the potential for spanning and therefore the need for span rectification, while avoiding potential hard substrate habitats. Where span rectification is required concrete mattresses may be positioned at the identified free span location by the use of the ROV. The dimensions for each concrete mattress are expected to be 6 m x 3 m x 3 m. Post-lay span rectification may involve placing grout bags or mattresses on the seabed, with the extent of any impact limited to the footprint of the installed flowline. Concrete mattresses may be used for stabilisation of some sections of the LD flowline or umbilical, subject to detailed design.An array of underwater acoustic positioning transponders may be placed on the seabed for the accurate positioning of the flowline and pre-lay structures, as described in **Section 3.9.2**. LBL transponders may be moored to the seabed by a clump weight or be deployed in stands. The standard clump weights used weigh about 80 kg and are recovered if practicable to do so or may be left in-situ. At the completion of installation, the LBL transponders are recovered via an acoustic release mechanism, leaving only the concrete clump weight on the seabed.

Wet storage of infrastructure components on the seabed, where required, would also result in localised disturbance to the seafloor and may require mattresses or other means of providing stability during the wet storage period.

ROV

The use of the ROV during the Petroleum Activities Program may result in temporary seabed disturbance and suspension of sediment causing increased turbidity as a result of working close to, or occasionally on, the seabed. An ROV used close to or on the seabed is limited to that required for effective and safe subsea activities. The footprint of a typical ROV is about 2.5 m × 1.7 m.

Additionally, it is anticipated that the ROV will be used to displace sediment via jetting (or similar) to create a corridor/short trench to submerge flowline/umbilicals for crossing via other pipeline/subsea infrastructure. An ROV may be used to relocate sediment material around the well location to help manage cement or cuttings flow. Sediment relocation techniques are described in **Section 3.11.9**. This may cause localised and temporary impacts to water quality from increased turbidity in the lower water column above the seabed and may cause localised and temporary impacts to physical habitat and benthic communities of the seabed.

Wellhead Remains In-Situ

As outlined in **Sections 3.11.7** and **3.11.8**, wells may need to be abandoned if a respud is required. This is considered a contingent activity and if a well is abandoned due to respud, routine techniques will be used to remove the wellhead(s). Wellhead assemblies may be left in-situ if these routine removal techniques are unsuccessful. If a wellhead is left in-situ, there would be localised seabed disturbance at the wellhead location.

Impact Assessment
Seabed Habitat and Benthic Communities Drilling operations, MODU mooring (including anchor hold testing), subsea installation activities and ROV operations are likely to result in localised physical modification to the seabed and disturbance to soft sediment. The Operational Area is composed primarily of soft, fine, unconsolidated sediments, which are typical of the broader NWMR. The Operational Area overlaps a section of the Ancient coastline at 125 m depth contour KEF (**Section 4.7.5**). As discussed in **Section 4.4**, there are patchy outcroppings of hard substrate which may support sparse patches of filter feeding biota such as sessile sponges and gorgonians (sea whips and fans), refer to **Section 4.5.1.3.** In general, the benthic communities within the Operational Area comprise sparse epifauna and infauna associated with the soft sediment physical habitat that are of low diversity and are typical and representative of the wider region. The nearest sensitive receptors with primary benthic producer benthic communities (coral reef habitat) are Glomar Shoal and Rankin Bank. Glomar Shoal (about 1 km from the Operational Area, LD) is a submerged shoal feature/ sedimentary bank composed of coarser biogenic material than the surrounding seabed and has been defined as a KEF within the NWMR. The shoal depth ranges from 26 – 70 m depth (Falkner et al. 2009). The closest proposed production well to Glomar Shoal is LDA-01 which is about 16 km away. Rankin Bank is a submerged shoal feature located on the continental shelf about 19 km and 91 km west of the GWF-3 and LD Operational Areas, respectively. The bank rises from around 40 – 50 m to 18 m below the sea surface. Refer to **Sections 4.7.5.** and **4.7.6** for full descriptions of ecological composition. *Drilling Activities* Physical impacts from drilling activities (excluding impacts from routine and non-routine discharges such as drilling discharges which are assessed in **Section 6.6.5**) are expected to be confined to a localised area around each well location, typically within 100 m radial maximum distance, due to direct physical or mechanical disturbance. The disturbed seabed habitat primarily supports sediment burrowing infauna and surface epifauna invertebrates, particularly, the potential occurrence of sparse filter feeders, inhabiting the seabed around the well location. Impacts from anchoring (including anchor hold testing) are expected to be confined to sediment burrowing infauna and surface epifauna invertebrates, particularly filter feeders, inhabiting the seabed directly around the anchor test location (Hughes et al., 2010; Gates and Jones, 2012). Impacts to these broadly represented communities are expected to be highly localised with no significant impact to environment receptors. In areas of soft sediment with no sensitive benthic communities, any impact from anchoring is likely to be minimal and typically temporary (UK Marine SAC, 2001). *Subsea Installation Activities* Impacts from the installation of subsea infrastructure are expected on the seabed habitat and benthic communities within the physical footprint of the infrastructure. These impacts are expected to represent a narrow physical footprint due to the size (8 and 10 inch diameter) of the flowlines but will be over extended distances given the length (between 1.2 and 15 km) and the size of the subsea infrastructure (**Table 3-7**). Installation is expected to cause localised and temporary impacts to water quality from increased turbidity in the lower water column near seabed and may cause relatively small scale, permanent impacts to the physical seabed habitat and benthic communities where the subsea infrastructure is installed. During installation underlying and nearby biota (epifauna and infauna) have the potential to be buried by sediment or coated in suspended sediments. Any filter feeding biota in proximity to these activities (which is patchy and sparse in nature) may be affected with potential for sediment to clog respiratory and feeding structures for a short duration. Significant impacts to the broadly represented benthic communities are not expected. *ROV operations* ROV activities near the seabed and associated seabed sediment relocation activities as part of the flowline installation activities may result in slight and short-term impacts to the physical habitat and benthic communities, as a result of elevated turbidity in the lower water column near seabed and sediment burial or coating with suspended sediments. However, elevated turbidity would only be expected to be very localised, short term and temporary, and is therefore not expected to have any significant impact to environment receptors, particularly given the low densities of benthic biota at the water depths of the Operational Area. The closest coral reef habitats are at Glomar Shoal and Rankin Bank, which are about 1 and 19 km, respectively from the closest point to the Operational Area, at the closest point, respectively and will not be impacted from ROV activities. Additionally, the ROV may be used to relocate sediment material around the well location to help manage cement or cuttings flow and to create a short corridor to submerge flowlines and umbilicals for crossings. This will cause localised and temporary impacts to water quality from increased turbidity, and may cause localised and temporary impacts to benthic biota. During contingent operations, an ROV may be used to relocate sediment/cuttings around the wellhead to keep the area clear and safe for operations and equipment. This may generate plumes of suspended sediment in the lower water column above the seabed during pumping and cause disturbance to benthic fauna in the immediate area. Any plumes are expected to dissipate and are not considered likely to impact on corals (closest coral habitat is Glomar Shoals and Rankin Bank with are 16 and 19 km away from the well locations). Impacts to demersal fish communities would be minor with temporary avoidance of the disturbed area. ROV may also be used for water jetting and/ or acid injection activities for cleaning of subsea infrastructure.

Artificial Benthic Habitats

Subsea infrastructure such as the flowlines have the potential to act as artificial habitat and is likely with time to establish benthic biota such as filter feeding invertebrates such as sponges and gorgonians (sea whips and fans).

In the unlikely event the wellhead cannot be removed, over time the cement surrounding the wellhead will likely become buried in sediment as a result of prevailing ocean currents. Over time, the steel wellhead structure will corrode and marine fouling is expected to accumulate, whereby a marine life structure may remain above the seafloor. The wellhead remaining in-situ is expected to have a localised non-significant impact to environmental receptors. No further impacts to benthic habitats are likely.

Survey findings at the Goodwyn facility (McLean et al., 2017), showed that the presence of subsea infrastructure (pipeline) supported the development of demersal fish communities that would otherwise not occur in the area. Generally speaking, the structures that are located in shallower water (<135 m) had a greater diversity of fish compared to habitats at 350 m depth, where the number of fish species and abundance declined markedly (McLean et al., 2018). The study by Bond et al. (2018) also confirmed that compared to adjacent natural seabed habitats, pipeline fish fauna were characterised by higher relative abundance and biomass of commercially important species. The additional subsea infrastructure to be installed as part of the Petroleum Activities Program is, therefore, likely to provide additional hard substrate which would be colonised over time by epifauna and provide habitat for demersal fish communities.

Based on the above assessment, and given that operational area only overlaps about 0.75 percent of the Ancient Coastline at 125 m depth contour KEF, the seabed disturbance is unlikely to negatively impact on the ecological value of the KEF or benthic habitat in the area.

Cumulative Impacts

Given the number of wells planned to be drilled during the Petroleum Activities Program, there is the potential for cumulative disturbance to the seabed and benthic communities. Cumulative seabed disturbance associated with the Petroleum Activities Program is expected to be restricted to an accumulation of disturbance areas from overlapping well footprints and subsea infrastructure installation sites. Recovery from any such cumulative impacts is expected to be relatively rapid due to the expected re-colonisation from adjacent sediments.

As benthic habitats within the Operational Area are well represented throughout the North West Shelf and wider NWMR, cumulative impacts associated with seabed disturbance is not expected to significantly increase the risk to benthic habitats present within the Operational Area, including those of the Ancient Coastline at 125 m depth contour KEF.

Summary of Potential Impacts to Environmental Values

Given the adopted controls, seabed disturbance from the Petroleum Activities Program will result in localised, slight and generally short-term impacts to benthic habitat and communities (i.e. Environment Impact – E).

Demonstration of ALARP

Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[9]***	***Benefit/Reduction in Impact***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
An ROV inspections will be undertaken, post installation, to confirm all installation aids (as defined in Section 3.9) have been removed.	F: Yes CS: ROV inspections post installation standard practice	In accordance with OPGGS Act Section 572 all equipment is removed when no longer in use	Legislative requirement	Yes **C 3.1**
Good Practice				
Project-specific Basis of Well Design, which includes an assessment of seabed sensitivity.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of anchoring occurring in areas of high sensitivity. Assessment of seabed topography reduces the likelihood of anchor drag leading to seabed disturbance.	Benefits outweigh cost/sacrifice.	Yes **C 3.2**

9 Qualitative measure

Demonstration of ALARP				
Project-specific Mooring Design Analysis.	F: Yes. CS: Additional costs associated with upgraded MODU mooring design.	The mooring design analysis determines the number and spread of anchors required based on sediment type and seabed topography, reducing the likelihood of anchor drag leading to seabed disturbance.	Benefits outweigh cost/sacrifice.	Yes **C 3.3**
Positioning technology used to place seabed infrastructure within the planned footprint.	F: Yes. CS: Minimal cost. Standard practice.	Using positioning technology to accurately position infrastructure, including the flowlines and umbilicals, within the planned footprint which was determined using bathymetry data to avoid seabed features, where possible during the design phase. This will reduce disturbance to the seabed.	Benefits outweigh cost/sacrifice.	Yes **C 3.4**
Environmental monitoring of the seabed before and after the Petroleum Activities Program to assess any impacts to seabed.	F: Yes. CS: Significant. Monitoring of the seabed, particularly the deep waters of the Operational Area, would involve significant additional costs to obtain and analyse data with the spatial resolution to accurately assess changes to the seabed habitat.	Environmental monitoring would not result in any additional information of the seabed above that already collected. Therefore, no additional reductions in likelihood or consequence would occur.	Control grossly disproportionate. Monitoring will not reduce the consequence or likelihood of any impacts to the seabed, and the cost associated with the level of monitoring required to accurately assess any impacts greatly outweighs the benefits gained. Although adopting this control could be used to verify EPOs, alternative controls identified also allow demonstration that the environmental outcome has been met based on the nature of the activity (i.e. predictable impacts) and relatively low sensitivity of the area.	No

Demonstration of ALARP				
Routine removal of wellheads will be attempted in the event of a respud.	F: Yes. CS: Additional cost. Standard practice.	Routine removal of wellheads may reduce the likelihood of interfering with other marine users.	Benefits outweigh cost/sacrifice. Control is also standard practice.	Yes **C 2.1**
Professional Judgement – Eliminate				
Only use DP MODU (no anchoring required).	F: No. CS: It is not technically feasible for the MODU to use DP in the water depths of the well locations (about 125-130 m). Woodside has a demonstrated capacity to manage the environmental risks and impacts from mooring to a level that is ALARP and acceptable.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Do not use ROV close to, or on, the seabed.	F: No. The use of ROVs (including work close to or occasionally landed on the seabed) is critical as the ROV is the main tool used to guide and manipulate equipment during drilling and some subsea infrastructure installation. ROV usage is already limited to only that required to conduct the work effectively and safely. Due to visibility and operational issues, ROV work on or close to the seabed is avoided unless necessary. CS: Not assessed, control not feasible.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				

ALARP Statement

On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts of benthic habitat disturbance from MODU station holding, drilling operations, flowline and other subsea infrastructure installation and ROV operations. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of ALARP
Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, disturbance to benthic habitats is unlikely to result in a potential impact greater than a slight and short term effect on benthic habitats (not affecting ecosystem function). Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil and gas industry practice and meet the requirements of Woodside's relevant systems and procedures. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of seabed disturbance to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 2 Routine removal of wellheads will be attempted during Petroleum Activities Program if required following respud.	**C 2.1** Routine removal of wellheads will be attempted in the event of a respud	**PS 2.1** Removal of wellheads attempted during the Petroleum Activities Program in the event of a respud.	**MC 2.1.1** Records demonstrate routine removal of wellheads was attempted.
EPO 3 No impact to benthic habitats greater than a consequence level of E inside the Operational Area during the Petroleum Activities Program[10].	**C 3.1** An ROV inspection will be undertaken, post installation, to confirm all installation aids (as defined in Section 3.9.1) have been removed.	**PS 3.1** All installation aids (as defined in Section 3.9.1) are removed.	**MC 3.1.1** As-built report confirms wet storage of all installation aids (defined in Section 3.9.1) are removed
	C 3.2 Project-specific Basis of Well Design, which includes an assessment of seabed sensitivity.	**PS 3.2** MODU well site locations consider seabed sensitivities.	**MC 3.2.1** Records confirm Basis of Well Design includes the assessment of seabed sensitivities.
	C 3.3 Project-specific Mooring Design Analysis.	**PS 3.3** Seabed disturbance from MODU mooring limited to that required to ensure adequate MODU station holding capacity.	**MC 3.3.1** Records demonstrate Mooring Design Analysis completed and implemented during anchor deployment.
	C 3.4 Positioning technology used to place seabed infrastructure within the planned footprint.	**PS 3.4** Infrastructure will be positioned in the planned location where impacts have been assessed.	**MC 3.4.1** As-built, surveys verify installation of equipment within acceptable tolerance[11].

[10] Defined as 'Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function), physical or biological attributes' as in **Figure 2-6**/**Section 2.6.3**.

[11] Acceptable tolerance is considered to be ±150 m, given the homogenous and low sensitivity habitat.

6.6.3 Routine Acoustic Emissions: Generation of Noise from Project Vessels, MODU, Positioning Equipment, Helicopter Transfers & Flaring

Context	
Project Vessels – **Section 3.5** Other support – **Section 3.6** Project Vessel-based Activities – **Section 3.7** Drilling Activities – **Section 3.8** Subsea Installation and Pre-commissioning Activities – **Section 3.9**	Biological Environment – **Section 4.5**

Impact Evaluation Summary

Source of Impact	*Environmental Value Potentially Impacted*							*Evaluation*				
	Soil and groundwater	*Marine sediment*	*Water quality*	*Air quality (incl odour)*	*Ecosystems/habitat*	*Species*	*Socioeconomic*	*Decision type*	*Consequence*	*ALARP tools*	*Acceptability*	*Outcome*
Generation of acoustic signals from MODU, drilling and project vessels during normal operations						X		A	F	GP PJ	Broadly acceptable	N/A
Generation of acoustic signals from dynamic positioning systems on project vessels						X		A	F			
Generation of airborne noise from helicopter transfers						X		A	F			
Generation of noise from flaring						X		A	F			EPO 6

Description of Source of Impact

The MODU, project vessels, helicopters and positioning transponders generate noise both in the air and underwater, due to the operation of thrusters, engines, propeller movement, drilling operations, etc. These noises contribute to and can exceed ambient noise levels which range from around 90 dB re 1 µPa (rms) under very calm, low wind conditions, to 120 dB re 1 µPa (rms) under windy conditions (McCauley, 2005).

MODU Noise

Noise associated with a moored MODU is restricted to drilling activities, such as drill pipe operations and onboard machinery. A range of broadband values (59 to 185 dB re 1 µPa at 1 m (rms)) have been quoted for various MODUs (Simmonds et al., 2004); with noise likely to be between 100 to 190 dB re 1 µPa at 1 m SPL (rms) during drilling and between 85 to 135 dB re 1 µPa at 1 m SPL (rms) when not actively drilling. McCauley (1998) recorded received noise levels of about 117 dB re 1 µPa at 1 m SPL (rms) at 125 m from a moored MODU while actively drilling (with support vessel on anchor). The MODU will be moored and therefore there will be no additional noise from using DP equipment.

The MODU is expected to be on location for about 70 days per well.

Project Vessel Noise

The main source of noise from a DP vessel (such as primary installation vessels) relates to using DP thrusters. There is no applicable sound data available for a typical DP primary installation vessel; however, frequencies and sound levels are expected to be similar to those from a DP drill ship (e.g. MODU). A noise assessment for the Deepwater Millennium (McPherson et al., 2013) estimated the broadband source level for drilling operations at 196 dB re 1 µPa at

1 m, with all six thrusters working at 100%. 196 dB re 1 µPa at 1 m is expected to be the worst case as a primary installation vessel is not expected to operate on 100% DP capacity on a continual basis.

Support vessels and primary installation vessels use DP while the vessel is maintaining position. McCauley (1998) measured underwater broadband noise equivalent to about 182 dB re 1 µPa at 1 m (RMS SPL) from a support vessel holding station in the Timor Sea. Similar noise levels are expected to be generated by support vessels used for this Petroleum Activities Program.

Note that all project vessels are required to comply with EPBC Regulations 2000 – Part 8 Interacting with Cetaceans to reduce the likelihood of collisions with cetaceans (refer to **Section 6.7.8**). Implementing this control may incidentally reduce the noise generated by vessels in proximity to cetaceans as vessels will be travelling slower; slower vessel speeds may reduce underwater noise from machinery noise (main engines) and propeller cavitation.

Generation of Noise from Helicopter Transfers

Helicopter engines and rotor blades are recognised as a source of noise emissions, that may constitute a source of environmental risk resulting in behavioural disturbance to marine fauna. Activities relevant to the Operational Area relate to the landing and take-off of helicopters on the subsea activity vessels. During these critical stages of helicopter operations, safety takes precedence. Helicopter flights are at their lowest (i.e. closest point to the sea surface) during these periods of take-off and landing from Heli-decks, that constitutes a short phase of routine flight operations.

Noise levels for typical helicopters used in offshore operations (AW139, AW189 and S92) at 150 m separation distance have been measured at up to a maximum of 99.1 EPNdB. Unconstrained point source noise in the atmosphere (such as helicopter noise) spreads spherically (Truax, 1978), with noise received at the sea surface decreasing with increasing distance from the aircraft (Nowacek et al., 2007). Based on spherical geometric spreading (and not considering transmission loss from atmospheric absorption), the sound level is expected to decrease by 6 dB for every doubling of the distance from the source (Truax, 1978). Using this model, a maximum sound level of about 90 dB at 150 m would be reduced to about 76 dB directly below a helicopter travelling at an altitude of 500 m.

Generation of Underwater Noise from Positioning Equipment

An array of LBL and/or USBL transponders may be installed on the seabed for metrology and positioning. Transponders typically emit pulses of medium frequency sound, generally within the range 21 to 31 kHz. The estimated SPL would be 180 to 206 dB re 1 µPa at 1 m (Jiménez-Arranz et al., 2017).

Transmissions are not continuous but consist of short ‘chirps’ with a duration that ranges from 3 to 40 milliseconds. Transponders do not emit any sound when on standby. When required for general positioning they emit one chirp every five seconds (estimated to be required for four hours at a time). When required for precise positioning they emit one chirp every second (estimated to be required for two hours at a time). For development drilling transponders may be in place for a period of about three months but only active at the commencement of the drilling where positioning is required, while for subsea installation the LBL arrays may be deployed for up to a week in total.

Generation of Underwater Noise from Flaring

Received levels from airborne propagation modelling were used to ascertain the underwater received levels during flaring activities. Only a very small fraction of the acoustic energy produced from flaring is expected to transmit through the air/ water boundary due to the surface of water acting as a reflective plane and a significant component of acoustic energy reflecting back into the air. This is due to the principles of wave propagation between two mediums. When the two mediums have the same density and elasticity, then the ratio of incidental wave (noise from source) to transmitted wave (noise in the secondary medium) is 1:1. This ratio significantly reduces when the density of the initial medium (air) for the incidental wave (flare noise) is significantly less than the density of the transmitted medium (sea water). Additionally, the angle at which the sound path meets the surface (angle of incidence) influences the transmission of noise energy from the atmosphere through the sea surface; with angles ±>13° from vertical being almost entirely reflected (Richardson et al. 1995).

The transmission of sound from air to water was conservatively calculated assuming worst-case vertical incidence. Results indicate the underwater received sound pressure level during flaring is estimated to be 136 dB re 1µPa at 1 m below the sea surface.

Impact Assessment

Potential Impacts to Protected Species

The Operational Area is located in waters about 80 m – 130 m deep. The fauna associated with this area will be predominantly pelagic and demersal species of fish, with migratory species such as whale sharks and cetaceans present in the area seasonally.

Elevated underwater noise can affect marine fauna, including cetaceans, fish, turtles, sharks and rays in three main ways (Richardson et al., 1995; Simmonds et al., 2004):

- by causing direct physical effects on hearing or other organs (injury)
- by masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey)
- through disturbance leading to behavioural changes or displacement from important areas.

The thresholds that could result in behavioural response for cetaceans is expected to be 120 dB re 1 µPa SPL (rms) for continuous noise sources, and 160 dB re 1 µPa SPL (rms) for impulsive noise sources (NMFS, 2014). These thresholds are adopted by the United States National Oceanic and Atmospheric Administration (NOAA). Potential for injury to hearing (Permanent Threshold Shift – PTS) from continuous noise on low frequency cetaceans (i.e. humpback and pygmy blue whales) would be expected to occur at received levels above 199 dB re 1 $\mu Pa^2.s$) (weighted SEL_{24h})(NMFS, 2018). Typical noise levels generated by a DP primary installation vessel or support vessel likely to be used for this Petroleum Activities Program does not exceed that level; therefore, injury to Listed Threatened and Migratory species is not anticipated.

The Operational Area overlaps with the whale shark foraging BIA (presence during northward migration mainly occurring between July and November) and an internesting BIA for flatback turtles nesting at the Montebello Islands (with peak nesting in December and January). However, scientific evidence supports that flatback turtle internesting movements do not extend into offshore waters (refer to **Section 4.5.2.7**) and furthermore, turtle presence within the Operational Area is most likely isolated records of transient individuals.

MODU and Project Vessels

There may be increased numbers of whale sharks during migratory periods, considering the overlap with the BIA. In addition, cetaceans may be seasonally present, though limited to individuals infrequently transiting through. The potential impacts to these environmental receptors are not considered to be significant, given the noise levels associated with routine operations of vessels and the MODU. Consideration of the acoustic emissions from the MODU (up to 158 dB re 1 µPa at 1 m) and support vessels (up to 182 dB re 1 µPa at 1 m), the potential for received levels to exceed weighted thresholds defined for PTS or TTS for marine mammals is not credible. Behavioural response thresholds for marine mammals are estimated to be exceeded out to approximately 50 m from the MODU during drilling and up to 7500 m from the support vessel on DP. It is reasonable to expect that fauna may demonstrate avoidance or attraction behaviour to the noise generated by the Petroleum Activities Program. For example, when transiting through the area fauna, may deviate slightly from their route. Note that the Operational Area is surrounded by open water, with no restrictions (e.g. shallow waters, embayments) to an animal's ability to avoid the activities. Potential impacts from predicted noise levels from the MODU and project vessels are not considered to be ecologically significant at a population level.

In summary, potential impacts from vessel noise are likely to be restricted to temporary avoidance behaviour to individuals transiting through the Operational Area and are, therefore, considered localised with no lasting effect. As the wells will not be drilled concurrently, there is no potential for cumulative impacts from drilling concurrent wells.

Helicopter Noise

Water has a very high acoustic impedance contrast compared to air, and the sea surface is a strong reflector of noise energy (i.e. very little noise energy generated above the sea surface crosses into and propagates below the sea surface (and vice versa) – the majority of the noise energy is reflected). The angle at which the sound path meets the surface influences the transmission of noise energy from the atmosphere through the sea surface; angles ±>13° from vertical being almost entirely reflected (Richardson et al., 1995). Given this, and the typical characteristics of helicopter flights within the Operational Area (duration, frequency, altitude and air speed), the opportunity for underwater noise levels that may result in behavioural disturbance are not considered to be credible. Note that helicopter noise during approach, landing and take-off is more likely to propagate through the sea surface due to the reduced air speed and lower altitude. However, helicopter noise during approach, landing and take-off mingles with underwater noise generated by the facility hosting the helipad (e.g. thruster noise from vessels, machinery noise from MODU, etc.). Additionally, approach, landing and take-off are relatively short phases of the flight, resulting in little opportunity for underwater noise to be generated.

Given the standard flight profile of a helicopter transfer, maintenance of a >500 m horizontal separation from cetaceans (as per the EPBC Regulations), and the predominantly seasonal presence of whales within the Operational Area, interactions between helicopters and cetaceans resulting in behavioural impacts are considered to be highly unlikely. In the highly unlikely event that cetaceans are disturbed by helicopters, responses are expected to consist of short-term behavioural responses, such as increased swimming speed; the consequence of such disturbance is considered to have no lasting effect and be of no significance.

Impact Assessment
Potential Impacts to Protected Species
Marine turtle presence within the Operational Area is likely to be isolated to records of transient individuals. The potential impact pathway identified is from exposure to helicopter noise when on the sea surface (e.g. when basking/resting at the surface or breathing). Typical startle responses occur at relatively short ranges (tens of metres) (Hazel et al., 2007) and as such, startle responses during typical helicopter flight profiles are considered to be remote. In the event of a behavioural response to the presence of a helicopter, marine turtles are expected to exhibit diving behaviour, which has no lasting effect/impact. Seabirds and migratory shorebirds within the Operational Area may avoid helicopters. Given the expected low density of seabirds and migratory shorebirds within the Operational Area, the relative infrequency of helicopter flights, and lack of lasting effect of potential behavioural responses to helicopter noise, the likelihood and consequence of subsequent impacts are considered to be very low and result in no lasting effect, respectively. ***Positioning Equipment Noise*** Transponders used for positioning have the potential to cause some temporary behavioural disturbance to marine fauna, however noise levels are well below injury thresholds. Due to the short duration chirps, the temporary and intermittent use and the mid-frequencies used by positioning equipment, the acoustic noise from the transponders is unlikely to have a substantive effect on the behavioural patterns of marine fauna. The Operational Area overlaps with the seasonal BIA for whale sharks (as described above). Should the short period during which transponders are in use (intermittent over a period of about 12 months) overlap with the seasonal timing of the BIA, individual animals at most may deviate slightly from their migration route but continue on their migration pathway. Notably, the Operational Area is surrounded by open water, with no restrictions (e.g. shallow waters, embayments) to an animal’s ability to avoid these activities. ***Underwater Noise from Flaring*** Underwater received sound pressure level during flaring is estimated to be 136 dB re 1µPa at 1 m below the sea surface and is estimated to attenuate below the marine mammal behavioural response threshold of 120 dB re 1µPa (SPL) within only 7 m from the sea surface. Accordingly, the potential impacts associated with noise produced during flaring is considered highly localised and with no lasting effects to marine fauna.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[12]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No controls identified.				
Good Practice				
The use of dedicated marine fauna observers (MFOs) on support vessels for the duration of the Petroleum Activities Program to watch for cetaceans and provide direction on and monitor compliance with Part 8 of the EPBC Regulations.	F: Yes. However, support vessel bridge crews already maintain a constant watch during operations. CS: Additional cost of MFOs	Given that support vessel bridge crews already maintain a constant watch during operations, additional MFOs would not further reduce the likelihood or consequence of impact.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
The well unload acceptance criteria that define the well objectives will be established.	F: Yes. CS: Standard practice	Eliminates unnecessary flared volumes and corresponding emissions.	Benefits outweigh the cost/sacrifice.	Yes **C 4.1**

12 Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[12]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Eliminate				
Removal of support vessel on standby at the Petroleum Activities Program location.	F: No. Activity support vessel required for safety reasons, particularly for maintaining the 500 m petroleum safety zone around the MODU/ primary installation vessels. CS: Introduces unacceptable safety risk.	Not considered – control not feasible.	Not considered – control not feasible.	No
Elimination of noise from the MODU, primary installation vessels, support vessels or survey positioning equipment.	F: No. The generation of noise from these sources cannot be eliminated due to operating requirements. Note that vessels operating on DP may be a safety critical requirement. CS: Inability to conduct the Petroleum Activities Program. Loss of project.	Not considered – control not feasible.	Not considered – control not feasible.	No
Do not flare.	F: No. Flaring is the only feasible way to manage the reservoir fluids and achieve the well objectives. CS: Not considered – Control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Substitute				
Management of vessel noise by varying the timing of the Petroleum Activities Program to avoid migration periods.	F: Not feasible. Variation of timing of specific activities is not feasible as activity is subject to schedule constraints and vessel availability. CS: Significant cost and schedule impacts if activities avoid specific timeframes.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Engineered Solution				
No additional controls identified.				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[12]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***

ALARP Statement

On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the potential impacts of underwater noise emissions from MODU drilling activities, project vessels, helicopters and positioning transponders to be ALARP. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that MODU, drilling activities, project vessels, helicopters and positioning transponder underwater noise emissions are unlikely to result in a potential impact greater than localised impacts; will not result in significant impacts to marine fauna; and will have no lasting effect. Relevant recovery plans and conservation advice have been considered during the impact assessment, and the Petroleum Activities Program is not considered to be inconsistent with the overall recovery objectives and actions of these recovery plans and conservation advice. Further opportunities to reduce the impacts and risks have been investigated above.

The adopted controls are considered good oil and gas industry practice. Therefore, Woodside considers standard operations appropriate to manage the impact of MODU, drilling activities, project vessels, helicopters and positioning transponder noise emissions to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 4 Flaring emissions during the Petroleum Activities Program are restricted to those necessary to perform the activity to limit impacts to the environment from noise.	**C 4.1** The well unload acceptance criteria that define the well objectives will be established.	**PS 4.1** Flaring limited to a duration necessary to achieve the well objectives.	**MC 4.1.1** Records demonstrate that flaring was restricted to a duration necessary to achieve the well objectives.

6.6.4 Routine and Non-routine Discharges to the Marine Environment: MODU and Project Vessels

Context

Project Vessels – **Section 3.5**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**

Impact Evaluation Summary

<table>
<tr><th rowspan="2">Source of Impact</th><th colspan="7">Environmental Value Potentially Impacted</th><th colspan="5">Evaluation</th></tr>
<tr><th>Soil and groundwater</th><th>Marine sediment</th><th>Water quality</th><th>Air quality (incl odour)</th><th>Ecosystems/habitat</th><th>Species</th><th>Socioeconomic</th><th>Decision type</th><th>Consequence/impact</th><th>ALARP tools</th><th>Acceptability</th><th>Outcome</th></tr>
<tr><td>Routine discharge of sewage, grey water and putrescible wastes to marine environment from MODU and project vessels</td><td></td><td></td><td>X</td><td></td><td></td><td>X</td><td></td><td>A</td><td>F</td><td rowspan="3">LCS
PJ</td><td rowspan="3">Broadly acceptable</td><td rowspan="3">EPO 5</td></tr>
<tr><td>Routine discharge of deck and bilge water to marine environment from MODU and project vessels</td><td></td><td></td><td>X</td><td></td><td></td><td>X</td><td></td><td>A</td><td>F</td></tr>
<tr><td>Routine discharge of cooling water or brine to the marine environment from MODU and project vessels</td><td></td><td></td><td>X</td><td></td><td></td><td>X</td><td></td><td>A</td><td>F</td></tr>
</table>

Description of Source of Impact

The MODU and project vessels routinely generate/discharge:

- Small volumes of treated sewage, putrescible wastes and grey water to the marine environment (impact assessment based on approximate discharge of 15 m³ per vessel/MODU per day), using an average volume of 75 L/person/day and a maximum of 200 persons on board. However, it is noted that vessels such as support vessels have considerably fewer persons on board.
- Routine/periodic discharge of relatively small volumes of bilge water. Bilge tanks receive fluids from many parts of the support vessels, installation vessel or MODU. Bilge water can contain water, oil, detergents, solvents, chemicals, particles and other liquids, solids or chemicals.
- Variable water discharge from MODU/vessel decks, directly overboard or via deck drainage systems. Sources could include rainfall events and/or deck activities such as cleaning/wash-down of equipment/decks.
- Cooling water from machinery engines or mud cooling units and brine water produced during the desalination process of reverse osmosis to produce potable water on board the support vessels, installation vessel and MODU.

Environmental risks relating to the unplanned disposal/discharges are addressed in **Section 6.7.7**.

Impact Assessment

Potential Impacts to Water Quality and Marine Fauna

The main environmental impact associated with ocean disposal of sewage and other organic wastes (i.e. putrescible waste) is eutrophication. Eutrophication occurs when the addition of nutrients, such as nitrates and phosphates, causes adverse changes to the ecosystem, such as oxygen depletion and phytoplankton blooms. Other contaminants of concern occurring in these discharges may include ammonia, E. coli, faecal coliform, volatile and semi-volatile organic compounds, phenol, hydrogen sulphide, metals, surfactants and phthalates.

Woodside monitored sewage discharges at its Torosa-4 Appraisal Drilling campaign which demonstrated that a 10 m³ sewage discharge reduced to about 1% of its original concentration within 50 m of the discharge location. In addition to this, monitoring at distances of 50, 100 and 200 m downstream of the platform and at five different water depths

confirmed that discharges were rapidly diluted and no elevations in water quality monitoring parameters (e.g. total nitrogen, total phosphorous and selected metals) were recorded above background levels at any station (Woodside Energy Limited, 2011). Mixing and dispersion would be further facilitated in deep offshore waters, consistent with the location of the Operational Area, through regional wind and large-scale current patterns resulting in the rapid mixing of surface and near-surface waters where sewage discharges may occur. Studies investigating the effects of nutrient enrichment from offshore sewage discharges indicate that the influence of nutrients in open marine areas is much less significant than that experienced in enclosed areas (McIntyre and Johnston, 1975). Furthermore, open marine waters do not typically support areas of increased ecological sensitivity, due to the lack of nutrients in the upper water column and lack of light penetration at depth. Therefore, presence of other receptors such as fish, reptiles, birds and cetaceans in significant numbers, and in close proximity to the Operational Area, is unlikely. Research also suggests that zooplankton composition and distribution are not affected in areas associated with sewage dumping grounds (McIntyre and Johnston, 1975). Plankton communities are expected to rapidly recover from any such short-term, localised impact, as they are known to have naturally high levels of mortality and a rapid replacement rate. Additional discharges outlined, which may include other non-organic contaminants (e.g. bilge water), will rapidly dilute through the same mechanisms as above and are expected to be in very small quantities and concentrations as to not pose any significant risk to any relevant receptors. As such, no significant impacts from the planned (routine and non-routine) discharges that are listed above are anticipated because of the minor quantities involved, the expected localised mixing zone and high level of dilution into the open water marine environment of the Operational Area. The Operational Area is located more than 12 NM from land, which exceeds the exclusion zones required by Marine Order 96 (Marine pollution prevention – sewage) 2013 and Marine Order 95 (Marine pollution prevention – garbage) 2013. While the Petroleum Activities Program may extend for a total of about one to two years activities are conducted intermittently and vessels will not be in the Operational Area continuously for that period. Vessels are continuously moving (i.e. not in a single location for an extended period of time), with the exception of the MODU which will maintain drilling location for up to about 70 days. As a result, these routine and non-routine discharges are expected to be intermittent in nature for the duration of the Petroleum Activities Program. Therefore, cumulative impacts to water quality within the Operational Area are expected to be localised and short-term with no lasting effect. It is possible that protected marine fauna transiting the localised area may come into contact with these discharges (e.g. whale sharks and marine turtles) as they traverse the Operational Area during their seasonal migrations (**Section 4.5.2**). However, given the localised extent of cumulative impacts from multiple vessel discharges within the Operational Area, significant impacts to marine fauna are not expected.
Summary of Potential Impacts to Environmental Values
Given the adopted controls, it is considered that routine or non-routine discharges described will not result in a potential impact greater than localised contamination not significant to environmental receptors, with no lasting effect (i.e. Environment Impact – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[13]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 95 – pollution prevention – garbage (as appropriate to vessel class) which requires putrescible waste and food scraps to pass through a macerator so it is capable of passing through a screen with no opening wider than 25 mm.	F: Yes. CS: Minimal cost. Standard practice.	No reduction in likelihood or consequence would result.	Controls based on legislative requirements – must be adopted.	Yes **C 5.1**
Marine Order 96 – pollution prevention – sewage (as appropriate to vessel class) which includes the following requirements: • a valid International Sewage Pollution	F: Yes. CS: Minimal cost. Standard practice.	No reduction in likelihood or consequence would result.	Controls based on legislative requirements – must be adopted.	Yes **C 5.2**

[13] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[13]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Prevention Certificate, as required by vessel class • an AMSA-approved sewage treatment plant • a sewage comminuting and disinfecting system • a sewage holding tank sized appropriately to contain all generated waste (black and grey water) • discharge of sewage which is not comminuted or disinfected will only occur at a distance of more than 12 NM from the nearest land • discharge of sewage which is comminuted or disinfected using a certified approved sewage treatment plant will only occur at a distance of more than 3 NM from the nearest land • discharge of sewage will occur at a moderate rate while support vessel is proceeding (> 4 knots), to avoid discharges in environmentally sensitive areas.				
Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage must be collected via a closed drainage system. E.g. drill floor.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of contaminated deck drainage water being discharged to the marine environment. No change in consequence would occur.	Benefits outweigh cost/sacrifice.	Yes **C 5.3**
Marine Order 91 – oil (as relevant to vessel class) requirements, which includes mandatory measures for processing oily water prior to discharge: • Machinery space bilge/oily water shall have International Maritime Organization (IMO) - approved oil filtering equipment (oil/water separator) with an on-line monitoring device to measure Oil in Water (OIW) content to	F: Yes. CS: Minimal cost. Standard practice.	No reduction in likelihood or consequence would result.	Controls based on legislative requirements – must be adopted.	Yes **C 5.4**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[13]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
be less than 15 ppm prior to discharge. • IMO-approved oil filtering equipment shall also have an alarm and an automatic stopping device or be capable of recirculating if OIW concentration exceeds 15 ppm. • A deck drainage system shall be capable of controlling the content of discharges for areas of high risk of fuel/oil/grease or hazardous chemical contamination. • There shall be a waste oil storage tank available, to restrict oil discharges. • If machinery space bilge discharges cannot meet the oil content standard of <15 ppm without dilution or be treated by an IMO-approved oil/water separator, they will be contained on-board and disposed of onshore. • Valid International Oil Pollution Prevention Certificate.				
Good Practice				
No additional controls identified.				
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
Storage, transport and treatment/disposal onshore of sewage, greywater, putrescible and bilge wastes.	F: Not feasible. Would present additional safety and hygiene hazards resulting from the storage, loading and transport of the waste material. Distance of activity offshore also makes implementing this control not feasible. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[13]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts of planned (routine and non-routine) discharges. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, planned discharges (routine and non-routine) are likely to result in no potential impact greater than localised impacts not significant to environmental receptors, and no lasting effect. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil and gas industry practice and meet legislative requirements under Marine Orders 91, 95 and 96. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 5 No impact to water quality greater than a consequence level of F from discharge of sewage, greywater, putrescible wastes, bilge and deck drainage to the marine environment during the Petroleum Activities Program.	**C 5.1** Marine Order 95 – Pollution prevention – garbage (as appropriate to vessel class) which requires putrescible waste and food scraps are passed through a macerator so that it is capable of passing through a screen with no opening wider than 25 mm.	**PS 5.1** MODU and project vessels compliant with Marine Order 95 – Pollution prevention – garbage.	**MC 5.1.1** Records demonstrate MODU and project vessels are compliant with Marine Order 95 – Pollution prevention (as appropriate to vessel class).
	C 5.2 Marine Order 96 – Pollution prevention – sewage (as appropriate to vessel class) which includes the following requirements: • a valid International Sewage Pollution Prevention Certificate, as required by vessel class • an AMSA approved sewage treatment plant • a sewage comminuting and disinfecting system • a sewage holding tank sized appropriately to contain all generated	**PS 5.2** MODU and project vessels compliant with Marine Order 96 – Pollution prevention – sewage (as appropriate to vessel class).	**MC 5.2.1** Records demonstrate MODU and project vessels are compliant with Marine Order 96 – Pollution prevention – sewage (as appropriate to vessel class).

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	waste (black and grey water) • discharge of sewage which is not comminuted or disinfected will only occur at a distance of more than 12 NM from the nearest land • discharge of sewage which is comminuted or disinfected using a certified approved sewage treatment plant will only occur at a distance of more than 3 NM from the nearest land • discharge of sewage will occur at a moderate rate while support vessel is proceeding (>4 knots), to avoid discharges in environmentally sensitive areas.		
	C 5.3 Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage must be collected via a closed drainage system, e.g. drill floor.	**PS 5.3** Contaminated drainage contained, treated and/or separated prior to discharge.	**MC 5.3.1** Records demonstrate MODU has a functioning bilge/oily water management system.
	C 5.4 Marine Order 91 – oil (as relevant to vessel class) requirements, which include mandatory measures for the processing of oily water prior to discharge: • Machinery space bilge/oily water shall have IMO approved oil filtering equipment (oil/water separator) with an on-line monitoring device to measure Oil in Water (OIW) content to be less than 15 ppm prior to discharge. • IMO approved oil filtering equipment shall also have an alarm and an automatic stopping device or be capable of recirculating in the event	**PS 5.4** Discharge of machinery space bilge/oily water will meet oil content standard of <15 ppm without dilution.	**MC 5.4.1** Records demonstrate discharge specification met for MODU and project vessels.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	*Controls*	*Standards*	*Measurement Criteria*
	that OIW concentration exceeds 15 ppm. • A deck drainage system shall be capable of controlling the content of discharges for areas of high risk of fuel/oil/grease or hazardous chemical contamination. • There shall be a waste oil storage tank available, to restrict oil discharges. • In the event that machinery space bilge discharges cannot meet the oil content standard of <15 ppm without dilution or be treated by an IMO approved oil/water separator, they will be contained on board and disposed of onshore. • Valid International Oil Pollution Prevention Certificate.		

6.6.5 Routine and Non-routine Discharges to the Marine Environment: Drill Cuttings and Drilling Fluids (WBM and NWBM)

Context	
Drilling Activities – **Section 3.8** Drilling Fluid System – **Section 3.8.10**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**

Impact Evaluation Summary

Source of Impact	Environmental Value Potentially Impacted: Soil and groundwater	Marine sediment	Water quality	Air quality (incl odour)	Ecosystems/habitat	Species	Socioeconomic	Evaluation: Decision type	Consequence/impact	ALARP tools	Acceptability	Outcome
Routine discharge of WBM drill cuttings to the seabed and the marine environment		X	X		X			A	D	GP PJ	Broadly acceptable	EPO 6
Routine discharge of NWBM drill cuttings to the seabed and the marine environment		X	X		X			A	D			
Routine discharge of drilling muds (WBM) to the seabed and the marine environment		X	X		X			A	E			
Non-routine discharge of wash water from mud pits and vessel tank wash fluids		X	X		X			A	E			
Routine discharge of well clean-out fluids		X	X		X			A	E			
Discharge of well annular fluids from abandoned well		X	X		X			A	F			

Description of Source of Impact

Drilling Program

The proposed Petroleum Activities Program includes the drilling of four production wells (**Table 3-2**), all within a seabed depth range of 125 – 130 m.

Drilling activities are described in **Section 3.8**. Wells will be drilled as a series of sections; the top hole sections of each well will be drilled without a riser in place (i.e. riser-less drilling). Upon drilling of the top hole sections, casings will be cemented in place, a BOP installed and a riser put in place between the BOP and the MODU. The riser remains in place during drilling of the bottom hole sections and facilitates the circulation of drilling fluids and cuttings between the well bore and the MODU.

The following describes the source of impact with respect to discharge of drill cuttings, mud and clean-up fluids only (see **Section 6.6.6** for cement, cementing fluids and subsea control fluids). The base case (e.g. typical drilling operations) for the management of cuttings is to discharge into the marine environment along with WBM drilling muds which are used to transport the cuttings out of the well.

For the purposes of this impact assessment, the indicative dimensions, discharge locations and approximate cuttings volumes provided in **Table 6-3** represent the worst case for a single section, taking into account each well to be drilled during the Petroleum Activities Program.

Table 6-3: Estimated discharges of cuttings and volumes of drilling fluids used for the Petroleum Activities Program[14]

	Well section width (inches)	Cuttings ~ volume (m^3)	Drilling fluid type	Drilling fluid ~ volume (m^3)	Hole section	Discharge point
	42	64	Seawater[1] with pre-hydrated bentonite (PHB) sweeps/XC polymer	469	Top hole	Seabed
	26	44	Seawater[1] with PHB sweeps/XC polymer	626		
	17.5	304	WBM	1908	Production hole #1	Surface
	13.5 or 12.25	163	WBM	1590	Production hole #2	
	9.875	15	WBM	954	Reservoir section	
Total Planned Activities		**591 m^3 per well**	**WBM**	**5573 m^3 per well**		
If NWBM required, these volumes will replace WBM volumes for production hole #2	13.5 or 12.25	163	NWBM	670 (retained fluid on cuttings)	Production hole #2	Surface
Indicative Contingent Activities - one top-hole respud	42" + 26" + 17.5" sections	412	Seawater[1] with PHB sweeps/ XC polymer for 42"/26" sections. WBM for 17.5" sections.	3030	Top hole + production hole #1	As above for each section
Indicative Contingent Activities - sidetrack one section (WBM or NWBM, not both)	13.5" section	163	WBM	1590	Production hole #2	Surface
	13.5" section	163	NWBM	670	Production hole #2	Surface

[1]*Seawater volume is not included in the estimated 'Drilling Fluid Volume'*

[14] Volumes provided here are approximate and may be subject to change due to well design and operational requirements.

Drill Cuttings

Indicative drill cuttings generated from each well have been estimated to comprise a total of about 591 m³ per well (Table 6-3). Typically, drilling generates drill cuttings ranging in size from clay-sized particles (~0.002 mm) to coarse gravel (>30 mm) (IOGP, 2016). Cuttings size is determined by TD, lithology, drill bit employed and Solid Control Equipment (SCE) specifications.

Cuttings resulting from drilling the top Top hole section of each well is drilled using a seawater, pre-hydrated bentonite (PHB) sweeps drilling fluid (WBM) system, resulting in discharge of the drill cuttings and drilling fluids directly to the seabed at the well site where they deposit and accumulate in a localised physical footprint near the wellhead (known as a cuttings pile). The total volume of drill cuttings and drilling fluid (WBMs) represent approximately 20% and 18%, respectively, of the total predicted discharge volumes per well (refer to (Table 6-3).

The bottom hole sections will be drilled with a marine riser that enables cuttings and drilling fluid to be circulated back to the MODU, where the cuttings are separated from the drilling fluids by the SCE. The SCE uses shale shakers to remove coarse cuttings from the drilling fluids. After processing by the shale shakers, the recovered fluids from the cuttings may be directed to centrifuges, which are used to remove fine solids (~4.5 to 6 µm). The cuttings with retained fluids are discharged below the water line and the mud is recirculated into the fluid system. Cuttings will typically drop out of suspension in the vicinity of the well site (particularly the coarser materials), and finer materials deposit in a location slightly offset from the well site based on prevailing metocean conditions, and for the a porportion form part of the cuttings pile created from the above mentioned top hole sections. Fluids, if not flocculated with the cuttings, will disperse further as they are composed of finer particle material, temporarily elevating Total Suspended Solids (TSS) in the upper surface layers of the water column in the vicinity of the MODU, and eventually settle and deposit on the seabed as a thin sediment layer extending beyond the vicinity of the well site.

Where NWBM is needed to drill a well section, the cuttings from the NWBM drilling fluid system also pass through a cuttings dryer to reduce the average residual oil on cuttings (OOC) for the well (only sections using NWBM) to ALARP, prior to discharge. In the event of SCE failures, cuttings may be discharged without having passed through the dryer; however, this only occurs for a short duration while the drill string is being moved to a safe location in the well and existing cuttings are circulated out of the hole. A decision is then made on the case for drilling ahead without the failed SCE, while still meeting residual OOC discharge limits. Drilling ahead while SCE breakdown assessment and repairs occur is a contingent activity subject to additional controls (C 6.8); however, the standard mode of operation to ensure management of cuttings to ALARP is to treat cuttings through a dryer.

An OOC discharge limit of <6.9% on wet cuttings will be averaged over the well sections drilled with NWBM. The estimated volume of cuttings discharged with residual NWBM is shown in **Table 6-3** for a hypothetical worst-case well. Typical NWBM cuttings volumes may be around 163 m³ (per well).

Completion and Well Bore Clean-Out Fluids

As required throughout activities with the riser connected, wells may be displaced from one drilling fluid system to another, or from the drilling fluid system to completion brine. A chemical clean out pill or fluids train will be circulated between the two fluids. Brine is typically filtered to reduce suspended solids. This results in a discharge of operational fluids in accordance with the Woodside internal guidelines.

Should there be clean-up fluid or completion brine contaminated with NWBM drilling fluid or base oil, it will be captured and stored on the MODU for discharge or back-loading to shore. Discharge may occur if the oil content is <1% hydrocarbon contamination by volume. For initial clean-up fluids (usually returned to the rig within the first few hours of circulation) which are predominantly drilling mud (concentration of mud compared to brine is a higher percentage of mud), fluids will be retained and returned to shore if hydrocarbon contamination is not <1% by volume and WBM will be discharged as per requirements in this EP.

Drilling Fluids

WBMs are operationally discharged to the marine environment at the location of the well being drilled during the Petroleum Activities Program under the following scenarios:

- at the seabed when drilling the top hole (riserless) sections
- below sea surface as fluid remaining on drill cuttings, after passing through the SCE (bottom hole sections, drilled with riser in place)
- from the mud pits from a pipe below the sea surface, if the WBM cannot be re-circulated/re-used through the drilling fluid system (due to deterioration/contamination), re-used on the well or on another well, or stored.

NWBM may be used to drill well sections should the offset history, geohazards assessment and borehole stability studies indicate that NWBM is required to manage well stability to safe levels.

Drilling fluids are contained within the drilling fluids circulation system. Mud pits (tanks) within this system provide capacity for storing drilling fluids. The mud pits are cleaned out when drilling operations are complete. Should NWBM be used, mud pit residue may be discharged to the sea where the residue contains <1% oil volume. Where the mud pit residue exceeds 1% by volume, the residue will be retained and disposed onshore.

Base oil and chemicals used in WBM and NWBM are assessed using a defined framework and set of tools to ensure the potential impacts of the chemicals selected are acceptable, ALARP and meet Woodside's expectation for environmental performance (**Section 3.8.11**).

Contingent Activities

Respud

The requirement to respud a well is overall a low likelihood event. If required, the most likely scenario is that the decision to respud is made when drilling the top hole section of a well. Therefore, the incremental increase in cuttings and fluid discharges are associated with the repeat drilling of the same top hole sections for the respudded well with the same associated discharges. A respud once drilling of the bottom hole sections has commenced is far less likely given the time and effort already committed to the well. However, if this was to occur the associated discharges would also be a repeat of the discharges as per **Table 6-3**, to re-drill the same sections of the respudded well.

Sidetrack

The option of a sidetrack instead of a respud may be determined, if operational issues are encountered. Sidetracks (if required) result in an increase in the volume of cuttings generated and a potential increase in the use of drilling fluids (i.e. WBM). Additional drill cuttings volumes are estimated in **Table 6-3.**

Well Annular Fluids

After drilling is complete, some wellbore fluids remain in the annular spaces between the casing. Should any well be abandoned during drilling due to the requirement for a respud, upon wellhead removal small volumes (around 1.5 m^3) of fluid exchange between the annular spaces and the ocean may occur. The exchange is not instantaneous as the annular spaces are small and the fluids are typically heavier than seawater.

Impact Assessment

Potential Impacts to Water Quality, Marine Sediment Quality and Habitats and Communities

The four production wells will be drilled in Permit Areas WA-5-L (GWF-3) and WA-16-L (LD), situated in offshore waters (around 74 km south-east from the nearest coastline at the Montebello Islands) in water depths of around 125 – 130 m. The physical habitat in the area comprises deepwater, soft, unconsolidated sediment, which is relatively flat and featureless (**Sections 4.4.4** and **4.4.3**).

A number of direct and indirect impact pathways are possible for drill cuttings and drilling fluids, as follows:

- temporary increase in TSS in the water column leading to attenuation of light penetration and change in water quality
- sediment deposition to the seabed leading to the alteration of the physico-chemical composition of seabed sediments (i.e. a change in sediment quality including particle size distribution, elevated metals concentrations and possible anoxic conditions), and burial and potential smothering effects to sessile benthic biota
- potential contamination and toxicity effects to benthic and in-water biota.

The top hole well sections drilled riser-less have drill cuttings and drilling fluids discharged at seabed at the well site and typically result in a localised area of sediment deposition (known as a cuttings pile) close to the well site. Depending on the seabed current regime, a greater spread of cuttings and WBMs may occur downstream from the well site. The deposition of cuttings and WBMs is expected to a maximum distance of about 150-200 m from the discharge location, based on a review of seven studies summarised by IOGP (2016).

Predicted impacts for bottom hole cuttings (process described above) discharged below the water line are generally confined to a maximum of 500 m distance from the discharge point (IOGP, 2016) but more typically depending on water depth of seabed and prevailing metocean conditions deposited at the seabed over an area extending several hundred metres (IOGP, 2016). Documented case studies for NWBM cuttings discharges below the water line from the MODU (process described above) at depths less than about 300 – 400 m typically deposited in sediments within about 100 – 200 m of the discharge point (IOGP, 2016). The impacts and impact pathways are discussed below. It is noted there are no associated ecosystem level effects from potential impacts.

Habitats and Communities

The Operational Area is composed primarily of soft, fine, unconsolidated sediments, which are typical of the broader NWMR. The Operational Area overlaps a section of the Ancient coastline at 125 m depth contour KEF (**Section 4.7.5**). As discussed in **Section 4.4, 4.5.2.4 and 4.7.7**, there are patchy outcroppings of hard substrate and established filter feeding biota such as sessile sponges and gorgonians (sea whips and fans associated with exposed hard substrate seabed. In general, the benthic communities within the Operational Area comprise sparse epifauna (associated with exposed hard substrate and infauna associated with the soft sediment physical habitat that are of low diversity and are typical and representative of the wider region. Pelagic and demersal fish species may transit the area, as they have been recorded from surveys of existing petroleum infrastructure nearby to the Operational Area. These habitats and communities are regionally considered of low sensitivity and are widely represented throughout the NWMR.

Physical Impacts

Burial

Cuttings discharged at the seabed while drilling wells will result in localised cuttings piles on the seabed surrounding the wellhead (Balcom et al. 2012; as detailed above) with a greater spread of cuttings expected to occur downstream from the well site due to the action of prevailing seabed currents. Benthic organisms (including benthic infauna and epifauna) below each cuttings pile may be smothered; however, the cuttings piles are expected to be recolonised over time. Ecological impacts to benthic biota as a result of smothering are predicted to occur when sediment deposition is equal to or greater than 6.5 mm in thickness (IOGP, 2016). This thickness of sediment deposition is a result of top hole direct discharge at the seabed and bottom hole cuttings (discharged below surface from the MODU). The larger cuttings particles will drop out of suspension and deposit in proximity to the well site (tens of metres distance). The primary deposition of top-hole and bottom-hole well section cuttings is expected to be confined to an area within a few hundred metres of each well location, with the heaviest deposition occurring within tens of metres of the well site. Low levels of sediment deposition outside of this immediate area may occur due to the fines from the drilling fluids remaining in suspension in the water column, rapidly dispersing and eventually depositing over a larger area (hundreds of metres) downstream of the well site. Such deposition outside the ecological zone of potential impact would represent a thin layer of drilling fluids (known as an area of influence). Within the area of influence, drilling discharges are likely to be naturally reworked into surface sediment layers through bioturbation (US Environmental Protection Agency, 2000). Ecological impacts associated with the burial and smothering of benthic fauna is, therefore, be restricted to within a few hundred metres of each well location and may include areas of sparse filter feeding.

Organic Enrichment

Organic enrichment may also occur due to the accumulation of retained NWBM on drill cuttings deposited on the seabed and the subsequent degradation of the base fluid adhering to these drill cuttings, which increases the availability of organic compounds to the benthic environment. NWBMs will only be used if technical specifications of the drilling activity require this fluid type. This may subsequently lead to anoxic conditions in the surface sediments and a loss of infauna species that have a low tolerance to low oxygen concentrations (Jorrisen et al. 2009; Balcom et al. 2012). These impacts may include changes in community composition, such as the replacement of low tolerance infauna species with those that are hypoxia tolerant and/or with more opportunistic species (Jorissen et al. 2009; Balcom et al. 2012).

Chemical Impacts

Metals

Metals such as barium act as tracers for the weighting agents such as barite (insoluble barium sulphate) used in WBM and WBM retained on drill cuttings, primarily as insoluble mineralised salts. Barium is considered inert in the marine environment (Jorrisen et al. 2009) and has low bioavailability to those benthic fauna which may come into contact with it (Crecelius et al., 2007; Neff, 2008; IOGP 2016). Ecological impacts to benthic fauna and communities are, therefore, not expected. The WBMs comprise fines and are therefore, expected to disperse over a wider area beyond the ecological impact area and detectable levels of Ba may be expected over several kilometres distance (downstream) of the well site.

Toxicity

Tracer components of the WBM system have a low toxicity. Bentonite and chemicals from the family of XC polymers (Xanthan Gum or similar) are listed as ‘E’ category fluids under the OCNS (**Figure 3-6**) and are considered to ‘pose little or no risk to the environment’. The XC polymer and bentonite sweeps are also considered by OSPAR to pose little or no risk to the environment. They may, however, cause physical damage to benthic organisms by abrasion or clogging, or through changes in sediment texture that can inhibit the settlement of planktonic polychaete and mollusc larvae (Swan et al., 1994). However, these impacts are not expected to be significant due to the rapid biodegradation and dispersion of WBM drilling fluids (Terrens et al., 1998) and the dilution of solid elements of the WBM into the near seabed environment. The rate of this process depends largely on the energy level of the local environment and the ‘mixing’ that takes place, but is expected to occur rapidly following release (especially with WBM).

NWBMs are also designed to be low in toxicity and are not readily bioavailable to benthic fauna due to their physical/chemical properties. Furthermore, the combination of low toxicity and rapid dilution of unrecoverable NWBMs discharged in association with drill cuttings poses little risk of causing direct toxicity to water-column biota or benthic biota (Neff et al., 2000).

Base fluids for NWBM are assessed in accordance with Woodside’s Chemical Selection and Assessment Environment Guideline. They are designed to be biodegradable in offshore marine sediments. As mentioned above, biodegradation can result in anoxic conditions resulting in temporary modification of the surface sediment layer environment and changes in infauna community composition.

Should there be clean-up fluid or completion brine contaminated with NWBM drilling fluid or base oil, it will be captured and stored on the MODU for discharge or back-loading to shore. Discharge may occur if the oil content is <1% hydrocarbon contamination by volume.

A small quantity of WBM and NWBM residue may be discharged at the sea surface while cleaning the mud pit (<1%), typically at the conclusion of drilling activities or when changing between mud types. This discharge is expected to dilute rapidly, with a potential impact to the environment considered to be a local, temporary decrease in water quality.

Conclusion – Benthic Habitats and Communities

Studies indicate that a decrease in species richness, species evenness and species diversity for infauna and epifauna biota may occur within a few hundred metres but more likely tens of metres from the well site where discharge of drill cuttings and drilling fluids have occurred, due to the abovementioned possible depositional impacts (Balcom et al. 2012; IOPGP, 2016). However, these impacts are expected to be highly localised to the area of the discharge deposition and represent a very small spatial area of potential mortality of benthic biota. This area that may include sparse filter feeding sponges and gorgonians, which are widespread and of higher abundance in shallower depths than the planned well sites (see Section 4.5.2.7). The recovery of benthic communities typically occurs by recruitment of new colonizing benthic biota and the migration of such biota from nearby undisturbed sediments (IOGP, 2016). Notably, community composition may vary successively during recolonization of the localised area impacted. Recovery typically begins once drilling has finished and is expected to be well progressed within the first year for infauna benthic communities (IOGP, 2016).

In summary, due to the lack of bulk discharge of NWBM, the low toxicity and bioavailability of WBM and NWBM retained on drill cuttings, the highly localised discharge at the seabed (for top hole well sections) and deposition of cuttings from the surface (bottom hole well sections) and rapid dilution of WBMs and undetectable micron level of deposition of fines, the recovery of impacted benthic communities as described above and the absence of significant benthic habitats and communities within the Operational Area (**Section 4.5**), impacts to benthic communities are considered likely but of a minor, localised and short term environmental consequence.

In addition, ecological impacts are not expected for mobile benthic fauna, such as crabs, or for pelagic and demersal fish species, given their ability to move away from the area and the rapid dispersion of drill cuttings (IOGP, 2016). Fish may, however, be temporarily displaced from areas where drill cuttings accumulate and/or experience clogging of the gills or digestive tract if passing within the immediate area of discharge (IOGP, 2016). Plankton populations may be temporarily impacted from physical contact of fine particulate matter but the localised area and short duration of the temporary elevation of suspended sediment from drilling discharges and the high turnover rate of plankton populations would not result in an impact to oceanic plankton populations. The seabed area within the Operational area does not support suitable habitat, such as coral reef or seagrass communities, it is unlikely that there are site attached fish species within the Operational Area which would be impacted as a result of displacement from the discharge area.

Sediment Quality

Accumulation of drill cuttings on the seabed results in variable physical and chemical impacts to existing sediments, as alluded to in the discussion for benthic habitats and communities. Impacts may include (IOGP, 2016):

- changes to surface topography due to variable thickness of drill cuttings accumulation, which may in turn alter the distribution of motile megafauna (as mentioned above);
- changes in sediment grain size and minerology due to the mixing/settlement of drill cuttings with/on existing sediments;
- changes in concentrations of metals (typically barium, as discussed above, or cadmium); and
- presence of base fluids (organic content), which may lead to anoxia (as discussed above).

These impacts are expected to be minor and highly localised (within a few hundred metres of discharge) with minimal subsequent impacts to benthic fauna or water column biota (IOGP, 2016). The action of prevailing currents and bioturbation leading to sediment grain size, topography and presence of metals re-distributing/ mixing with existing sediments over time, further reducing potential for impacts.

Indirect impacts to benthic communities and habitats associated with the above listed changes to sediment quality are similarly expected to be highly localised and minimal, with no impacts at an ecosystem scale.

Water Quality

The discharge of drill cuttings and unrecoverable fluids is expected to increase turbidity and TSS levels in the water column in the immediate area of discharge with rapid dilution within tens of metres and over a very short duration. Associated with the elevated turbidity and TSS is an increased sedimentation rate above ambient levels associated with the settlement of suspended particles in close proximity to the seabed or through the water column, depending on the drilling of top hole or bottom hole well sections and the location of the discharge.

Drill cuttings discharge is, however, generally intermittent and of short duration during the drilling of a well, and TSS levels will return to normal shortly after the cessation of discharges. Cuttings with retained (unrecoverable) drilling fluids are discharged below the water line at the MODU location, resulting in drill cuttings and drilling fluids rapidly diluting, as they disperse and settle through the water column. The dispersion and fate of the cuttings is determined by particle size and density of the retained (unrecoverable) drilling fluids, therefore, the coarser and larger sediment particles are expected to primarily settle in proximity to the well locations with potential for localised spread downstream (depending on the speed of currents throughout the water column and seabed). The finer particles (associated with the drilling fluids) will remain in suspension and are transported further before settling on the seabed forming an undetectable thin veneer with negligible ecological impact to benthic biota.

Given the generally low concentration of TSS expected to occur away from the immediate discharge site (due to rapid dispersion) and the offshore oceanic location of the Operational Area and the short period of intermittent discharge, the drilling discharge plume is not expected to have more than a highly localised potential area of ecological impact and it is not predicted to impact productivity of the water column.

Indirect impacts to pelagic fauna as a result of altered water quality are not considered to be likely; while very high concentrations of suspended sediments have been shown to result in mortality of pelagic animals (>1830 mg/L), such concentrations do not occur as a result of drill cuttings discharges (IOGP, 2016). In addition, most visual orientated fish/fauna species would likely relocate to an unaffected area to avoid the plume or simply pass unaffected through turbid waters. Megafauna such as cetaceans and marine turtles are not expected to be in direct contact with the TSS plume given its proximity to the MODU. Any potential contact by these air-breathing species would be of a short duration, given the rapid dispersion of the plume and the expected transient movement of air-breathing megafauna in this offshore area. As described in **Section 4.5.1**, light-dependent benthic primary producers do not occur within the Operational Area and are, therefore, not expected to be indirectly impacted by attenuation of light penetration caused by an increase in TSS. Rankin Bank and Glomar shoal are 19 and 16 km from the operational area (drilling locations) and are therefore not expected to be impacted. ***KEFs*** Impacts to the values of the KEFs are not expected as a result of drill cuttings discharges. • The Ancient Coastline at the 125 m depth contour KEF has been mapped as overlapping the Operational Area, However (as discussed in **Sections 4.5.2.7** and **4.7.57**) the benthic biota and KEF values associated with this feature, including widespread hard substrates which provide benthic habitats and support fish communities, and increased nutrient productivity, have not been identified within the Operational Area. The spread of drill cuttings is expected to extend a few hundred metres, which represents less than 0.02% of the total KEF (about 3.14 km^2 of 16,190 km^2). • The Operational Area is about 1.1 km from the Glomar Shoal KEF at the closest point, and the nearest well is about 16 km from this KEF. Subsequently, it is not considered likely that drill cuttings and drilling fluids (WBM) will have any contact with the KEF or the potential for impacts resulting from any direct or indirect pathways affect the benthic biota or fish communities of this KEF. Given the area potentially impacted by drill cuttings discharge (up to a few hundred metres from the well site, as described above) and the distances between the well locations drilling discharges are not expected to impact the values of the Ancient coastline at the 125 m depth contour KEF or expected to affect the physical or ecological values of the Glomar Shoal KEF. ***AMPs*** The Montebello Australian Marine Park is the closest AMP to the Operational Area, at a distance of about 31 km south-west, at the nearest point. Due to the highly localised discharge and spread of drill cuttings it is not expected this Marine Park, or others within the EMBA, will be impacted directly or indirectly. ***Well Annular Fluids*** The non-instantaneous nature of the release of the well annular fluids is expected to result in rapid dilution to a no-effect concentration within metres of the release location. Ecological and physical impacts to receptors are, therefore, not expected. ***Cumulative Impacts*** Cumulative impacts from drill cuttings attributed to drilling four production wells for this Petroleum Activities Program which are at locations of kilometres to several kilometres apart, combined with the location of existing wells within the relevant Permit Areas, are not considered likely, particularly, due to the distance separating the four production wells and no concurrent drilling will occur. As described above, benthic habitats and communities are expected to be recovering within a year of cessation of discharges (and will continue to recover after one year), and any potential impacts to water quality and water column biota such as pelagic fish species are expected to cease shortly after cessation of discharges. Changes to sediment quality associated with discharges, such as Particle Size Distribution and elevated concentrations of metals/metalloids, are expected to be highly localised and, due to the distance between the proposed wells and existing wells, the drill cuttings piles are not expected to overlap.
Summary of Potential Impacts to Environmental Values
Given the adopted controls, it is considered that the drill cuttings and drilling fluids discharges described above will not result in a potential impact greater than localised burial and smothering of sparse, widely distributed benthic biota which will recover over the short term (i.e. Environment Impact – D).and slight, short term effects to water quality (e.g. turbidity and TSS increase). Regard to the Commonwealth Marine Environment (Part 3 MNES) has been made with reference to the KEFs and potential impacts identified as slight.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[15]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No controls identified.				
Good Practice				
Drilling, completions, cementing, flowline pre-commissioning and subsea control fluids and additives will have an environmental assessment completed prior to use.	F: Yes. CS: Minimal cost. Standard practice.	Environmental assessment of chemicals will reduce the consequence of impacts resulting from discharges to the marine environment by ensuring chemicals have been assessed for environmental acceptability. Planned discharges are required for safely executing activities; therefore, no reduction in likelihood can occur.	Benefits outweigh cost/sacrifice.	Yes **C 6.1**
For drilling and completions fluids, six-monthly chemical reviews are performed.	F: Yes. CS: Minimal cost. Standard practice.	Regular reviews will ensure chemicals selected for drilling and completions fluids remain ALARP.	Benefits outweigh cost/sacrifice.	Yes **C 6.2**
Written NWBM justification process followed.	F: Yes. CS: Minimal cost. Standard practice.	The written justification considers the technical need for NWBM use, receiving environment, cost and additional controls that may be required. By performing formal assessment, the potential impacts are well understood, allowing for development of control measures to reduce the consequence of NWBM use. This provides an overall environmental benefit.	Benefits outweigh cost/sacrifice.	Yes **C 6.3**
NWBM base oils selected based on expected toxicity.	F: Yes. CS: Minimal cost.	By selecting a base oil with lower toxicity, the consequence of the release on the environment is reduced.	Benefits outweigh cost/sacrifice.	Yes **C 6.4**

[15] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Backload of NWBM.	F: Yes. CS: Minimal cost. Standard practice.	By restricting the volume of NWBM for overboard discharge, the consequence of the release on the environment is reduced. Although no change in likelihood is provided, the decrease in consequence results in an environmental benefit.	Benefits outweigh cost/sacrifice.	Yes **C 6.5**
Bulk operational discharges conducted under MODU's PTW system (to operate discharge valves/pumps).	F: Yes. CS: Minimal cost. Standard practice.	The MODU's PTW may slightly reduce the likelihood of bulk discharges occurring, but it is unlikely to be significant given bulk discharges are often operationally required and cannot be eliminated.	Benefits outweigh cost/sacrifice.	Yes **C 6.6**
SCE used to treat NWBM cuttings prior to discharge.	F: Yes. CS: Minimal – more frequent cuttings sampling and testing.	Achieving average oil on cuttings (sections using NWBM only) discharge limit of 6.9% or less oil on wet cuttings will have a small reduction in consequence.	Benefits outweigh cost/sacrifice.	Yes **C 6.7**
In event of SCE failure (where no redundancy is available) while drilling with NWBM, the initial action will be to cease drilling and determine whether to repair SCE or drill ahead until next practicable opportunity to trip out of the hole. If cuttings are discharged during dryer or auger failure, measurement of OOC to occur more frequently from shakers.	F: Yes. CS: Cost and schedule implications due to cessation of drilling.	Ceasing drilling in the event of equipment failure will allow for time to assess feasibility of drilling ahead while still meeting residual OOC discharge requirements.	Benefits outweigh cost/sacrifice.	Yes **C 6.8**
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
Mud pit wash residue will be measured for oil content prior to discharge.	F: Yes. CS: Minimal cost. Standard practice.	Ensuring <1% oil content will provide a small reduction in consequence when	Benefits outweigh cost/sacrifice.	Yes **C 6.9**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[15]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
		residue is discharged to the environment.		
Drill cuttings returned to the MODU will be discharged below the water line.	F: Yes. CS: Minimal cost. Standard practice.	Discharging drill cuttings below the water line will reduce carriage and dispersion of cuttings, thereby reducing the consequence of cuttings discharges during the Petroleum Activities Program.	Benefits outweigh cost/sacrifice.	Yes **C 6.10**
Cuttings reinjection into formation. Cuttings are to be crushed, slurrified and pumped to a desired geological structure with a suitable seal, below the seabed through an annulus or tubing.	F: No. No concurrent drilling or direct sequential drilling planned which would require cuttings to be stored prior to reinjection. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
RMR system to return top hole cuttings/mud from the riserless section of the well to the MODU prior to treatment onboard and discharge from the MODU (below the water line) for <u>all wells</u>. Note: RMR may be used for technical reasons if a weighted fluid is required to successfully drill a top hole section (such as mitigating against shallow hazards or unstable formations).	F: Yes. RMR in the water depth where this Petroleum Activities Program will take place (125 – 130 m) is technically feasible with a specially designed/ engineered solution. CS: Primary cost/ sacrifice of this option is the installation of RMR equipment including the footprint of equipment onboard the rig, personnel on board (POB) for operation/ maintenance and risks associated with operational reliability of the installed system (particularly in the deeper waters of the Petroleum Activities Program).	Potential environmental benefit from disposing top hole cuttings/fluid from the MODU below the surface, instead of directly to seafloor, includes a reduction in the consequence of environmental impacts from smothering surrounding benthic fauna (due to a greater spread of cuttings on the seafloor). The magnitude of this reduction in smothering potential could depend upon metocean factors such as tide at the time of discharge (which impact dispersion efficacy and patterns). Because RMR allows for fluid recovery, mud is able to be reused down-hole, reducing the total volume of mud used for that section. The net environmental benefit for this option is reduced or neutral due to the introduction of suspended sediment impact potential for in-water fauna, which does not exist to the	Disproportionate to implement RMR for environmental reasons. Although use of the RMR system to bring mud/fluids back to the MODU (rather than discharging at seabed) includes a reduction in the likelihood of environmental impacts from smothering of proximate benthic fauna, the environmental impact potential is subsequently transferred to in-water fauna from resulting suspended sediment. The impacts are therefore not reduced by applying this control. Considering the already low level of impact from	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
		same extent for disposal of top hole cuttings/fluids at seafloor. The transfer of environmental consequence from reducing cuttings/mud discharged at each well location (i.e. less potential for smothering benthic fauna at seafloor) to reductions in water quality for in-water fauna by suspended sediment and final sedimentation levels, means the consequence of discharging cuttings to the marine environment during the Petroleum Activities Program is not reduced.	cuttings/fluid discharge predicted, the outcomes of the impact assessment described above (which determined no sensitive benthic receptors in the vicinity of the Petroleum Activities Program), and transfer of environmental impacts to another receptor should this control be applied, any minor environmental benefits gained from implementing this control are considered disproportionate to the costs and risks associated with RMR system installation and use.	
RMR system to return top hole cuttings from the riserless section of the well to the MODU prior to transport to an alternative discharge location or back to shore for disposal.	F: Yes. RMR in the water depth where this Petroleum Activities Program will take place (125 – 130 m) is technically feasible with a specially designed/engineered solution. CS: Primary cost/ sacrifice of this option is the additional handling required to transport drilling fluids and cuttings to an alternative disposal location. Particularly the health and safety risks associated with high frequency of support vessel activity alongside the rig and the amount of lifting operations required if	As described above, with additional environmental benefits of discharge at an alternative location or transported back to shore. With cuttings removed from the location, possible environment benefit comes from reduced smothering/ burial potential for local benthic habitat in the direct vicinity of the well, where cuttings would normally be discharged on the seafloor. Fluids are still discharged on location (from the MODU) in accordance with requirements in this EP. The net environmental benefit for this option is	Disproportionate. The cost/sacrifice outweighs the benefit gained over the duration of the Petroleum Activities Program. The potential environmental benefits derived from using RMR to bring cuttings/fluids back to the MODU (rather than discharging at seabed) are limited. The potential reduction in likelihood of burial/smothering due to removing cuttings for one	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	a cuttings skip/drilling waste container system were employed. The installation of RMR equipment including the footprint of equipment onboard the rig, POB for operation/ maintenance and risks associated with operational reliability of the installed system (particularly in the deeper waters of the Petroleum Activities Program) add undue cost/sacrifice. Other cost/sacrifice elements which are considered include: • further treatment of cuttings onshore is required to ensure a standard suitable for landfill: Class II disposed locally (e.g. Karratha); Class III landfill requires transport to Geraldton or Perth • increased risk of unplanned vessel collision or loss of cuttings during transfer activities • environmental impact (suspended sediment/ sedimentation) of discharging cuttings at new location and other regulatory approvals may also be required (e.g. sea dumping permit) • potential halt to drilling activity if transfer operations are delayed due to weather or operational issues • additional environmental impact incurred (air	reduced due to the introduction of suspended sediment impact potential for in-water fauna with the sub-surface discharge of fluids from the top hole, which does not exist to the same extent for disposal of top hole fluids at seafloor. Discharging at a different location reduces the consequence to environmental sensitivities in the Operational Area. However, the small risk of impact is transferred to an alternate site. Given the relatively low biological significance of sensitivities in the Operational Area, no environmental benefit is gained overall. Transportation of cuttings for onshore disposal eliminates any consequence of discharging cuttings. This only provides a small environmental benefit, given the low consequence of discharging cuttings on location.	hole section is offset by cuttings/ fluids discharged on location through drilling the rest of the well (i.e. discharges from the other well sections). There is also a transfer of risk and new risks introduced; bringing fluids back to the MODU and disposal at surface has an impact potential for in-water fauna compared to discharge at seabed. Considering the already low level of impact from cuttings/fluid discharge predicted and the outcomes of the impact assessment described above which determined no sensitive benthic receptors in the vicinity of the Petroleum Activities Program, any environmental benefits gained from implementing this control are considered disproportionate to the costs and risks introduced by onshore cuttings relocation or disposal at alternative offshore location.	

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	emissions) from vessel use and onshore trucking for transportation of cuttings.			
Return riser-in-place cuttings for disposal at another marine location or onshore for processing and land disposal (skip and ship) for whole well to reduce risk of benthic disturbance. OR Return riser-in-place cuttings for all sections drilled with NWBM for disposal onshore (to reduce potential residual OOC to environment).	F: Yes. CS: Primary cost/ sacrifice of this option is the additional handling required to transport cuttings to an alternative disposal location. Particularly the health and safety risks associated with high frequency of support vessel activity alongside the rig and the amount of crane lifting required if a cuttings skip/drilling waste container system were employed. Other cost/sacrifice elements which are considered include: • further treatment of cuttings onshore is required to ensure a standard suitable for landfill: Class II disposed locally (e.g. Karratha); Class III landfill requires transport to Geraldton or Perth • increased risk of unplanned vessel collision or loss of cuttings during transfer activities • environmental impact (suspended sediment/ sedimentation) of discharging cuttings at new location and other regulatory approvals may also be required (e.g. sea dumping permit) • potential halt to drilling activity if transfer operations	Compared to adopted control, return riser-in-place cuttings would reduce cuttings/ mud discharged (although discharge would still occur during riserless drilling on the basis that this control is not adopted) at each well location; however, given current impact assessment and controls adopted, this would not result in a significant reduction of consequence.	Disproportionate. Given the adopted controls and low current risk rating, the high cost/ sacrifice outweighs the benefit gained over the duration of the Petroleum Activities Program. Impact assessment has determined no sensitive benthic receptors in the vicinity and a low level of impact potential from overall cuttings/mud discharge; therefore, benefit to be gained from cuttings/mud recovery is disproportionate to the risks introduced by relocating cuttings (including if an alternative system which does not use transport containers was implemented).	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	are delayed due to weather or operational issues • additional environmental impact incurred (air emissions) from vessel use and onshore trucking for transporting cuttings • disposal via landfill and/or treatment does not eliminate an environmental impact. These options have their own impacts and therefore disadvantages if implemented.			
Reduce total drill cuttings by implementing slim well design	F: No. Slim well design is not considered feasible based on the following factors: • The wells to be drilled in the Petroleum Activities Program are expected to be deep. Designs have been optimised to minimise the size of hole drilled while still being able to reach the targets and meet development objectives. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Water quality and/or sediment monitoring of drilling fluids and cuttings to verify impact during activity.	F: Yes. CS: • for in-water sampling using ROV – time and logistics for tool change-out from operational tools to specialised scientific sampling tools • additional POB to operate ROV and	No environmental benefit would be gained by implementing monitoring during the activity. Monitoring could be used to inform additional control measures in future drilling activities; however, there is a considerable body of existing scientific literature on potential impacts of drill cuttings and impacts are	Disproportionate. Cost/sacrifice outweigh benefit to be gained in the context of existing environment (deep water, open ocean communities with no proximity to sensitive benthic communities or receptors).	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	coordinate sampling program • low ROV availability due to operations can limit time to monitor environment • if additional ROV is required on the MODU, deck space and resources to run/store/service ROV • resources for sample processing (space/equipment/ personnel).	generally well understood. Furthermore, it is not guaranteed that additional controls would be feasible, or if they would provide any environmental benefit.	Although adopting this control could be used to verify EPOs associated with drilling mud and cutting discharge, alternative controls identified achieve an appropriate outcome.	
Use SCE with secondary treatment for NWBM: Thermomechanical systems (to achieve <1% average oil on cuttings).	F: Yes – with associated infrastructure including vessels for offline storage and delivery to thermomechanical dryer. CS: The primary cost/sacrifice of this option is the monetary outlay for acquisition and implementation which is estimated at $800,000 to mobilise, install and demobilise, along with a running cost of around $32,000/day. Other factors considered include: • It is estimated that it would take a minimum of seven months to mobilise, install and commission the system on to the MODU. • Complex and unfamiliar system to integrate with the rig systems. • Increased health and safety exposure due to: – crew of nine engineers and technicians	The consequence would be reduced by reducing the average OOC discharged.	Disproportionate. Cost/sacrifice outweighs benefit to be gained in the context of existing environment and drilling campaign.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[15]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	required to run the plant – multiple crane lifting operations during installation, operations and demobilisation – rotating machinery – heat illness – deck congestion due to large footprint of the plant.			
WBM drill cuttings returned to the MODU will be processed using SCE equipment	F: Yes CS: Minimal cost. Standard practice.	Using the SCE equipment for WBM will allow the reuse of muds and therefore potentially reduce the volume discharged.	Benefits outweigh cost/sacrifice.	Yes **C 6.11**
Time-restricted discharge of WBM and/or cuttings to align with tide/current or other oceanographic events.	F: Yes. CS: Disruption to drilling operations in having to stop drilling at time when discharge of WBM and/or cuttings might not be permitted. Additional mud storage volume required.	Given the offshore location, oceanographic changes are unlikely to significantly affect the dispersion of cuttings; therefore, no environmental benefit would be gained.	Disproportionate. The cost/sacrifice outweighs the benefit gained – No hard coral or other photo-sensitive benthic communities in the vicinity of wells to rationalise phased/timed discharge.	No

ALARP Statement

On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision A type), Woodside considers the adopted standard 'good practice' controls appropriate to manage the impacts of discharges of drilling fluid and cuttings. A range of engineered solutions and other elimination options were considered to further reduce the impact of planned discharge of drilling fluids and cuttings to ALARP; however, technical and operational challenges, safety and environmental risk and additional financial costs resulted in these options being rejected on the basis that they were grossly disproportionate to the potential environmental benefit gained. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks, which are already low due to the low sensitivity of the environment, without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that, given the adopted controls, cuttings and fluid discharges are unlikely to result in a potential impact greater than minor, short-term impact on habitat (but not affecting ecosystem function), biological and physical attributes. Further opportunities to reduce the impacts and risks have been investigated above.

The adopted controls are considered good oil and gas industry practice to prevent the generation of significant volumes of drill cuttings. Other engineered solutions to manage drill cuttings and fluids were considered; however, these represented costly 'end of pipe' solutions rather than a preventative approach, with additional safety and environmental risks. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks (which due to the low sensitivity of the environment, are low) of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 6 No impact to water quality, sediment quality or marine biota greater than a consequence level of D[16] from discharging drilling cuttings or fluids during the Petroleum Activities Program.	**C 6.1** Drilling, completions, cementing, flowline pre-commissioning and subsea control fluids and additives will have an environmental assessment completed prior to use.	**PS 6.1** All chemicals intended or likely to be discharged into the marine environment reduced to ALARP using the chemical Assessment process.	**MC 6.1.1** Records demonstrate chemical selection, assessment and approval process for selected chemicals is followed.
	C 6.2 For Drilling and Completions fluids, six-monthly chemical reviews are performed.	**PS 6.2** Acceptability of previously approved chemicals are re-evaluated to ensure ALARP and alternatives are considered.	**MC 6.2.1** Records confirm six-monthly reviews have taken place, and any actions/changes are being tracked to closure.
	C 6.3 Written NWBM justification process followed.	**PS 6.3** The use of NWBM is consistently challenged using written justification.	**MC 6.3.1** Records demonstrate a formal justification has been completed prior to using NWBM.
	C6.4 NWBM base oils selected based on expected toxicity	**PS 6.4** Group III base oils used in NWBM	**MC 6.4.1** Records demonstrate that only Group III base oils used in NWBM
	C 6.5 Backload of NWBM	**PS 6.5** No overboard disposal of bulk NWBM	**MC 6.5.1** Incident reports of any unplanned discharges of NWBM.
	C 6.6 Bulk operational discharges conducted under MODU's PTW system (to operate discharge valves/pumps).	**PS 6.6** Increased level of assurance and verification on bulk operational discharges	**MC 6.6.1** Records demonstrate that bulk discharges are conducted under the MODU PTW system.
	C 6.7 SCE used to treat NWBM cuttings prior to discharge.	**PS 6.7** Average OOC (sections using NWBM only) discharge limit of 6.9% or less oil on wet cuttings.	**MC 6.7.1** Records confirm the average OOC for the entire well (sections using NWBM only) do not exceed limit.

[16] Defined as 'Minor, short-term impact (one to two years) on species, habitat (but not affecting ecosystem function), physical or biological attribute.' as in **Figure 2-6/Section 2.6.3**.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	C 6.8 In event of SCE failure (where no redundancy is available) while drilling with NWBM, the initial action will be to cease drilling and determine whether to repair SCE or drill ahead until the next practicable opportunity to trip out of the hole. If cuttings are discharged during dryer or auger failure, measurement of OOC to occur more frequently from shakers.	**PS 6.8** The decision whether to repair SCE or drill ahead will consider the estimated time for repairs and the amount of drilling until next planned trip out of hole, to ensure the OOC limit is not exceeded.	**MC 6.8.1** Records demonstrate that in the event of auger or cuttings dryer failure (where no redundancy is available), active drilling is initially stopped as soon as safe to do so. Evidence of the decision to drill ahead with failed SCE can be produced. Records confirm the average OOC for the entire well (sections using NWBM only) do not exceed limit.
	C 6.9 Mud pit wash residue will be measured for oil content before discharge.	**PS 6.9** Less than 1% by volume oil content before discharge.	**MC 6.9.1** Records after pit clean-out (for pits potentially contaminated with base oil) demonstrate mud pit wash residue was less than 1% by volume oil content before discharge.
	C 6.10 Drill cuttings returned to the MODU will be discharged below the water line.	**PS 6.10** Dispersion of cuttings increased by discharge below the water line.	**MC 6.10.1** Records confirm cuttings discharge chute/line is below the water line.
	C 6.11 WBM drill cuttings returned to the MODU will be processed (using SCE equipment, when functioning).	**C 6.11** WBM drill cuttings returned to the MODU processed using SCE equipment allowing reuse of mud prior to discharge.	**MC 6.11.1** Records demonstrate that operational SCE, when functional, is in use.

6.6.6 Routine and Non-routine Discharges to the Marine Environment: Cement, Cementing Fluids, Grout, Subsea Well Fluids, Produced Water and Unused Bulk Products

Context	
BOP and Marine Riser Installation – **Section 3.8.3** Well Abandonment – **Section 3.11.7** Span/Scouring Rectification and Stabilisation **– Section 3.9.6**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**

Impact Evaluation Summary

Source of Impact	Environmental Value Potentially Impacted							Evaluation				
	Soil and groundwater	Marine sediment	Water quality	Air quality (incl odour)	Ecosystems/habitat	Species	Socioeconomic	Decision type	Consequence/impact	ALARP tools	Acceptability	Outcome
Routine discharge of cement, cementing fluids, grout, subsea well fluids (BOP and well construction activity control fluids; completion fluids and well intervention/workover fluids) and other down-well products to the seabed and the marine environment		X	X		X			A	E	GP PJ	Broadly acceptable	EPO 8

Description of Source of Impact

Cementing Fluids, Cement and Grout

Cementing fluids may require discharge to the marine environment under various scenarios. When cementing the conductor and surface casings after top hole sections of the well have been drilled, cement is circulated to the seabed to ensure structural integrity of the well. Excess cement is pumped to ensure structural integrity is achieved.

If the hole is completely in-gauge and there are no downhole losses while running the cement, a maximum average volume of 55 m^3 per well is estimated to be circulated to the seafloor at the well location, which forms a thin cement film on the seabed in close proximity to the well.

After each cement job, leftover cement slurry in the cement pump unit and the surface lines is flushed and discharged to the sea to prevent clogging of the lines and equipment. This is estimated at about 5 m^3 of discharge per job.

Cement spacers can be used as part of the cementing process, within the well casing, to assist with cleaning the casing sections prior to cement flow-through. The spacers may consist of either seawater or a mixture of seawater and dye and surfactants. The dye is used to provide a pre-indicator of cement overflow to the seabed surface, to ensure adequate cement height.

Excess cement (dry bulk, after well operations are completed) may be used for subsequent wells; provided to the next operator at the end of the drilling program (as it remains on the rig); or, if these options are not practicable, discharged to the marine environment as a slurry.

Upon arrival on location at the Operational Area, the rig may be required to perform a cement unit test, or ‘dummy cement job’. Discharges from the test are either made through the usual cement unit discharge line, which may be up to 10 m above the sea level or through drill pipe below sea level, as a cement slurry. The slurry is usually a mix of cement and water, but may sometimes contain stabilisers or chemical additives.

Post-lay span rectification may also be required after flowline installation. This process typically involves placing grout bags under the span section. The empty bag is filled with grout on the seabed supplied from a mixing and pumping spread on the vessel via a downline. Typical grout volumes depend on the size of the span and may vary from about 200 kg to 2000 kg per span. If grout bags are used, the downline recovery time risks exceeding the grout curing time; if grout cures within the downline and pump, the equipment is likely to be rendered unserviceable, as well as the downline not being safely recoverable in the normal way. Therefore, after grouting activities at each span site, the downline and pump is purged using seawater. This results in an amount of grout, about equivalent to the downline volume (5 m^3), being discharged to the ocean. This flushing is required once per grout site. The actual number is not known until the line is laid and need for span rectification determined, if any.

Subsea Fluids – BOP and Well Construction Activity Control Fluids

Subsea fluids are likely to be released during drilling, completions and xmas tree installation, including release of BOP control fluids. The BOP is required to be regularly function-tested when subsea, as defined by legislative requirements. The BOP is function-tested during assembly and maintenance and during operation on the seabed. As part of this testing, small volumes of BOP control fluid (generally consisting of water mixed with a glycol-based detergent or equivalent water-based anti-corrosive additive) is released to the marine environment. The BOP will be function-tested about every seven days (when a pressure test is not occurring) and pressure-tested about every 21 days as per API 53 (an American Petroleum Institute standard for Well Control Equipment Systems for Drilling Wells). Discharges of up to about 90 L of BOP control fluids may be released per test.

Functioning and testing of the subsea xmas trees and subsea landing strings results in the discharge of small volumes of water glycol-based control fluid.

Subsea Fluids – Displacement, Completion and Well Bore Clean-Out Fluids

As required throughout activities with the riser connected, wells will be displaced from one drilling fluid system to another, or from the drilling fluid system to completion brine. A chemical clean-out pill or fluids train will be circulated between the two fluids. Cleanout fluids and completion brine will be captured and stored on the MODU and discharged if oil concentration is <1% by volume, or returned to shore if discharge requirements cannot be met.

During well unloading, it is expected that base oil will be sent to the flare. Refer to **Section 6.6.8** for an assessment of risk associated with planned flaring during well unloading.

Subsea Fluids – Well Intervention and Workover Fluids

A workover or intervention may be performed on any of the wells in the Petroleum Activities Program. If the well has been flowed previously, or if down-hole hydrocarbons remain in the well (e.g. reservoir fluid or if base oil has been left in the well), there is potential that the intervention/workover fluids will be contaminated with hydrocarbons. If hydrocarbon contamination of the intervention/workover fluids has occurred, the fluid will need to be treated on the MODU, to ensure hydrocarbon content prior to discharge is 1% by volume, or less.

During IMR or workover activities, it may be necessary to remove marine growth from subsea infrastructure using acid (typically sulphamic acid) to aid visual inspection and operation of valves and other mechanisms. It is also likely that removal of marine growth on existing infrastructure (e.g. the existing GDA manifold and Angel J-tubes) may berequired. This will be done using ROV tooling and possibly acid.

Produced Water

In the event that well unloading and completion activities are undertaken by the MODU, completion fluids and produced water will be discharged to the marine environment via the well test package. The well test water treatment package will be used to treat produced water that cannot be flared before discharge. Prior to discharge, the fluids are cycled through a water filtration system consistent with solids and polishing. About 500 bbls (80 m^3) of produced water is yielded per well, which may be discharged via the treatment package.

Other Down-Well Products

Additional products such as barite and bentonite may be discharged in bulk during or at the end of the activity if they cannot be reused or taken back to shore. Use and discharge of all chemicals will be performed in line with Woodside's internal guidelines (**Section 3.8.11**). Discharge may be in the form of dry bulk or as a slurry; however, discharges will not be contaminated with hydrocarbons.

Impact Assessment

Potential Impacts to Water Quality, Sediment Quality and Other Habitats and Communities

The benthic biota within the Operational Area are considered to be of low sensitivity and representative of the wider region. The Operational Area (and proposed well locations) overlaps with a portion of the Ancient Coastline at the 125 m Depth (**Section 4.7.5**). However, impacts to the values and sensitivities of this KEF are not expected due to the extremely localised and small physical footprint of the discharges, coupled with the low toxicity of the cementing fluids to be used for the Petroleum Activities Program. The likelihood of any significant impact to marine biota is subsequently considered to be low.

Cement and Grout

Impacts of cement on the marine environment are associated mainly with localised burial of benthic biota in the direct physical footpring of deposition. Cement is the most common material currently used in artificial reefs around the world (OSPAR, 2010) and is not expected to pose any toxicological impacts to benthic biota from leaching or direct contact. A minimum cement volume is required to be stored on the MODU for use in well control and plug and abandon activities. While cement volumes are calculated prior to use to minimise excess, the requirement for additional volumes on the MODU means some cement may require discharge if options for reuse on other wells is not possible. Discharge of excess cement may occur as dry bulk or as a slurry. Dry bulk has the potential to disperse

across a wider area of open water, eventually dropping out of suspension and settling to the seabed as neglible seabed layer. The slurry when discharged would deposit on the seabed in the vicinity of the well location. The impact of cement discharge and grout (if required) at the seabed will therefore be limited to a small localised area immediately around the well and likely within the area of drill cuttings deposition and potential impact to existing benthic biota (see **Section 6.6.5**). ***Cementing Fluids, Subsea Well Fluids (BOP and Well Construction Activity Control Fluids, Completion Fluids and Well Intervention/Workover Fluids) and Other Down-Well Products*** All chemicals that may be operationally released or discharged to the marine environment by the Petroleum Activities Program are evaluated using a defined framework and set of tools to ensure the potential impacts of the chemicals selected are acceptable, ALARP and meet Woodside's expectation for environmental performance. Therefore, any chemicals selected and potentially released are expected to be of low toxicity and biodegradable. Additionally, where cements have been mixed in excess and cannot be reused or returned to shore, these are turned into a slurry and discharged. As chemicals have initially been chosen based on the environmental performance and based on an ALARP assessment, additional dilution prior to discharge further reduces the environment impact to water quality, sediment quality and marine benthic and/or infauna communities. Given the minor quantities of routine and non-routine planned discharges, short discharge durations and the low toxicity and high dispersion in the open, offshore environment, any impacts on the marine environment are expected to be slight and localised. Given the highly localised nature of these discharges and potential impacts, cumulative impacts to marine biota, water quality and sediments are not expected.
Summary of Potential Impacts to Environmental Values
Given the adopted controls, it is considered that the routine discharge of cement, cementing fluid, subsea well fluid and other down-well products described will not result in a potential impact greater than localised, slight and short term impacts to infauna and benthic communities, water quality and marine sediment (but not affecting ecosystems function) (i.e. Environment Impact – E).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[17]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No controls identified.				
Good Practice				
Drilling, completions, cementing, flowline pre-commissioning and subsea control fluids and additives will have an environmental assessment completed prior to use.	F: Yes. CS: Minimal cost. Standard practice.	Environmental assessment of chemicals will reduce the consequence of impacts resulting from discharges to the marine environment by ensuring chemicals have been assessed for environmental acceptability. Planned discharges are required for safely executing activities.	Benefits outweigh cost/sacrifice.	Yes **C 6.1**
For drilling and completions fluids, six-monthly chemical reviews are performed.	F: Yes. CS: Minimal cost. Standard practice.	Regular reviews will ensure chemicals selected for Drilling and Completions fluids remain ALARP.	Benefits outweigh cost/sacrifice.	Yes **C 6.2**

[17] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[17]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Bulk operational discharges conducted under MODU's PTW system (to operate discharge valves/pumps).	F: Yes. CS: Minimal cost. Standard practice.	The MODU's PTW may slightly reduce the likelihood of bulk discharges occurring, but it is unlikely to be significant given bulk discharges are often operationally required and cannot be eliminated.	Benefits outweigh cost/sacrifice.	Yes **C 6.5**
Displacement, brine, workover or intervention fluids contaminated with hydrocarbons will be treated prior to discharge or contained. If discharge specification not met, the fluid will be returned to shore.	F: Yes. CS: Minimal cost. Standard practice.	Ensuring <1% oil content will provide a small reduction in consequence when fluids are discharged to the environment.	Benefits outweigh cost/sacrifice.	Yes **C 7.1**
During well unloading and completion activities, if produced water is not flared, it will be processed through the well test water treatment package prior to discharge to the environment.	F: Yes. CS: Minimal cost. Standard practice.	Reduced toxicity to the marine environment when discharged.	Benefits outweigh cost/sacrifice.	Yes **C 7.2**
Professional Judgement – Eliminate				
Do not use BOP control fluids.	F: No. BOP control fluids are critical to the operation of the BOP. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Return cement and other down-well products onshore for treatment/disposal.	F: No. It is not feasible to transport wet cement, as slurry may harden during transport, introducing difficulty in handling and transportation. It is also not feasible to transport dry bulks back to the supply vessel, or from the vessel back to shore because the equipment and processes are not in place to do so safely. CS: The cost involved in transporting cement for shore-based disposal is significant.	Not considered – control not feasible.	Not considered – control not feasible.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[17]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Options for use of excess bulk cement, bentonite and barite will be assessed prior to discharge to the marine environment.	F: Yes. However, the cement may not meet the required technical specifications and hence not be usable. A CS: Minor.	Using excess bulk cement, bentonite and barite on subsequent wells would eliminate the bulk discharge to the marine environment and would eliminate the likelihood and consequence of impacts from such activities.	Benefits outweigh cost/sacrifice	Yes **C 7.3**
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts of cement, cementing fluids, subsea well fluids and unused bulk products. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, routine cement, cementing fluids, subsea well fluids and unused bulk products are unlikely to result in a potential impact greater than localised, slight and short-term impacts to infauna and benthic communities, water quality and marine sediment (but not affecting ecosystems function). Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil and gas industry practice. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 7 No impact to water quality or marine biota greater than a consequence level of E[18] from discharge of cement, cementing fluids, subsea well fluids and unused bulk products during the Petroleum Activities Program.	**C 6.1** Drilling, completions, cementing, flowline pre-commissioning and subsea control fluids and additives will have an environmental assessment completed prior to use.	**PS 6.1** All chemicals intended or likely to be discharged into the marine environment reduced to ALARP using the chemical assessment process.	**MC 6.1.1** Records demonstrate chemical selection, assessment and approval process for selected chemicals is followed.
	C 6.2 For drilling and completion fluids, six-monthly chemical reviews are undertaken.	**PS 6.2** Acceptability of previously approved chemicals are re-evaluated to ensure ALARP and alternatives are considered.	**MC 6.2.1** Records confirm six-monthly reviews have taken place, and any actions/changes are being tracked to closure.
	C 6.6 Bulk operational discharges conducted under MODU's PTW system (to operate discharge valves/pumps).	**PS 6.6** To ensure an increased level of assurance and verification on bulk operational discharges.	**MC 6.6.1** Records demonstrate that bulk discharges are conducted under the MODU PTW system.
	C 7.1 Displacement, brine, workover or intervention fluids contaminated with hydrocarbons will be treated prior to discharge or contained. If discharge specification not met the fluid will be returned to shore.	**PS 7.1** Achieve oil concentration <1% by volume prior to discharge.	**MC 7.1.1** Records demonstrate that discharge criteria were met prior to discharge or contained.
	C 7.2 During well unloading and completion activities, if produced water is not flared, it will be processed through the well test water treatment package prior to discharge to the environment.	**PS 7.2** Produced water discharged to the marine environment achieves discharge specification of <30 ppm oil in water.	**MC 7.2.1** Records demonstrate that formation water met discharge specification.
	C 7.3 Options for use of excess bulk cement, bentonite or barite will be assessed prior to discharge to the marine environment.	**C 7.4** No bulk cement, bentonite or barite discharged without documented ALARP assessment.	**C7.4.1** Records demonstrate that prior to discharge of excess bulk cement, bentonite or barite options for use were assessed.

[18] Defined as 'Slight and short term impact on species or habitat but not affecting ecosystem function' as in **Figure 2-6/Section 2.6.3**.

6.6.7 Routine and Non-routine Discharges to the Marine Environment: Subsea Installation Discharges

Context		
Subsea Installation and Pre-commissioning Activities – **Section 3.9** Drilling Fluid System – **Section 3.8.10** and Assessment of Project Fluids **Section 3.8.11**	Biological Environment – **Section 4.5** Physical Environment – **Section 4.4**	Stakeholder Consultation – **Section 5**

Impact Evaluation Summary												
Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***				
	Soil and groundwater	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence/impact***	***ALARP tools***	***Acceptability***	***Outcome***
Discharge of flowline, subsea installation fluids and hydrocarbons to the marine environment		X	X		X	X		A	E	GP PJ	Broadly acceptable	EPO 8

Description of Source of Impact

The following activities may result in the discharges of preservation and pre-commissioning fluids and hydrocarbons:

- connection of umbilicals, flying leads, flexible flowlines and jumper to new and existing subsea infrastructure
- leak testing to check system integrity
- dewatering of LD flowline
- small leaks from subsea infrastructure during leak testing
- barrier testing and tie-in to existing GDA manifold.

Flowline Fluids

The flexible flowlines and jumper will be installed pre-filled with a mixture of MEG and treated water. The GWF-3 and LD flowlines will have a MEG/water ratio of 55%wt although this may be reduced for the LD flowlines during detailed engineering. The LD jumper will be installed with a MEG/water ratio of 62%wt. The water will be chemically treated with sufficient chemical concentration to provide a minimum protection period of two years, resulting in a concentration up to 650 ppm.

To facilitate subsea connections, fluid retaining caps are removed from the flexibles, manifolds and xmas trees by the ROV just prior to connection of flowlines. This is likely to result in the loss of a small amount of fluids each time a cap is removed, with a cumulative amount not expected to exceed 5 m^3. Fluid losses may also occur during leak testing from leaks which may occur.

After leak testing the LD flexible flowline will be dewatered with discharges to occur at the subsea manifold at 130 m water depth. The total flowline volume estimated to be discharged for dewatering is 2600 m^3, which includes a contingency of 230% in the event additional pig runs are required (**Table 6-4**).

The GWF-3 flowlines contents will be produced to the GWA platform and managed under the GWA Facility Operations EP.

All subsea chemicals have an environmental assessment completed prior to use to demonstrate that the potential impacts of the chemicals selected are acceptable and ALARP (subject to technical and economic constraints).

Table 6-4: Estimated discharges from subsea pre-commissioning activities (including contingency)

Action Description	Line Discharge %	Line Volume Discharge (m^3)	Fluorescein volume (L)	Water Treatment Chemicals (m^3)	MEG %	MEG Volume (m^3)
LD dewatering of the 14 km flowline	330	2600	200	4	55	830

Subsea Installation Fluids

Small leak tests result in discharges of MEG and leak testing fluid in very small quantities. The total leak test discharge volume for the Petroleum Activities Program is expected to be about 5 m^3, discharged at the locality of the subsea infrastructure; e.g. each of the well centres.

After the GWF-3 flowlines leak test is completed, the system pressurisation volume may be released to the environment to mitigate the risk of hydrocarbons returning to the PIV. This will result in the release of approximately 16.5 m^3 of MEG and approximately 50 L of chemicals subsea.

Subsea Control Fluids

During tie-in of EHUs and flying leads, pre-filled subsea control fluid Oceanic HW443 may be released. This volume is expected to be up to 100 L total across all tie-ins.

Hydrocarbon

Prior to flowline tie in at the GDA manifold, testing of the manifold isolation valves, over a short period of time (<1 hour), will be undertaken. Releases associated with valve testing are expected to be very small (up to approximately 50 L condensate and 150 kg gas per test). This will provide an understanding of the potential manifold isolation valve pass rates during flowline tie-in. When the flowline tie-ins take place, hydrocarbons may be released at the manifold isolation valves. A conservative estimate of hydrocarbons that may be released during each flowline tie-in at the GDA manifold is up to 0.5 m^3 condensate and 3.7 Te gas over a 24 hour period (total of 3 tie ins).

Following the GWF-3 flowline leak test, system pressurisation may also result in a small release of hydrocarbons (15 L condesate and 135 kg of gas).

Impact Assessment

Potential Impacts to Water Quality, Sediment Quality, Species and Other Habitats and Communities

The Operational Area is located in waters about 80 m – 130 m deep. The benthic biota within the Operational Area are considered to be of low sensitivity and representative of the wider region. The fauna associated with this area are predominantly pelagic and demersal species of fish, with migratory species such as turtles, whale sharks and cetaceans present in the area seasonally.

Flowline Fluids and Subsea Installation Fluids

Woodside has performed hydrotest discharge modelling (RPS, 2019b) for the LD flowline to assess the near field dispersion of a dewatering discharge of treated seawater. The modelling conservatively used a discharge volume of 3500 m^3 to be comparable with previous modelling undertaken.

The dispersion modelling, based on 3500 m^3, indicated a minimum (95% exceedance case) of 661 dilutions are achieved within 50 m of the release site. This indicates that based on an in-pipe chemical concentration of 650 ppm, the plume would dilute to below 1 ppm (based on LC_{50} over 96 hours) within 50 m of the discharge location. An average of 697, 637 and 603 dilutions are achieved within 20 m of the discharge location during summer, transitional and winter periods respectively.

MEG may be released subsea during during leak-testing, de-watering and nitrogen filling activities. MEG is listed as an 'E' category fluid under the OCNS and is considered to pose little or no risk to the environment by OSPAR (2012) for operational discharges, however very high concentrations of MEG (>50%) may cause irritation to sensitive areas of larger marine fauna (e.g. eyes, gills). MEG is biodegradable and water soluble and dilutes rapidly in the marine environment to low concentrations. Impacts may occur if marine fauna are within the mixing zone when the MEG is released. For small releases, leak testing and during system pressurisationit is unlikely there would be any measurable effects on marine species resident in the vicinity of the release, given MEG's low toxicity. These small MEG discharges are expected to mix rapidly with the local receiving environment with short-term environmental impact. As such, potential impacts (from leak testing and system pressurisation) to benthic communities, fish or pelagic invertebrates would be limited to within the low-sensitivity Operational Area around subsea installation.

Furthermore, it is expected that motile fish and other marine fauna adapt their behaviour and move away from the discharge, if exposed.

Further assessement of MEG impacts was undertaken for the larger one off during dewatering of the LD flowline (up to 830 m^3). Modelling results were reviewed to determine the potential spatial impact from this release. Direct toxicity testing of MEG (100% concentration), on eight mainly tropical species, representing seven taxonomic groups, established the lowest no observable effect concentration (NOEC) is for sea urchin fertilisation at 130 mg/L (Woodside 2019). The dispersion modelling indicated that a minimum (95% exceedance case) of 4476 dilutions are achieved within 600 m of the release site. This indicates that based on a 55%, by weight, MEG (total release of 830 m^3), the plume would dilute to below 130 mg/L within 600 m of the discharge location. An average of 4998, 8607 and >20,000 dilutions are achieved within 200 m of the discharge location during summer, transitional and winter periods respectively.

The modelling provides a good indication that potential impacts to benthic communities, fish or pelagic invertebrates would be limited to within the low-sensitivity Operational Area (600 m) around the LD subsea manifold, and on average within 200 m of the discharge location, given the discharge volumes are less than a third of the modelled volume. The worst-case discharge is expected to result in a localised plume leading to localised and temporary reduction in water quality.

The habitats in the vicinity of the proposed release locations are mostly composed of benthic communities typical of the North West Shelf and the seabed is relatively flat and featureless with limited, if any, hard substrate habitat observed in proximity to the release location in local surveys (**Section 4.4**), although the Operational Area does overlap the Ancient Coastline 125 m Depth Contour KEF (**Figure 4-18**). It is, therefore, unlikely for sensitive species to be present. Impacts on benthic communities are predicted to be negligible due to the relatively low biological abundance and wide distribution of similar community types throughout the region. In the unlikely event of lethal/sub-lethal stress to infauna, the ecological consequences may include temporary and localised impact to infauna individuals with a temporary decline in abundance in the immediate area of the leak test discharge. Based on the above assessment, and given that operational area only overlaps about 0.75 percent of the Ancient Coastline at 125 m depth contour KEF, the release of MEG is unlikely to negatively impact on the ecological value of the KEF.

Potential impacts to marine fauna such as pelagic fish or motile invertebrate species and marine mammals are expected to be limited to temporary avoidance of the plume in the localised area. Plankton populations may be affected in the immediate discharge plume; however, given the fast population turnover of open water plankton populations, the potential ecological impacts are considered very minor. Therefore, localised, short term and negligible impacts are predicted.

Subsea Control Fluids

Oceanic HW443, a water based subsea control fluid,is currently in use on GWA subsea system and has an OCNS ranking of D, with a substitution warning. The substitution warning is a result of the fluorescein dye which is approximately 150 ppm within the product. The dye is used to support leak detection. The product is non-toxic and does not have a potential to bioaccumulate. During tie-in, any release of the control fluid is expected to mix rapidly in the water column and become diluted. Based on the small release volume at each tie-in and rapid dilution, impacts are considered to be localised to the immediate vicinity of the release location with no lasting effect.

Hydrocarbons

It has been conservatively estimated that for each flowline tie-in (total of 3) up to 0.5 m^3 condensate and 3.7 Te of gas may be released over a 24 hour period. Based on modelling of a similar size/rate condensate release at a similar depth (APASA 2013), the condensate has potential to reach the surface due to low discharge velocities resulting in relatively large droplet sizes. Therefore it is expected that due to the buoyancy these droplets will rise to the surface presenting a surface slick. The worst-case impact of a condensate release is predicted to be a temporary surface slick visible only as a rainbow sheen. Based on GWF-1 condensate characteristics about 87 % of the hydrocarbons are expected to evaporate in the first 24 hours. Impacts from a surface slick are expected to be limited to individual megafauna that are within the release affected area and therefore predicted to be localised and not significant to environmental receptors. Note that a 0.5 m^3 discharge discharge over 24 hours is considered worst case, and for lower isolation valves pass rates, a surface slick is unlikely to occur.

For a similar size gas release modelled over four days, the maximum modelled gas concentrations were predicted to be 70 ppm and highly localised around the release location. The width of the resulting plume, at peak concentrations, was predicted to be 5 m or less. This was based on the assumption of no currents when in reality currents will dilute the plume through forced entrainment. These concentrations drop rapidly once discharged and are expected to be below 1 ppm within 1.25 days. Any impacts from this release will be localised and short term. This is due to the rapid dilution of the release and the low sensitivity of the receiving environment.

Potential impacts to benthic habitats and pelagic fauna are as discussed above.

Cumulative Impacts

Given that only localised, short term and negligible impacts are predicted to water quality and marine biota, cumulative impacts affecting marine biota from the discharge of subsea installation fluids including MEG and hydrocarbons are considered unlikely.

Summary of Potential Impacts to Environmental Values

Impact Assessment
Potential Impacts to Water Quality, Sediment Quality, Species and Other Habitats and Communities
Given the adopted controls, it is considered that the routine discharge of flowline fluids and subsea installation fluids described will not result in an impact greater than localised, slight and short-term impacts to infauna and benthic communities, marine sediment, water quality and pelagic marine fauna (but not affecting ecosystems function) (i.e. Environment Impact – E).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[19]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No controls identified.				
Good Practice				
Drilling, completions, cementing, flowline pre-commissioning and subsea control fluids and additives will have an environmental assessment completed prior to use.	F: Yes. CS: Minimal cost. Standard practice.	Environmental assessment of chemicals will reduce the consequence of impacts resulting from discharges to the marine environment by ensuring chemicals have been assessed for environmental acceptability. Planned discharges are required for safely executing activities; therefore, no reduction in likelihood can occur.	Benefits outweigh cost/sacrifice.	**C 6.1**
Chemical dosage volume and concentration will be monitored during flooding.	F: Yes. CS: Minimal cost. Standard practice.	Monitoring volumes of dosage chemicals during flooding will reduce the likelihood of impacts.	Benefits outweigh cost/sacrifice.	**C 8.1**
ROV inspection during leak test.	F: Yes. CS: Minimal cost. Standard practice.	A procedure for leak testing work that includes inspection (including by ROV) during testing to identify leakage and trigger activity to stop will reduce the likelihood of impacts.	Benefits outweigh cost/sacrifice.	**C 8.2**
Test GDA manifold isolation valves prior to flowline tie-in	F: Yes. CS: Minimal cost. Standard practice.	Testing of the isolation valves will provide a valve pass rate to be used to asses isolation requirements and determine the isolations required to conform to the relevant internal Woodside standards.	Benefits outweigh cost/sacrifice.	**C 8.3**

[19] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[19]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Subsea isolations conform to the relevant internal Woodside standards which include: • Using a double block isolation • If it is not practicable to establish a double block isolation, then – one effective, proven and monitored barrier (single block isolation) shall be in place, with the following conditions – It must be possible to isolate the reservoir by remote operation of tree isolation valves – The residual risks must be shown to be ALARP by a documented isolation risk assessment. – Procedures and response plans for the activity must be developed and implemented and address all applicable hazards appropriately, including provision for closing tree isolation valves.	F: Yes. CS: Minimal cost. Standard practice.	Pass rate (≤ 0.05kg/s) across valve with proven single block isolation. Conditions for single block isolation reduce the likelihood and consequence of an uncontrolled release.	If valve testing confirms proven barrier (≤ 0.05kg/s pass rate), slight environmental impact associated with hydrocarbon release is disproportionate to requirement to shut in 5 wells over 3 days to achieve double isolation. Benefit for additional conditions for single isolation outweigh cost. Benefit outweighs cost.	**C 8.4**
Professional Judgement – Eliminate				
Reduce volume or not use preservation and pre-commissioning chemicals including MEG.	F: No. Preservation and pre-commissioning fluids are required to verify the structural integrity of the subsea infrastructure and avoidance of hydrate formation. The volumes selected are required to achieve verification. CS: Potential loss of production due to loss of integrity, possibly leading to a larger environmental incident.	Not considered – control not feasible.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
Do not conduct flooding and leak testing activities.	F: No. Flooding and leak testing activities are	This would eliminate any potential impacts from the flooding and	Disproportionate The cost/sacrifice	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[19]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	required to control the potential for corrosion of the flowlines and to determine if any unacceptable restrictions and/or obstructions exist in the line. CS: Potential loss of production due to loss of integrity, possibly leading to a larger environmental incident.	leak testing activities but increases the likelihood of loss of integrity during operation and potentially greater environmental impacts.	outweighs the benefit gained.	
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts of flowline and subsea installation fluid discharges. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, flowline and subsea installation fluid discharges are unlikely to result in a potential impact greater than localised, slight and short-term impacts to infauna and benthic communities, marine sediment, water quality and pelagic marine fauna (but not affecting ecosystems function). Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil and gas industry practice. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 8 No impact to water quality or marine biota greater than a consequence level of E[20] from routine discharges of flowline and subsea installation fluids during the Petroleum Activities Program.	**C 6.1** Drilling, completions, cementing, flowline pre-commissioning and subsea control fluids and additives will have an environmental assessment completed prior to use.	**PS 6.1** All chemicals intended or likely to be discharged into the marine environment reduced to ALARP using the chemical assessment process.	**MC 6.1.1** Records demonstrate chemical selection, assessment and approval process for selected chemicals is followed.
	C 8.1 Chemical dosage volume and concentration will be monitored during flooding.	**PS 8.1** Chemical dosage concentration to not exceed 650 ppm, and	**MC 8.1.1** Records demonstrate compliance with maximum dosage concentration.

[20] Defined as 'Slight and short term impact on species or habitat but not affecting ecosystem function' as in **Figure 2-6/Section 2.6.3**.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
		where possible reduced following detailed engineering.	
	C 8.2 ROV inspection during hydrotest test.	**PS 8.2** ROV inspection during leak test to identify leakage and trigger activity to stop.	**MC 8.2.1** Records demonstrate ROV inspection during leak test and record any instances of activity required to stop due to identified leak(s).
	C 8.3 Test GDA manifold isolation valves prior to flowline tie-in.	**PS 8.3** Valve testing undertaken prior to flowline tie-in.	**MC 8.3.1** Records demonstrate testing of isolation valves is completed.
	C 8.4 Subsea isolations conform to the relevant internal Woodside standards which include: • Using a double block isolation • If it is not practicable to establish a double block isolation, then • one effective, proven and monitored barrier (single block isolation) shall be in place, with the following conditions – It must be possible to isolate the reservoir by remote operation of tree isolation valves – The residual risks must be shown to be ALARP by a documented isolation risk assessment. – Procedures and response plans for the activity must be developed and implemented and address all applicable hazards appropriately, including provision for closing tree isolation valves.	**PS 8.4** Subsea Isolations implemented conform with the relevant internal Woodside standards and any single isolation will have a proven barrier (pass rate of ≤ 0.05 kg/s).	**MC 8.4.1** Records demonstrate isolations are implemented and compliant with the relevant internal Woodside standards. **MC 8.4.2** Where a single isolation was used records demonstrate that during testing of valves the pass rate was ≤ 0.05 kg/s.

6.6.8 Routine Atmospheric Emissions: Fuel Combustion, Flaring, Incineration and Venting

Context	
Project Vessels – **Section 3.5** Well unloading – **Section 3.8.9**	Physical Environment – **Section 4.4**

Impact Evaluation Summary

Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***				
	Soil and groundwater	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence/Impact***	***ALARP tools***	***Acceptability***	***Outcome***
Internal combustion engines and incinerators on MODU and project vessels				X				A	F	LCS GP PJ	Broadly acceptable	EPO 9
Flaring during well unloading				X				A	F			EPO 10
Contingent venting of gas (i.e. in the event of well kick)				X				A	F			EPO 11

Description of Source of Impact

Atmospheric emissions are generated by project vessels from internal combustion engines (including all equipment and generators) and incineration activities (including onboard incinerators) during the Petroleum Activities Program. Emissions include SO_2, NO_x, ozone depleting substances, CO_2, particulates and volatile organic compounds (VOCs).

During well unloading and testing it is expected that gas condensate and base oil in the wellbore will be flared. The volumes of hydrocarbons flared are unknown and subject to operational requirements. To inform the impact assessment, Woodside has estimated that well unloading may require intermittent flaring for up to two days per zone, up to 75 million standard cubic feet per day of gas flared and 4000bbls of condensate/liquids flared via burner head per zone (two single zone wells and two dual zone wells are planned). Total estimated flaring volumes of 450MMScf of gas and 24,000bbls of flammable liquids.

These estimates are based on Woodside's operational experience and are considered applicable for the Petroleum Activities Program.

During drilling of the well, a 'kick' may occur. A kick is an undesirable influx of formation fluid into the wellbore. The resultant effect would be a release of a small volume of greenhouse gases via the degasser to the atmosphere during well control operations, known as 'venting'. Venting is required to ensure well integrity is maintained in the event of a kick, thereby avoiding an emergency condition.

Impact Assessment

Potential Impacts to Air Quality

Fuel combustion, flaring and incineration have the potential to result in localised, temporary reduction in air quality. Potential impacts include a localised reduction in air quality, generation of dark smoke and contribution to greenhouse gas emissions. Given the short duration and exposed location of the MODU and project vessels (which lead to the rapid dispersion of the low volumes of atmospheric emissions), the potential impacts are expected to have no lasting effect, with no cumulative impacts when considered in the context of existing or future oil and gas operations in the region.

Venting may result in localised and temporary reduction in air quality as the gas vents to the atmosphere, and localised and temporary contribution to greenhouse gas emissions. There is potential for human health effects for workers in the immediate vicinity of atmospheric emissions. The closest sensitive residential receptor is on Barrow Island, about 127 km south-south-east of the Operational Area; therefore, any risks associated with off-site human health effects are negligible beyond the immediate zone of release and dispersion. Given the short duration and isolated location of the

Petroleum Activities Program (which leads to the rapid dispersion of the low volumes of atmospheric emissions), the potential impacts are expected to be minor.
Summary of Potential Impacts to Environmental Value(s)
Given the adopted controls, it is considered that fuel combustion, flaring, incineration and venting emissions will not result in a potential impact greater than a temporary decrease in local air quality and/or water quality standards with no lasting effect and no significant impact to environmental receptors (i.e. Environment Impact – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[21]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 97 (Marine pollution prevention – air pollution) which details requirements for: • International Air Pollution Prevention Certificate, required by vessel class • use of low sulphur fuel • Ship Energy Efficiency Management Plan, where required by vessel class • onboard incinerator complies with Marine Order 97.	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed may slightly reduce the likelihood of air pollution.	Control based on legislative requirements – must be adopted.	Yes **C 9.1**
Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: Accepted Well Operations Management Plan (WOMP) and application to drill.	F: Yes. CS: Minimal cost. Standard practice.	The accepted WOMP will manage the risk of well kicks, reducing the likelihood of occurrence. No reduction in consequence will occur.	Benefits outweigh cost/sacrifice.	Yes **C 10.1**
As-built checks that shall be completed during well operations to establish a minimum acceptable standard of well integrity is achieved.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of occurrence. No reduction in consequence will occur.	Benefits outweigh cost/sacrifice.	Yes **C 10.2**
Good Practice				

[21] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[21]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Subsea BOP installed and function-tested during drilling operations. The BOP shall include as minimum: • one annular preventer • two pipe rams (excluding the test rams) • a minimum of two sets of shear rams, one of which must be capable of sealing • deadman functionality • the capability of ROV intervention • independent power systems.	F: Yes. CS: Standard practice. Required by Woodside standards.	BOP testing reduces the volume of gas vented in the event of a well kick.	Benefits outweigh cost/sacrifice.	Yes **C 10.3**
Process conducted to calculate, update and monitor kick tolerance for use in well design and while drilling, including: • Closing the BOP upon detecting a positive well influx. • The shut-in procedure shall be according to the rig contractor procedures or as the well conditions dictate. • Kick tolerance calculations will be made for drilling all hole sections based on the weakest known point in the well. Kick detection techniques will be adjusted based on the level of kick tolerance through management of change (MoC). The manual also includes requirements for kick tolerance management in the event of down-hole losses.	F: Yes. CS: Minimal cost. Standard practice for Woodside activities.	Processes will reduce the volume of gas vented in the event of a well kick.	Benefits outweigh cost/sacrifice.	Yes **C 10.4**
Well control bridging document (WCBD) for alignment of Woodside and the MODU contractor in order to manage the equipment and procedures for preventing and handling a well kick.	F: Yes. CS: Minimal cost. Standard practice for Woodside activities.	Implementing equipment and procedures in the well control bridging document will reduce the volume of gas vented in the event of a well kick.	Benefits outweigh cost/sacrifice.	Yes **C 10.5**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[21]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Burning and flaring during well unloading activities will be conducted using Woodside and Vendor TPS package.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of atmospheric emissions impacting air quality. Consequence remains unchanged.	Benefits outweigh cost/sacrifice.	Yes **C 11.1**
Oil burner will have an independent certified emissions testing certificate.	F: Yes. CS: Minimal cost. Standard practice.	This control results in a reduction on likelihood of atmospheric emissions impacting air quality, consequence remains unchanged.	Benefits outweigh cost/sacrifice.	Yes **C 11.2**
Professional Judgement – Eliminate				
Do not combust fuel.	F: No. There are no MODUs or vessels that do not use internal combustion engines. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Do not vent during well kick.	F: No. Venting is a critical safety activity required in the event of a kick to reduce pressure build up. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (Decision Type A), Woodside considers the adopted controls are good oil and gas industry practice, and appropriate to manage the impacts of fuel combustion, flaring, incineration and venting. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, fuel combustion, flaring, incineration and venting may result in a temporary decrease in local air quality standards, with no lasting effect. Further opportunities to reduce the impacts have been investigated above. The controls adopted are considered good oil and gas industry practice and meet the legislative requirements within Marine Order 97. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of the described emissions to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 9 Fuel combustion emissions during the Petroleum Activities Program are restricted to those necessary to perform the activity.	**C 9.1** Marine Order 97 (Marine pollution prevention – air pollution) which details requirements for: • International Air Pollution Prevention Certificate, required by vessel class • use of low sulphur fuel • Ship Energy Efficiency Management Plan, where required by vessel class • onboard incinerator complies with Marine Order 97.	**PS 9.1** MODU and project vessels compliant with Marine Order 97 (Marine pollution prevention – air pollution) to restrict emissions to those necessary to perform the activity. Vessel marine assurance process conducted prior to contracting vessels, to ensure suitability and compliance with vessel combustion certification/ Marine Order requirements.	**MC 9.1.1** Marine Assurance inspection records demonstrate compliance with Marine Order 97.
EPO 10 Emissions to air as a result of venting from well kick are restricted to those necessary to maintain well integrity.	**C 10.1** Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: accepted Well Operations Management Plan (WOMP), which describes the well design and barriers to be used to prevent a loss of well integrity, specifically: • all permeable zones penetrated by the well bore, containing hydrocarbons or over-pressured water, shall be isolated from the surface environment by a minimum of two barriers (primary and secondary) (a single fluid barrier may be implemented during the initial stages of well construction if appropriateness is confirmed by a shallow hazard study) • discrete hydrocarbon zones shall be isolated from each other (to prevent cross flow) by a minimum of one barrier where deemed required	**PS 10.1** Wells drilled in compliance with the accepted WOMP, including implementation of barriers to prevent a loss of well integrity.	**MC 10.1.1** Acceptance letter from NOPSEMA demonstrates the WOMP and application to drill were accepted by NOPSEMA prior to the drilling activity commencing.
			MC 10.1.2 Records demonstrate minimum of two verified barriers (a single fluid barrier may be implemented during the initial stages of well construction if appropriateness is confirmed by a shallow hazard study) were in place for all permeable zones penetrated by the wellbore.

	• all normally pressured permeable water-bearing formations shall be isolated from the surface by a minimum of one barrier. The barriers shall: • be effective over the lifetime of well construction. • Fluid barriers shall remain monitored and provide sufficient pressure to counter pore pressure during well construction. • Cementing barriers (including conductor, casing and liners) shall conform to the relevant minimum standards set out in the Woodside Engineering Standard – Well Cementation. Verification: • Effectiveness of primary and secondary barriers shall be verified (physical evidence of the correct placement and performance) during the drilling of the well.		**MC 10.1.3** Records demonstrate composition and weight of drilling fluids were applicable to down hole conditions.
	C 10.2 As-built checks that shall be completed during well operations to establish a minimum acceptable standard of well integrity is achieved.	**PS 10.2** A minimum acceptable well integrity standard is achieved and verified through as-built checks completed during well operations.	**MC 10.2.1** Records show Well Acceptance Criteria are developed for each well.
			MC 10.2.2 Records demonstrate Well Acceptance Criteria have been met.
	C 10.3 Subsea BOP installed and function-tested during drilling operations. The BOP shall include: • one annular preventer • two pipe rams (excluding the test rams) • a minimum of two sets of shear rams, one of which must be capable of sealing • deadman functionality • the capability of ROV intervention • independent power systems.	**PS 10.3** Subsea BOP specification, installation and function testing compliant with internal Woodside Standards and international requirements (API Standard 53 4th Edition) as agreed by Woodside and MODU contractor.	**MC 10.3.1** Records demonstrate that BOP and BOP control system specifications and function testing were in accordance with minimum standards for the expected drilling conditions as agreed by Woodside and MODU contractor.

	C 10.4 Process conducted to calculate, update and monitor kick tolerance for use in well design and while drilling, including: • Closing the BOP upon detecting a positive well influx. • The shut-in procedure shall be according to the rig contractor procedures or as the well conditions dictate. • Kick tolerance calculations will be made for drilling all hole sections based on the weakest known point in the well. Kick detection techniques will be adjusted based on the level of kick tolerance through management of change (MoC). • The manual also includes requirements for kick tolerance management in the event of down-hole losses.	**PS 10.4** Kick tolerance is calculated, managed, monitored and updated while drilling.	**MC 10.4.1** Records demonstrates well kick tolerance is calculated, managed, monitored and updated while drilling. **MC 10.4.2** Records demonstrate shut-in procedures followed in the event of a potential well kick.
	C 10.5 Well Control Bridging Document (WCBD) for alignment of Woodside and the MODU contractor in order to manage the equipment and procedures for preventing and handling a well kick.	**PS 10.5** Well is drilled in accordance with the contractor WCBD to ensure no unplanned emissions to air from a well kick during operations.	**MC 10.5.1** Records demonstrate well drilled in accordance with WCBD.
EPO 11 Maximise efficiency of combustion during flaring and oil-burning.	**C 11.1** Burning and flaring during well unloading activities will be conducted using Woodside and vendor approved TPS package.	**PS 11.1** Maintain gas flare and oil burner to maximise efficiency of combustion and minimise venting.	**MC 11.1.1** Records demonstrate that a Woodside approved well test package is in use during well unloading/testing.
	C 11.2 Oil burner will have an independent certified emissions testing certificate.	**PS 11.2** Maintain gas flare and oil burner to maximise efficiency of combustion and minimise venting.	**MC 11.2.1** Records demonstrate that oil burner is certified and emissions tested.

6.6.9 Routine Light Emissions: External Lighting on MODU and Project Vessels

Context	
Project Vessels – **Section 3.5**	Biological Environment – **Section 4.5**

Impact Evaluation Summary

Source of Impact	***Environmental Value Potentially Impacted***							***Evaluation***				
	Soil and groundwater	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence/Impact***	***ALARP tools***	***Acceptability***	***Outcome***
External light emissions on-board MODU, installation vessels and other project vessels						X		A	F	PJ	Broadly acceptable	EPO 12

Description of Source of Impact

The MODU and project vessels have external lighting to facilitate navigation and safe operations at night throughout the Petroleum Activities Program. External light emissions from the MODU and project vessels are typically managed to maintain good night vision for crew members.

Lighting on the MODU is used to allow safe operations during night hours, as well as to communicate the MODU's presence and activities to other marine users (i.e. navigation lights). Lighting is required for the safe operation of the MODU and cannot reasonably be eliminated.

External lighting is located over the entire MODU, with most external lighting directed towards working areas such as the main deck, pipe rack and drill floor. These areas are typically less than 20 m above sea level when the MODU is on station. The highest point on the MODU is the top of the derrick, which is typically about 50 m above sea level.

Note that flaring, which is a relatively bright light source, may occur during well unloading. The flare is an intermittent and temporary source of light on the MODU. Flaring is expected to occur intermittently over a cumulative total of about 12 days.

The approximate distances at which various MODU components (and associated light sources) are visible at sea level are:

- Main deck (~20 m above sea level): about 16 km from the MODU
- Derrick top (~50 m above sea level): about 25 km from the MODU
- Flare (~12 m above sea level): about 12 km from the MODU.

Impact Assessment

Potential Impacts to Protected Species

Light emissions can affect fauna in two main ways:

- Behaviour: Many fauna are adapted to natural levels of lighting and the natural changes associated with the day and night cycle, as well as the night time phase of the moon. Artificial lighting has the potential to create a constant level of light at night that can override these natural levels of light and cycles of lighting levels, subsequently impacting fauna behaviour.
- Orientation: Species such as marine turtles and birds may also use lighting from natural sources to orient themselves in a certain direction at night. In instances where an artificial light source is brighter than a natural source, the artificial light may act to override natural cues leading to disorientation.

The fauna within the Operational Area are predominantly pelagic fish and zooplankton, with potential for the presence of transient individuals of species such as migratory marine turtles, whale sharks, humpback whales and sea birds such as the wedge-tailed shearwater (with an overlapping BIA). There is no known habitat critical for survival for EPBC Act listed species within the Operational Area.

The National Light Pollution Guidelines for Wildlife (NPLG) (Commonwealth of Australia, 2020) have been considered with reference to potential impacts.

Marine Turtles

The National Light Pollution Guidelines for Wildlife (Commonwealth of Australia, 2020) specify a 20 km buffer around vessel activities when considering the assessment of potential impacts to turtle behaviour from both direct light and sky glow. Given the distance of the nearest turtle nesting and internesting areas (habitat critical to survival to marine turtles) is the Montebello Islands, about 74 km south-west, at the nearest point, there is no potential for lighting impacts. This is with specific reference to turtle hatchling emergence.

Although individuals undertaking migration and potential foraging at the nearest suitable habitat at Glomar Shoal (1 km distance at its closest point from the Operational Area), marine turtles do not use light cues to guide these behaviours. Further, there is no evidence, published or anecdotal, to suggest that foraging or migrating turtles are impacted by light from offshore vessels. As such, light emissions from the vessels are unlikely to result in displacement of, or behavioural changes to individuals in these life stages (PENV 2020b).

Seabirds and Migratory Birds

Artificial lighting can attract and disorient seabird species resulting in species behavioural changes (e.g. circling light sources or disrupted foraging), injury or mortality near the light source as a result of collision (Longcore and Rich, 2004; Gaston et al. 2014). The Operational Area may be occasionally visited by seabirds and migratory shorebirds but there is no emergent land that could be used for roosting or nesting habitat in the Operational Area. The nearest suitable habitat is the Montebello Islands, 74 km to the south-west. One BIA for wedge-tailed- shearwater breeding overlaps with the Operational Area, with the breeding period occurring from August to April (**Section 4.5.2.3**). Adult shearwaters are vulnerable to artificial lighting during the breeding cycle, when returning to and leaving the nesting colony to maintain nesting sites or forage. Foraging wedge-tailed shearwaters may be attracted to sources of light emissions to feed on fish drawn to the light, however, the species feeds predominantly during the day (Catry et al. 2009). Migratory shorebirds may be present in or fly through the region between July and December, and again between March and April as they complete migrations between Australia and offshore locations (Commonwealth of Australia, 2015c).

The risk associated with collision from seabirds or migratory shorebirds attracted to artificial lighting is considered to be low, impacts are expected to be limited to minor behavioural disturbance to isolated individuals, with no displacement from important habitat.

Fish (including sharks and rays)

Lighting from the presence of a vessel may result in the localised aggregation of fish below the vessel. These aggregations of fish are considered localised and temporary and any long-term changes to fish species composition or abundance is considered highly unlikely. This localised increase in fish extends to those comprising the whale shark's diet. However, given that a large proportion of the diet comprises krill and other planktonic larvae, it is unlikely that a light source will lead to a significant increase in whale shark abundance in the vicinity of the MODU and vessels. Similarly, any localised impacts to marine fish is not expected to impact on any commercial fishers in the area.

Summary of Potential Impacts to Environmental Value(s)

Light emissions from the MODU and project vessels will not result in an impact greater than localised and temporary disturbance to fauna in the vicinity of the Operational Area, with no lasting effect (i.e. Environment Impact – F).

Demonstration of ALARP

Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[22]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No controls identified.				
Good Practice				
No additional controls identified.				
Professional Judgement – Eliminate				
Substitute external lighting with 'turtle friendly' light sources (reduced emissions in turtle visible spectrum).	F: Yes. Replacement of external lighting with turtle friendly lighting is technically feasible,	Given the potential impacts to turtles during this activity is insignificant, implementation of this	Grossly disproportionate. Implementation of the control requires	No

[22] Qualitative measure

Demonstration of ALARP				
Control Considered	*Control Feasibility (F) and Cost/Sacrifice (CS)*[22]	*Benefit in Impact/Risk Reduction*	*Proportionality*	*Control Adopted*
	although is not considered to be practicable. CS: Significant cost sacrifice. The retrofitting of all external lighting on the MODU, etc., would result in considerable cost and time expenditure. Considerable logistical effort to source sufficient inventory of the range of light types onboard the MODU.	control would not result in a reduction in consequence.	considerable cost sacrifice for minimal environmental benefit. The cost/sacrifice outweighs the benefit gained.	
Do not flare.	F: No. Flaring is the only feasible way mange the reservoir fluids and achieve the well objectives. CS: Not considered – Control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
The well unload acceptance criteria that define the well objectives will be established.	F: Yes. CS: Standard practice	Eliminates unnecessary flared volumes and corresponding emissions.	Benefits outweigh the cost/sacrifice	Yes **C 4.1**
Variation of the timing of the Petroleum Activities Program to avoid peak turtle internesting periods (December to January).	F: No. The Operational Area has a minor overlap with the flatback turtle internesting BIA in an area not known to provide foraging habitat. Given the low potential for internesting turtles to be present within the Operational Area, the risk of potential impacts from vessel light emissions on adult turtles is considered to be low. CS: Significant cost and schedule impacts due to delays in securing vessels/ MODU for specific timeframes.	Not considered, control not feasible.	Not considered, control not feasible.	No
Professional Judgement – Engineered Solution				
No additional controls identified.				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[22]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
ALARP Statement On the basis of the environmental impact assessment outcomes and use of the relevant tools appropriate to the decision type (Decision Type A), Woodside considers the potential impacts from routine light emissions from the MODU and project vessels to be ALARP in its current risk state. As no reasonable additional/alternative controls were identified that would further reduce the impacts without grossly disproportionate sacrifice, the impacts are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, in its current state, routine light emissions from the MODU and project vessels may result in localised behavioural disturbance to fauna within the Operational Area, with no lasting effect. Regard has been given to relevant conservation advice and wildlife conservation plans during the assessment of potential impacts and the NLPG were taken into consideration during the impact evaluation. Further opportunities to reduce the impacts have been investigated above. The potential impacts are consistent with good oil and gas industry practice and are considered to be broadly acceptable in its current state. Therefore, Woodside considers standard operations appropriate to manage the impacts of routine light emissions to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 12 Flaring emissions during the Petroleum Activities Program are restricted to those necessary to perform the activity to reduce impacts to the environment from light.	**C 4.1** The well unload acceptance criteria that define the well objectives will be established.	**PS 4.1** Flaring restricted to a duration necessary to achieve the well objectives.	**MC 4.1.1** Records demonstrate flaring was restricted to a duration necessary to achieve the well objectives.

6.7 Unplanned Activities (Accidents, Incidents, Emergency Situations)

6.7.1 Quantitative Spill Risk Assessment Methodology

Quantitative hydrocarbon spill modelling was undertaken by RPS, on behalf of Woodside, using a three-dimensional (3D) hydrocarbon spill trajectory and weathering model, SIMAP (Spill Impact Mapping and Analysis Program), which is designed to simulate the transport, spreading and weathering of specific hydrocarbon types under the influence of changing meteorological and oceanographic forces.

A stochastic modelling scheme was followed in this study, whereby SIMAP was applied to repeatedly simulate the defined credible spill scenarios using different samples of current and wind data. These data samples were selected randomly from an historic time-series of wind and current data representative of the study area. Results of the replicate simulations were then statistically analysed and mapped to define contours of percentage probability of contact at identified thresholds around the hydrocarbon release point.

The model simulates surface releases and uses the unique physical and chemical properties of a hydrocarbon type to calculate rates of evaporation and viscosity change, including the tendency to form oil in water emulsions. Moreover, the unique transport and dispersion of surface slicks and in-water components (entrained and dissolved) are modelled separately. Thus, the model can be used to understand the wider potential consequences of a spill, including direct contact of hydrocarbons due to surface slicks (floating hydrocarbon) and exposure of organisms to entrained and dissolved aromatic hydrocarbons in the water column.

During each simulation, the SIMAP model records the location (by latitude, longitude and depth) of each of the particles (representing a given mass of hydrocarbons) on or in the water column, at regular time steps. For any particles that contact a shoreline, the model records the accumulation of hydrocarbon mass that arrives on each section of shoreline over time, less any mass that is lost to evaporation and/or subsequent removal by current and wind forces.

The collective records from all simulations are then analysed by dividing the study region into a 3D grid. For surface hydrocarbons (floating oil), the sum of the mass in all hydrocarbon particles located within a grid cell, divided by the area of the cell, provides hydrocarbon concentration estimates in that grid cell at each model output time interval. For entrained and dissolved aromatic hydrocarbon particles, concentrations are calculated at each time step by summing the mass of particles within a grid cell and dividing by the volume of the grid cell. The process is also subject to the application of spreading filters that represent the expected mass distribution of each distinct particle. The concentrations of hydrocarbons calculated for each grid cell, at each time step, are then analysed to determine whether concentration estimates exceed defined threshold concentrations.

All hydrocarbon spill modelling assessments undertaken by RPS undergo initial sensitivity modelling to determine appropriate time to add to the simulation after the cessation of the spill. The amount of time following the spill is based on the time required for the modelled concentrations to practically drop below threshold concentrations anywhere in the model domain in the test cases. This assessment is done by post-processing the sensitivity test results and analysing time-series of median and maximum concentrations in the water and on the surface.

6.7.1.1 Credible Spill Scenarios and hydrocarbon characteristics

As part of the risk identification process, Woodside identified the range of credible hydrocarbon spill scenarios that may occur from the Petroleum Activities Program. These scenarios are considered in the risk assessments of accidental hydrocarbon spill scenarios (**Sections 6.7.2** to **6.7.4**). They include:

- Scenario 1: A long-term (71-day) uncontrolled surface/subsurface release of 382,486 m^3 (2,405,768 bbl) of GWF-3 Condensate from the GDA05 Well, representing loss of containment after a loss of well control.

- Scenario 2: A long-term (77-day) uncontrolled surface/subsurface release of 67,822 m^3 (426,585 bbl) of Lambert Deep Condensate from the Lambert Deep well, representing loss of containment after a loss of well control.
- Scenario 3: A short-term (instantaneous) surface release of 1000 m^3 of marine diesel near the GDA05 Well, representing loss of fuel tank integrity after a vessel collision (19° 45' 10.681" S, 115° 52' 42.898" E).

The characteristics of the hydrocarbons, used as the basis for the modelling studies used to inform the assessment, are summarised in **Table 6-5**.

Table 6-5: Summary of hydrocarbon characteristics

Hydrocarbon Type	Density (g/cm³)	Viscosity (cP)	Component Boiling Point Percentage of Total				Aromatic (%) of whole oil <380°C (boiling point)
			Volatiles <180˚C	Semi-volatiles 180–265°C	Low volatility (%) 265–380°C	Residual (%) >380°C	
			Non-persistent			Persistent	
GWF-3 condensate	0.7449 at 15°C	1.61 at 15°C	65.9	22.5	10.8	0.8	16.3
LD condensate	0.7870 at 15°C	1.76 at 15°C	18.8	56.1	16.9	8.2	16.3
Marine diesel	0.829 at 25°C	4.00 at 25°C	6.0	34.6	54.4	5.0	3.0

6.7.1.2 Environment that May Be Affected and Hydrocarbon Contact Thresholds

The outputs of the quantitative hydrocarbon spill modelling are used to assess the environmental risk, if a credible hydrocarbon spill scenario occurred, by delineating which areas of the marine environment could be exposed to hydrocarbon levels exceeding hydrocarbon threshold concentrations. The summary of all the locations where hydrocarbon thresholds could be exceeded by any of the simulations modelled is defined as the 'environment that may be affected' (EMBA), which is driven by the worst-case credible hydrocarbon spill scenario, which in this instance is the loss of well control.

As the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean mechanism of transportation, the EMBA combines the potential spatial extent of the different fates. The EMBA also includes areas that are predicted to experience shoreline contact with hydrocarbons above threshold concentrations.

The EMBA covers a larger area than the area that is likely to be affected during any single spill event, as the model was run for a variety of weather and metocean conditions (100 simulations in total). The EMBA therefore represents the total extent of all the locations where hydrocarbon thresholds could be exceeded from all modelling runs.

A conservative approach for defining thresholds was used by adopting the guideline impact thresholds (NOPSEMA 2019) for floating, entrained, dissolved and accumulated hydrocarbons to define the EMBA for condensate spills from a loss of well control. An additional threshold has been included to define the boundary within which socio-cultural impacts may occur, based on visible surface oil (1 g/m^2) impacting on the visual amenity of the marine environment.

The threshold concentration value for dissolved and entrained hydrocarbons for diesel has been established with reference to results from Woodside-commissioned ecotoxicity tests on Marine

Diesel Oil (Ecotox Services Australia (ESA 2013)). The justification for the different thresholds for diesel is presented below.

These hydrocarbon thresholds for condensate and diesel are presented in **Table 6-6**.

Table 6-6: Summary of EMBA thresholds applied to the quantitative hydrocarbon spill risk modelling results

	Surface hydrocarbon (g/m^2)	Dissolved hydrocarbon (ppb)	Entrained hydrocarbon (ppb)	Accumulated hydrocarbon (g/m^2)
Condensate	10	50	100	100
Diesel	10	500	500	100

Dissolved Marine Diesel Hydrocarbon Threshold Concentration

The ecotoxicity tests were undertaken on a broad range of taxa of ecological relevance for which accepted standard test protocols are well established. These ecotoxicology tests are focused on the early life stages of test organisms, when organisms are typically at their most sensitive. The eight ecotoxicology tests were conducted on seven mainly tropical-subtropical species representatives from six major taxonomic groups. The seven species were tested for chronic (function of life) effects of immobilisation, early life stage development/growth and acute toxicity (i.e. mortality).

The laboratory-based ecotoxicity tests used a range of water accommodated fraction (WAF) concentrations to expose the different test organisms. For each ecotoxicity test, samples of the WAF were analysed to determine the total petroleum hydrocarbons (TPH) concentration of the solution. The ecotoxicity testing focusses on the TPH concentration of the WAF of the hydrocarbon and includes the carbon chains C6 to C36. TPH concentration is representative of the sum of the hydrocarbons in each test solution for C6–C36. Typically, C4 to C10 compounds are volatile (boiling point (BP) < 180 °C), C11 to C15 compounds are semi-volatile (BP 180–265 °C), C16 to C20 compounds have low volatility (265–380 °C) and C21 compounds and above are residual (BP > 380 °C).

Table 6-7 presents the results of the 'no-observed-effect concentrations' (NOEC) for the marine diesel WAFs. The reported NOECs for organisms tested ranged from 520 ppb to 3500 ppb. For seven of the nine tests, no statistically significant effect on the test organisms was observed even at the highest WAF concentration used in the testing (denoted with the symbol # in Table 6-7).

Based on these ecotoxicology tests, a conservative threshold of 500 ppb has been adopted. This 500 ppb threshold is below the lowest NOEC for the most sensitive organism tested. These thresholds are calculated based on exposure of organisms to dissolved aromatic hydrocarbons for periods of 1 to 96 hours and are, therefore, conservative when used for instantaneous contact.

Table 6-7: Summary of Total Petroleum Hydrocarbons (TPH) NOECs for key life histories of different biota based on Toxicity tests for WAF of marine diesel (ESA 2013)

Biota and life stage	Exposure duration	NOEC TPH (ppb)
Sea urchin fertilisation	1 hours	3500 #
Sea urchin larval development	72 hours	3500 #
Milky oyster larval development	48 hours	3500 #
Micro-algal growth test	72 hours	520
Macro-algal (kelp) germination test	72 hours	2530 #
Rock oyster larval spat	48 hours	3500 #
Amphipod juvenile survival	96 hours	520

Biota and life stage	Exposure duration	NOEC TPH (ppb)
Copepod juvenile survival	48 hours	2530 #
Larval fish imbalance test	96 hours	2530 #

Lowest-observable-effect concentration (LOEC) was not reached during test.

Entrained Marine Diesel Hydrocarbon Threshold Concentration

The threshold concentration of entrained hydrocarbons that could result in a biological impact cannot be determined directly using available ecotoxicity data for WAF of hydrocarbons (Table 6-7). However, entrained hydrocarbons are less biologically available to organisms through absorption into their tissues than dissolved aromatic hydrocarbons. Therefore adoption of a threshold based on WAF toxicity data will be a conservative approach. The selected threshold of 500 ppb is below the NOEC for the seven sensitive organisms tested in relation to dissolved hydrocarbons.

Scientific Monitoring

A planning area for scientific monitoring is also described in Section 5.7 of the Oil Spill Preparedness and Response Mitigation Assessment (**Appendix D**). This planning area has been set with reference to the low exposure entrained value of 10 ppb detailed in NOPSEMA Bulletin #1 Oil Spill Modelling (2019).

A scientific monitoring program would be activated following a Level 2 or 3 unplanned hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors. This would consider receptors at risk (ecological and socioeconomic) for the entire predicted EMBA and in particular, any identified Pre-emptive Baseline Areas (PBAs) for the worst-case credible spill scenario(s) or other identified unplanned hydrocarbon releases associated with the operational activities.

6.7.2 Accidental Hydrocarbon Release: Loss of Well Control

Context		
Drilling Activities – **Section 3.8** Project Vessels – **Section 3.5**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5** Socioeconomic Environment – **Section 4.6** Values and Sensitivities – **Section 4.7**	Stakeholder Consultation – **Section 5**

Risk Evaluation Summary

Source of Risk	Environmental Value Potentially Impacted							Evaluation						
	Soil and groundwater	Marine sediment	Water quality	Air quality (incl odour)	Ecosystems/habitat	Species	Socioeconomic	Decision type	Consequence/impact	Likelihood	Risk rating	ALARP tools	Acceptability	Outcome
Loss of hydrocarbons (condensate) to marine environment due to loss of well integrity		X	X	X	X	X	X	B	B	1	M	LCS GP PJ RBA CS SV	Acceptable if ALARP	EPO 14

Description of Source of Risk

Loss of Well Control – Background

Woodside has identified a loss of well control as the scenario with the worst-case credible environmental outcome as a result of loss of well integrity. A blowout is an incident where formation fluid flows out of the well or between formation layers after all the predefined technical well barriers (e.g. the BOP), or activation of the same, have failed.

Industry Experience

The spill likelihood was evaluated using blowout and well release frequencies based on SINTEF offshore blowout database 2012 (Scandpower, 2013). This uses data from 1991-2010 to determine likelihood for well blowouts and releases. For a gas well, the SINTEF calculated probability of blowout during drilling and completion is 2.93 X 10^{-4}.

Operation	Frequency, average well	Frequency, gas well	Frequency, oil well
Development drilling, deep (normal wells)	2.24 E-05	1.33 E-05	3.34 E-05
Completion	1.85 E-04	2.83 E-04	8.72 E-05
Total per well	2.07 E-04	2.93 E-04	1.26 E-04

The SINTEF data supports a likelihood of ‘highly unlikely’ for a well blowout with potential to result in the worst-case credible spill as the dataset does not account for Woodside and Industry Process Safety Improvements post the Gulf of Mexico Macondo event and is therefore likely to be conservative. The SINTEF data set is January 1991 – December 2010, whilst the Macondo blowout occurred in April 2010. Significant strengthening of barriers is now in place post the data set period, including, but not limited to:

- revised and more stringent API 53 Subsea BOP requirements in force
- competency assessment of offshore personnel is now more stringent for both Woodside and drilling contractors, for example through implementation of improvements to well control training as recommended by IOGP and requirements for Woodside personnel in safety critical roles to complete the Process Safety Management training requirements
- revision to Woodside barrier installation and verification process, including acceptance criteria and change control management.

The Lambert Deep and Greater Western Flank reservoirs are well appraised with a comprehensive set of measured pressure data from exploration, appraisal and producing wells. The likelihood of encountering significant overpressure in the overburden section is minimised through pre-drill geohazard evaluations including seismic surveys and multiple in-field and offset well data. This is believed another area of conservatism in the SINTEF likelihood data when applied to Lambert Deep and Greater Western Flank.

When considering likelihood from an 'Experience' perspective a ranking of 'Has occurred many times in the industry' is considered too high when assessing the worst credible event of blowout with no pipe in hole, and no significant bridging or flow restriction through the BOP or other means. This is supported by SINTEF data, showing that none of the 17 blowouts analysed were open hole with no pipe in hole, whilst 28% had an annulus 'full flow' but the flow area is unknown (though it is unlikely to be as large as the open hole, no pipe in hole case).

When considering likelihood of the environmental consequence of the blowout event, historic blowouts that have had major to catastrophic impact to the environment ('B' to 'A' consequence rating) have not occurred many times in the industry. This also further supports the likelihood ranking of 'highly unlikely'.

Drilling Timeframe

Drilling is scheduled to occur throughout the year (all seasons) to provide operational flexibility for requirements and schedule changes and vessel/MODU availability.

Credible Scenario – Loss of Well Integrity

The Petroleum Activities Program consists of drilling four production wells (**Table 3-2**). A loss of well integrity could result in a loss of containment at any of these wells. Woodside has identified two worst-case credible spill scenarios:

- *Scenario 1* – loss of well control – an uncontrolled surface release for five days (during which time the MODU would provide a conduit to the surface for the uncontrolled flow) followed by a 71-day uncontrolled seabed release from the **GDA05 well**[23] (as the MODU would no longer be present to provide a conduit).
- *Scenario 2* – loss of well control – an uncontrolled surface release for five days (during which time the MODU would provide a conduit to the surface for the uncontrolled flow) followed by a 77-day uncontrolled seabed release from the **LDA01 well** (as the MODU would no longer be present to provide a conduit).

The MODU would no longer be present after five days for the following reasons:

- In a non-explosion scenario, the MODU is likely to be moved off location as soon as is practicable to prevent escalation and further harm to personnel.
- In an explosion scenario, the MODU is expected to sink due to an anticipated compromise in structural integrity and stability after a period of time. The most recent example of a similar scenario is the Deepwater Horizon (DWH) incident, when the semi-submersible MODU sank after 36 hours following the uncontrolled loss of well control in the Gulf of Mexico in April 2010.

Notably, studies of the North Sea and US Gulf of Mexico OCS events also indicate that the majority of loss of well control scenario durations are less than five days (Holland, 1997).

A number of Woodside procedures were followed to identify credible spill scenarios, including spill duration. The process followed is outlined in **Figure 6-1,** with a breakdown of timeframes and justification for the reduced relief well drill time provided in **Table 6-8**.

For each EP loss of well integrity scenario, Woodside assesses whether the standard 77-day release typically modelled is most appropriate. The 77-day (11 weeks) release duration assumes the maximum depth of the hydrocarbon reservoir would be open and takes into account the estimated time to drill a relief well. Based on the timeframes of **Table 6-8** this 77-day assumption is valid for loss of well control modelling and relief well planning inputs for this EP.

[23] Well blowout volumes for the GDA03 and GDA04 wells were assessed as less than the GDA05 well (RPS 2019a).

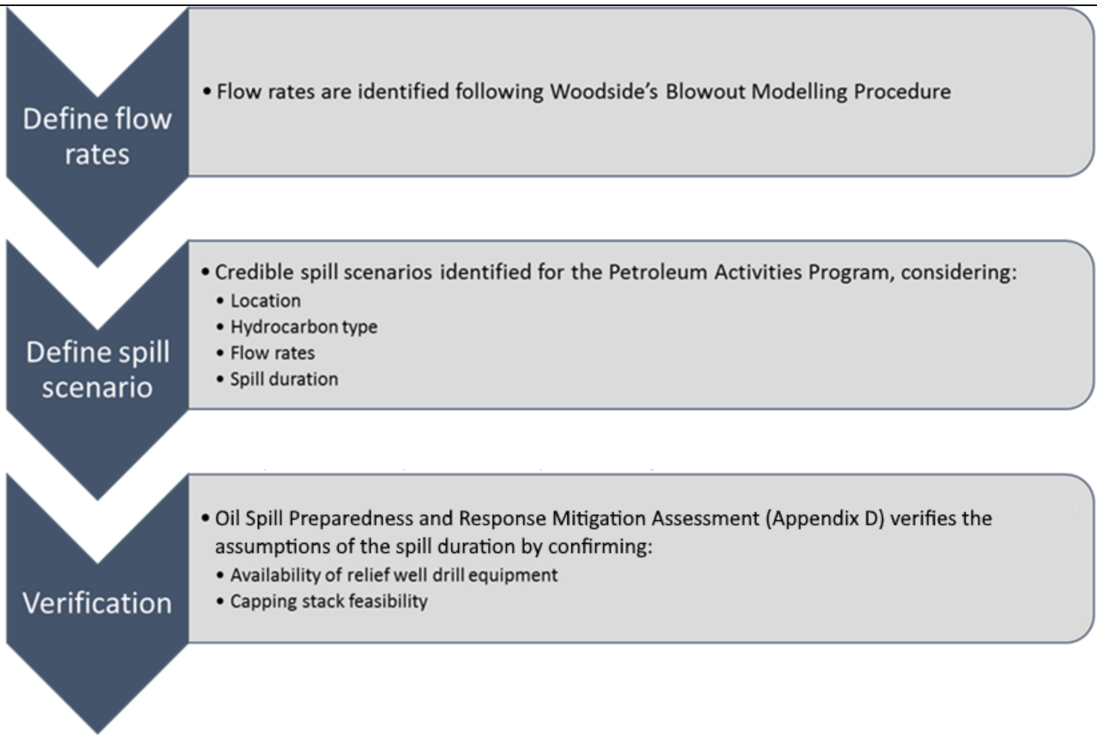


Figure 6-1: Credible oil spill scenario identification process

Table 6-8: Relief well drill times

Phase	Description	Time for completion (days)	
		Scenario 1 (GWF-3)	**Scenario 2** (LD)
Mobilisation of relief MODU	Sourcing a MODU through APPEA MoU and mobilisation	37	37
Relief well drill time	Mooring and drill well to 9 - 5/8" / 10 - ¾" shoe	20	26
Intersect and kill	Relief well intersects uncontrolled well, kills well, ceasing release of hydrocarbons	14	14
	Total days	**71**	**77**

Loss of Well Control Volume

Woodside has determined that the worst-case credible total release for a loss of well control for the two loss of well control scenarios are as per **Table 6-9**. This volume is calculated based on estimated release rate and time to drill a relief well, taking into account well characteristics including total vertical depth, duel zones and time to mobilise a relief MODU.

Table 6-9: Loss of well control volumes for each scenario

Scenario	Hydrocarbon	Well	Blowout volumes (m^3)
1	GWF-3 Condensate	GDA05 (12.25[24])	381,867
2	LD Condensate	LDA01 (reservoir)	67,713

[24] Refers to the single zone lower completions with conventional upper completions (as opposed to reservoir volumes).

Quantitative Spill Risk Assessment – Loss of well control

Table 6-10: Summary of modelled credible scenario 1 – well blowout

	Loss of well integrity	
Parameter	**Scenario 1**	**Scenario 2**
Total discharge[25] at surface	Five days 29,836 m^3	Five days 4771 m^3
Total discharge at seabed	66 days 352,031 m^3	72 days 62,942m^3
Water depth	125 m	130 m
Fluid	GWF-3 Condensate	LD Condensate

Hydrocarbon Characteristics

GWF-3 Condensate – Scenario 1

The mass balance forecast for the constant-wind case for GWF-3 Condensate shows that about 89% of the hydrocarbons is predicted to evaporate within 24 hours. Under these calm conditions the majority of the remaining oil on the water surface weathers at a slower rate due to comprising the longer-chain compounds with higher boiling points. Evaporation of the residual compounds slows significantly, and they are then subject to more gradual decay through biological and photochemical processes (RPS 2019a).

Under the variable-wind case (**Figure 6-2**), where the winds are of greater strength, entrainment of GWF-3 Condensate into the water column is indicated to be significant. About 24 hours after the spill, around 14% of the hydrocarbons mass is forecast to have entrained and a further 81% is forecast to have evaporated, leaving only a small proportion of the oil floating on the water surface (<1%). The residual compounds tend to remain entrained beneath the surface under conditions that generate wind waves (about >6 m/s) (RPS 2019a).

The increased level of entrainment in the variable-wind case results in a higher percentage of biological and photochemical degradation. Given the large proportion of entrained oil and the tendency for it to remain mixed in the water column, the remaining hydrocarbons decay and/or evaporate over time scales of several weeks to a few months. This long weathering duration extends the area of potential effect (RPS 2019a).

[25] The discharge volumes in **Table 6-10** are predicted using reservoir modelling software packages that consider a number of factors (well design, reservoir properties and environmental conditions such as water depth, temperature and pressure) to provide a production profile over the oil spill modelling period.

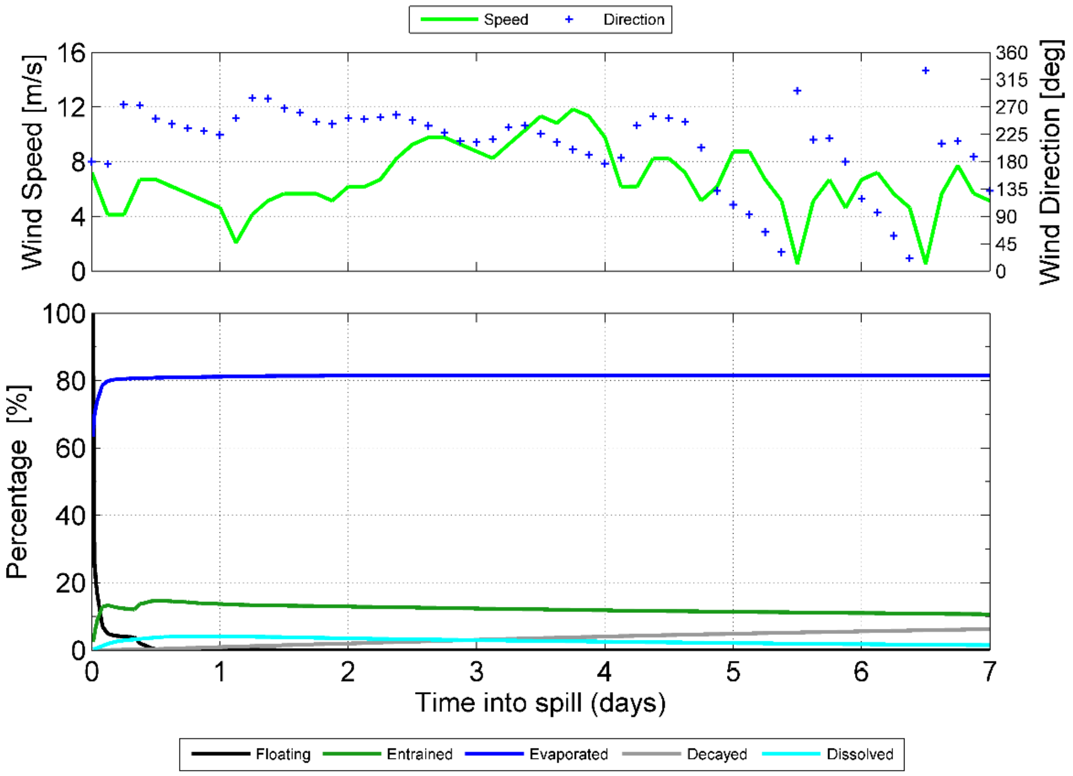


Figure 6-2: Mass balance plot representing, as a proportion (middle panel) and as a volume (bottom panel), the weathering of GWF-3 Condensate spilled onto the water surface as a one-off release (50 m^3 over one hour) and subject to variable wind at 27°C water temperature and 25°C air temperature.

LD Condensate – Scenario 2

The mass balance forecast for the constant-wind case for LD Condensate shows that about 75% of the hydrocarbons is predicted to evaporate within 24 hours. Under these calm conditions the majority of the remaining oil on the water surface weathers at a slower rate due to comprising the longer-chain compounds with higher boiling points. Evaporation of the residual compounds slows significantly, and they are then subject to more gradual decay through biological and photochemical processes (RPS 2019a).

Under the variable-wind case (**Figure 6-3**), where the winds are of greater strength, entrainment of Lambert Deep Condensate into the water column is indicated to be significant. About 24 hours after the spill, around 44% of the hydrocarbons mass is forecast to have entrained and a further 49% is forecast to have evaporated, leaving only a small proportion of the oil floating on the water surface (<1%). The residual compounds tend to remain entrained beneath the surface under conditions that generate wind waves (about >6 m/s) (RPS 2019a).

The increased level of entrainment in the variable-wind case results in a higher percentage of biological and photochemical degradation. Given the large proportion of entrained oil and the tendency for it to remain mixed in the water column, the remaining hydrocarbons decay and/or evaporate over time scales of several weeks to a few months. This long weathering duration extends the area of potential effect (RPS 2019a).

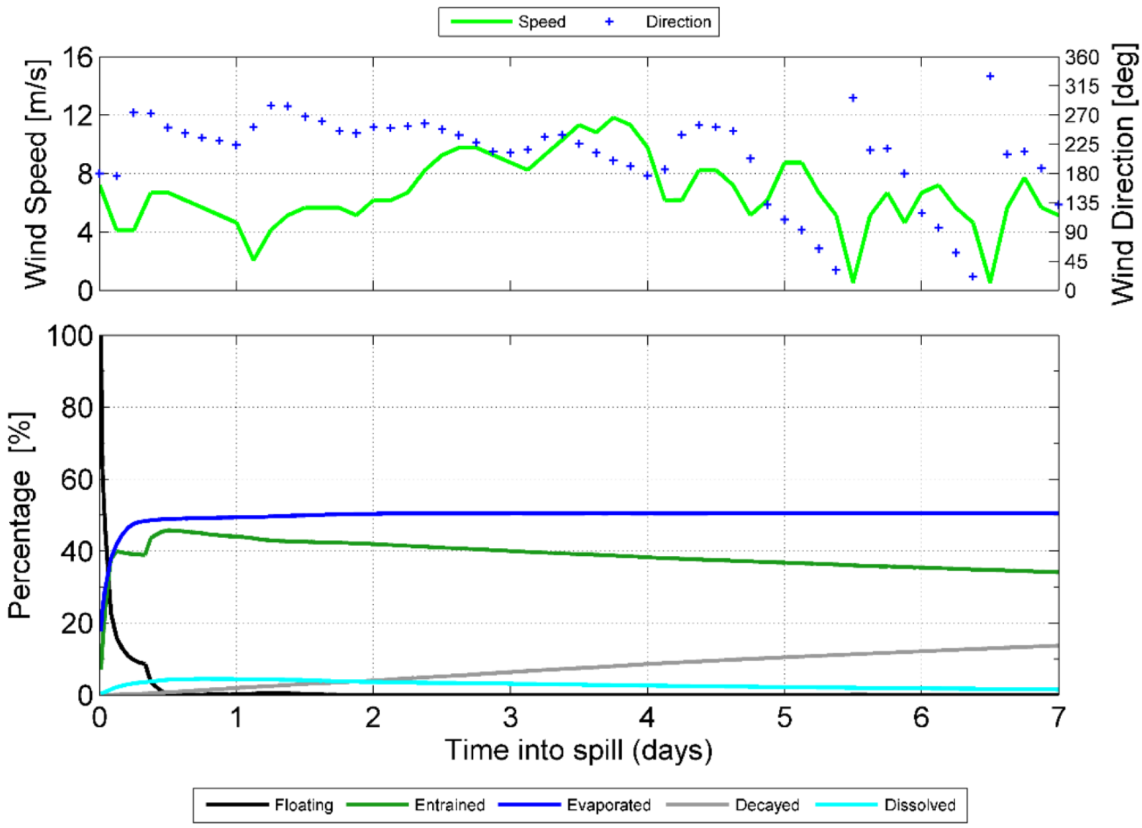


Figure 6-3: Mass balance plot representing, as proportion (middle panel) and volume (bottom panel), the weathering of Lambert Deep Condensate spilled onto the water surface as a one-off release (50 m^3 over one hour) and subject to variable wind at 27°C water temperature and 25°C air temperature.

Subsea Plume Dynamics

The likely fate of the GWF-3 and LD Condensate if discharged at the seabed under specific discharge conditions was modelled using the OILMAP model. **Table 6-11** summarises these conditions and the results of the OILMAP modelling for the two well blowout scenarios.

Table 6-11: Range of assumed inputs and range of calculated outputs, by OILMAP model for the seabed well loss of containment

	Variable	Scenario 1	Scenario 2
		GWF-3 Condensate	LD Condensate
Assumed discharge	Release depth (m)	125	130
	Hydrocarbon temp (°C)	44.9	62
	Gas:Condensate ratio (scf/bbl)	138,628	1,084,030
	Hydrocarbon flow rate (bbl/day)	4731 – 5931	800 – 944
	Diameter of exit hole (m)	0.31	0.31
Calculated gas plume dynamics	Plume diameter (m)	16.1	16.8
	Plume trapping height (m ASB)	125 (seabed)	130 (seabed)
Calculated droplet size distribution	20% droplets of size (µm)	94 - 432	94 - 390

The results of the OILMAP simulation predict that the discharges will generate a cone of rising gas that will entrain the hydrocarbons droplets and ambient sea water up to the water surface. This outcome was calculated by the model for both scenarios at all discharge rates specified throughout the blowout period. The mixed plume is initially forecast to jet towards the water surface with a vertical velocity of between 15 m/s and 17 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone of rising water and oil at the point of surfacing is predicted to be about 16 m for both scenarios.

The high discharge velocity and turbulence generated by the expanding gas plume is predicted to generate relatively small oil droplets between 94 µm and 432 µm in diameter for Scenario 1 and between 94 µm and 390 µm in diameter for Scenario 2 (**Table 6-11**). These droplets are subject to mixing due to turbulence generated by the lateral displacement of the rising plume, as well as vertical mixing induced by wind and breaking waves. Therefore, despite reaching the surface due to the lift produced by the rising plume, the droplets then tend to remain within the wave-mixed layer of the water column (3 - 10 m deep, depending on the conditions), where they can resist surfacing due to their weak buoyancy relative to other mixing processes.

The ongoing nature of the release combined with the potential for the plume to breach the water surface may present other hazards, including conditions that may lead to high local concentrations of atmospheric volatiles. The results suggest that beyond the immediate vicinity of the blowout the majority of the released hydrocarbons are present in the upper layers of the ocean, with the potential for oil to form floating slicks under sufficiently calm local wind conditions.

Impact Assessment

Potential Consequence Overview

Environment that May Be Affected

The overall EMBA for the Petroleum Activities Program is based on stochastic modelling which compiles data from 100 hypothetical worst-case spills under a variety of weather and metocean conditions (as described in **Section 6.7.1**). The EMBA therefore covers a larger area than would be affected during any one single spill event, and subsequently represents the total extent of all the locations where hydrocarbon thresholds could be exceeded from all modelling runs (i.e. the trajectory of a single spill would have a considerably smaller footprint).

As the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean mechanism of transportation, a different EMBA is discussed for each fate below, as well as for accumulated/shoreline hydrocarbons. Receptors with a probability of contact ≥1% are summarised in **Table 6-12** (Scenario 1) and **Table 6-13** (Scenario 2).

Scenario 1 – GWF-3

Surface Hydrocarbons

Modelling for floating/surface oil indicates that concentrations equal to or greater than the 10 g/m^2 threshold could potentially be found, in the form of slicks, up to 81 km from the spill site. Rankin Bank is the only receptor with surface hydrocarbons above the 10 g/m^2 threshold (**Table 6-12**), however it is noted that Rankin Bank lies about 18 m below the surface.

Entrained Hydrocarbons

Entrained hydrocarbons at concentrations equal to or greater than the 100 ppb threshold is predicted to be found up to around 804 km from the release site. Contact by entrained hydrocarbons at concentrations equal to or greater than 100 ppb is predicted at Montebello AMP (90%), Montebello State MP (43%), and Gascoyne MP (43%), as well as several other sensitive receptors with probabilities of less than 40% (**Table 6-12**). The maximum entrained hydrocarbons concentration forecast for any receptor is predicted to be 4400 ppb at Montebello AMP.

Dissolved Aromatic Hydrocarbons

Dissolved aromatic hydrocarbons at concentrations equal to or greater than the 50 ppb thresholds are predicted to be found up to around 747 km from the release site. Contact by dissolved aromatic hydrocarbons at concentrations equal to or greater than 50 ppb is predicted to be greatest at Rankin Bank (100%) and Montebello AMP (88%), as well as several other sensitive receptors with probabilities of less than 40% (**Table 6-12**). The maximum dissolved aromatic hydrocarbon concentration forecast for any receptor is predicted as 8400 ppb at Montebello AMP (40%).

Accumulated/Shoreline Hydrocarbons

The potential for accumulation of oil on shoreline,occurring above thresholds concentrations (100 g/m^2), is low with a maximum probabilityof shoreline accumulation at any location ≤8%. The maximum accumulated volume is 71 m^3 forecast at the Pilbara Islands (Southern Island Group) and a maximum local accumulated concentration of 3493 g/m^2 forecast at the same receptor. The Pilbara Islands (Southern Island Group) receptor is predicted to be contacted by shoreline hydrocarbons 20 days from the release (**Table 6-12**). The Pilbara Islands (Southern Island Group) receptor is the only receptor predicted to be contacted by shoreline oil above 1000 g/m^2.

Socioeconomic (floating 1 g/m^2)

Modelling for floating/surface hydrocarbons indicates that concentrations equal to or greater than the 1 g/m^2 threshold could potentially be found 265 km from spill source – with contact at the Pilbara Islands (Southern Island Group),

Impact Assessment
Muiron Islands Marine Management Area - World Heritage Area and Muiron Islands at probabilities of <7%. This threshold equates to a visible sheen and may have impacts on socioeconomic values in the area such as commercial and recreational fisheries. ***Scenario 2 – LD*** *Surface Hydrocarbons* Modelling for floating/surface hydrocarbons indicate that concentrations equal to or greater than the 10 g/m^2 thresholds could potentially be found, in the form of slicks, up to 19 km from the spill site (**Table 6-13**). *Entrained Hydrocarbons* Entrained hydrocarbons at concentrations equal to or greater than the 100 ppb threshold is predicted to be found up to around 543 km from the release site. Contact by entrained hydrocarbons at concentrations equal to or greater than 100 ppb is predicted at Montebello AMP (55%) and Montebello State MP (29%), as well as several other sensitive receptors with probabilities of less than 26% (**Table 6-13**). The maximum entrained oil concentration forecast for any receptor is predicted to be 964 ppb at Montebello AMP. *Dissolved Aromatic Hydrocarbons* Dissolved aromatic hydrocarbons at concentrations equal to or greater than the 50 ppb threshold are predicted to be found up to around 550 km from the release site. Contact by dissolved aromatic hydrocarbons at concentrations equal to or greater than 50 ppb is predicted to be greatest at Montebello AMP (38%) and Rankin Bank (18%), as well as several other sensitive receptors with probabilities of less than 10% (**Table 6-13**). The maximum dissolved aromatic hydrocarbon concentration forecast for any receptor is predicted as 644 ppb at Montebello AMP. *Accumulated/Shoreline Hydrocarbons* There is a potential for accumulation of hydrocarbons on shorelines, with a maximum accumulated volume of 93 m^3 forecast at the Montebello Islands and a maximum local accumulated concentration of 2454 g/m^2. The WA coast and the Pilbara Island (Southern Islands Group) are predicted to be contacted by shoreline hydrocarbons at the 100 g/m^2 threshold with a probability of 16%, with contact potentially occurring within 407 and 517 hours of the release, respectively (**Table 6-13**). *Socioeconomic (floating 1 g/m^2)* Modelling for floating/surface hydrocarbons indicates that concentrations equal to or greater than the 1 g/m^2 threshold could potentially be found 374 km from spill source – with contact at the Montebello AMP and Montebello State MP, Pilbara Southern Islands Groups, Muiron Islands Marine Management Area - World Heritage Area, Muiron Islands and WA coast at probabilities of <8%. This threshold equates to a visible sheen and may have impacts on socioeconomic values in the area such as commercial and recreational fisheries.

Table 6-12: Environment that May Be Affected – Key receptor locations / sensitivities that are predicted to be contacted by GWF-3 Condensate under Scenario 1

Environmental Setting	Location/Name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure (WM0000PG10055394))																													Hydrocarbon contact and fate of those receptors ≥1% probability (% probability)				
		Physical		Biological																						Socioeconomic and Cultural									
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities/Habitats								Protected Species										Other species										
		Open water – pristine	Marine sediment – pristine	Coral reef	Seagrass beds/macroalgae	Mangroves	Spawning/nursery areas	Open water – productivity/upwelling	Non biogenic coral reefs	Offshore filter feeders and/or deepwater benthic communities	Nearshore filter feeders	Sandy shores	Estuaries/tributaries/creeks/lagoons (including mudflats)	Rocky shores	Cetaceans – migratory whales	Cetaceans – dolphins and porpoises	Dugongs	Pinnipeds (sea lions and fur seals)	Marine turtles (including foraging and internesting areas and significant nesting beaches)	Sea snakes	Whale sharks	Sharks and rays	Sea birds and/or migratory shorebirds	Pelagic fish populations	Resident/demersal fish	Fisheries – Commercial	Fisheries – Traditional	Tourism and Recreation	Protected Areas/Heritage – European and Indigenous/Shipwrecks	Offshore Oil & Gas Infrastructure (topside and subsea)	Surface hydrocarbon (≥1 g/m²)	Surface hydrocarbon (≥10 g/m²)	Entrained hydrocarbon (≥100 ppb)	Dissolved aromatic hydrocarbon (≥50 ppb)	Accumulated/shoreline hydrocarbon (>100 g/m²)
Offshore[26]	Argo-Rowley Terrace AMP	✓						✓							✓	✓			✓			✓	✓	✓		✓			✓				8	5	
	Montebello AMP	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		8		90	88	
	Carnarvon Canyon AMP	✓	✓					✓		✓														✓	✓	✓			✓				2	1	
	Gascoyne AMP	✓	✓												✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			43	33	
Submerged Features[27]	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			40	8	10	100	
	Glomar Shoal	✓	✓				✓			✓												✓		✓	✓	✓								10	
Islands	Muiron Islands (including WHA, State Marine Park)	✓	✓	✓	✓		✓	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓		5		38	26	8
	Barrow Island (including State Nature Reserves, State Marine Park and Marine Management Area)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			34	36	
	Montebello Islands (including State Marine Park)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		1		43	38	5

[26] Note: Hydrocarbons cannot accumulate on open ocean, submerged receptors or receptors not fully emergent.

	Pilbara Southern Islands Groups (Serrurier, Thevenard and Bessieres Islands – State Nature Reserves)	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		7		38	36	8
	Lowendal Islands	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓				12	3	
	Rowley Shoals – Clerke Reef and Imperieuse Reef State Marine Parks	✓	✓	✓	✓		✓	✓		✓	✓	✓				✓			✓	✓		✓	✓	✓	✓			✓	✓				4		
Nearshore (mainland) waters	Ningaloo Coast (North, Middle, South; WHA and State Marine Park)										✓	✓	✓	✓					✓				✓					✓	✓				24	20	1
	Exmouth Gulf West	✓	✓		✓		✓					✓			✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓					4	2	

Table 6-13: Environment that May Be Affected – Key receptor locations / sensitivities that are predicted to be contacted by LD Condensate under Scenario 2

Environmental Setting	Location/Name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure (WM0000PG10055394))																													Hydrocarbon contact and fate of those receptors ≥1% probability (% probability)				
		Physical		*Biological*																						*Socioeconomic and Cultural*									
		Water Quality	*Sediment Quality*	*Marine Primary Producers*			*Other Communities/Habitats*								*Protected Species*										*Other Species*										
		Open water – pristine	*Marine sediment – pristine*	*Coral reef*	*Seagrass beds/macroalgae*	*Mangroves*	*Spawning/nursery areas*	*Open water – productivity/upwelling*	*Non biogenic coral reefs*	*Offshore filter feeders and/or deepwater benthic communities*	*Nearshore filter feeders*	*Sandy shores*	*Estuaries/tributaries/creeks/lagoons (including mudflats)*	*Rocky shores*	*Cetaceans – migratory whales*	*Cetaceans – dolphins and porpoises*	*Dugongs*	*Pinnipeds (sea lions and fur seals)*	*Marine turtles (including foraging and internesting areas and significant nesting beaches)*	*Sea snakes*	*Whale sharks*	*Sharks and rays*	*Sea birds and/or migratory shorebirds*	*Pelagic fish populations*	*Resident/demersal fish*	*Fisheries – Commercial*	*Fisheries – Traditional*	*Tourism and Recreation*	*Protected Areas/Heritage – European and Indigenous/Shipwrecks*	*Offshore Oil & Gas Infrastructure (topside and subsea)*	*Surface hydrocarbon (≥1 g/m²)*	*Surface hydrocarbon (≥10 g/m²)*	*Entrained hydrocarbon (≥50 ppb)*	*Dissolved aromatic hydrocarbon (≥100 ppb)*	*Accumulated/Shoreline hydrocarbon (>100 g/m²)*
Offshore[27]	Argo-Rowley Terrace AMP	✓						✓							✓	✓			✓			✓	✓	✓		✓			✓				4	1	
	Montebello AMP	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		8		55	38	9
	Gascoyne AMP	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		1		6	2	
Submerged Features[28]	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			1			18	
	Glomar Shoal	✓	✓				✓			✓												✓		✓	✓	✓					4			9	
Islands	Muiron Islands (including WHA, State Marine Park)	✓	✓	✓	✓		✓	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓		5		16	2	13
	Barrow Island (including State Nature Reserves, State Marine Park and Marine Management Area)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			22	8	12
	Montebello Islands (including State Marine Park)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		7		29	10	9

[27] Note: Hydrocarbons cannot accumulate on open ocean, submerged receptors or receptors not fully emergent.

Environmental Setting	Location/Name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside’s Risk Management Procedure (WM0000PG10055394))																													Hydrocarbon contact and fate of those receptors ≥1% probability (% probability)				
		Physical		*Biological*																					*Socioeconomic and Cultural*										
		Water Quality	*Sediment Quality*	*Marine Primary Producers*			*Other Communities/Habitats*								*Protected Species*									*Other Species*											
		Open water – pristine	*Marine sediment – pristine*	*Coral reef*	*Seagrass beds/macroalgae*	*Mangroves*	*Spawning/nursery areas*	*Open water – productivity/upwelling*	*Non biogenic coral reefs*	*Offshore filter feeders and/or deepwater benthic communities*	*Nearshore filter feeders*	*Sandy shores*	*Estuaries/tributaries/creeks/lagoons (including mudflats)*	*Rocky shores*	*Cetaceans – migratory whales*	*Cetaceans – dolphins and porpoises*	*Dugongs*	*Pinnipeds (sea lions and fur seals)*	*Marine turtles (including foraging and internesting areas and significant nesting beaches)*	*Sea snakes*	*Whale sharks*	*Sharks and rays*	*Sea birds and/or migratory shorebirds*	*Pelagic fish populations*	*Resident/demersal fish*	*Fisheries – Commercial*	*Fisheries – Traditional*	*Tourism and Recreation*	*Protected Areas/Heritage – European and Indigenous/Shipwrecks*	*Offshore Oil & Gas Infrastructure (topside and subsea)*	*Surface hydrocarbon (≥1 g/m²)*	*Surface hydrocarbon (≥10 g/m²)*	*Entrained hydrocarbon (≥50 ppb)*	*Dissolved aromatic hydrocarbon (≥100 ppb)*	*Accumulated/Shoreline hydrocarbon (>100 g/m²)*
	Pilbara Southern Islands Groups (Serrurier, Thevenard and Bessieres Islands – State Nature Reserves)	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		6		24	5	16
Islands	Pilbara – middle Pilbara Islands and Shoreline	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓						3
	Pilbara Islands – Northern Island Group (Sandy Island Passage Islands – State Nature Reserves)	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓				1		7
	Lowendal Islands	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓					1	8
	Rowley Shoals – Clerke Reef and Imperieuse Reef State Marine Parks	✓	✓	✓	✓		✓	✓		✓	✓	✓				✓			✓	✓		✓	✓	✓	✓	✓		✓	✓						2
	Dampier Archipelago	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓				1		8
Nearshore (mainland)	Ningaloo Coast (North, Middle, South; WHA and State Marine Park)	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		1		4	1	3

Summary of Potential Impacts to Environmental Values	
Summary of Potential Impacts to Protected Species	
Setting	***Marine Mammals*** *The sections below describe potential impacts to cetaceans, dugong and pinnipeds in offshore and nearshore settings from exposure to hydrocarbons from an accidental loss of well integrity.*
Offshore, Oceanic Reefs and Islands	**Cetaceans:** Marine mammals that have direct physical contact with surface, entrained or dissolved aromatic hydrocarbons may suffer surface fouling, ingestion of hydrocarbons (from prey, water and sediments), aspiration of oily water or droplets, and inhalation of toxic vapours (DWH Natural Resource Damage Assessment Trustees, 2016). This may result in the irritation of sensitive membranes such as the eyes, mouth, digestive and respiratory tracts and organs, impairment of the immune system, neurological damage (Helm et al., 2015), reproductive failure, adverse health effects (e.g. lung disease, poor body condition) and potentially mortality (DWH Natural Resource Damage Assessment Trustees, 2016). In a review of cetacean observations relating to a number of large-scale hydrocarbon spills, Geraci (1988) found little evidence of mortality associated with hydrocarbon spills. However, it was concluded that exposure to oil from the DWH resulted in increased mortality to cetaceans in the Gulf of Mexico (DWH Natural Resource Damage Assessment Trustees, 2016). Geraci (1988) did identify behavioural disturbance (i.e. avoiding spilled hydrocarbons) in some instances for several species of cetacean, suggesting that cetaceans have the ability to detect and avoid surface slicks. However, observations during spills have recorded larger whales (both mysticetes and odontocetes) and smaller delphinids travelling through and feeding in oil slicks. During the DWH spill, cetaceans were routinely seen swimming in surface slicks offshore (and nearshore) (Aichinger Dias et al., 2017). Impacts to cetaceans depends on the exposure pathway; with exposure to entrained oil and surface slicks not expected to result in significant impacts due to the relatively volatile, non-persistent nature of the hydrocarbons. Direct toxic effects from external exposure are not expected to occur, although mucous membranes and eyes may become irritated. Indirect toxic effects, such as hydrocarbon ingestion through accumulation in prey, may occur. Baleen whales feeding within entrained hydrocarbon plumes may ingest hydrocarbons, potentially resulting in toxic effects (particularly fresh hydrocarbons near the release location). This is expected to be limited in migrating baleen whales, such as pygmy blue and humpback whales, which are known to feed primarily in the Southern Ocean (although may opportunistically feed during migrations). A range of cetaceans were identified as potentially occurring within the Operational Area and EMBA (**Section 4.5.2**). In the event of a well blowout, surface, entrained and dissolved hydrocarbons exceeding threshold concentrations may drift across habitat for oceanic cetacean species and the migratory routes and BIAs of cetaceans considered to be MNES (**Section 4.5.2**), including humpback whales and the pygmy blue whale. EIO pygmy blue whale population and humpback whale populations are known to migrate seasonally through the area potentially spill-affected by surface, dissolved and entrained hydrocarbons (**Section 4.5.2**). A major spill in July to December would coincide with humpback whale migration through the waters off the Kimberley, Pilbara, North West Cape (Ningaloo) and Shark Bay (open ocean). A major spill in April to August or October to January would coincide with EIO pygmy blue whale migration. Double et al. (2014) suggest that pygmy blue whales migrate in offshore waters in the region of the Operational Area but in depths of about 200–1000 m (**Figure 4-10**). The EIO pygmy blue whale migration BIA overlaps the Operational Area; and the humpback whale migration BIA within the wider EMBA and may be overlapped by a worst-case hydrocarbon spill. Feeding during migrations is low level and opportunistic, reducing the potential for ingestion of hydrocarbons. Sub-lethal impacts from external exposure are therefore more likely. Migrations of both pygmy blue whales and humpback whales are protracted through time and space (i.e. the whole population will not be within the EMBA at any one time), and as such, a spill from the loss of well integrity is unlikely to affect an entire population. Cetacean populations that are resident within the potential EMBA may be susceptible to impacts from spilled hydrocarbons if they interact with an area affected by a spill. Such species are more likely to occupy coastal waters (refer to the *Mainland and Islands* section below for more information). Impacts from physical contact with hydrocarbons are likely to be in the form of irritation and sub-lethal biological effects (e.g. skin irritation, reproductive failure) and in rare circumstances, death. Suitable habitat for oceanic toothed whales (e.g. sperm whales) and dolphins (e.g. spinner dolphin) is broadly distributed throughout the region and as such, impacts from the spatial extent of a single spill trajectory (as opposed to the full EMBA) are unlikely to affect an entire population. Other species identified in **Section 4.5.2** may also have possible transient interactions with the EMBA (refer **Table 6-12 a**nd **Table 6-13** for the list of receptor locations important for cetaceans). Physical contact with hydrocarbons to these species may result in biological consequences. However, it is noted that spilled

	hydrocarbon is expected to weather quickly beyond the release location, thereby reducing the potential for impact with increasing distance. Based on the assessment above, a loss of well integrity resulting in a well blowout could disrupt a considerable number of migrating humpback or EIO pygmy blue whale populations, or other cetaceans. Such disruption could include behavioural impacts (e.g. avoidance of impacted areas), sub-lethal biological effects (e.g. skin irritation, irritation from ingestion or inhalation, reproductive failure) and, in rare circumstances, death. Given that impacts are expected to be largely sub-lethal, such disruptions or impacts are not predicted to impact on the overall population viability of cetaceans within offshore waters of the EMBA.
Mainland and Islands (Nearshore Waters)	**Cetaceans and Dugongs:** In addition to a number of whale species that may occur in nearshore waters, coastal populations of small cetaceans (such as spotted bottlenose dolphins and Indo-Pacific humpback dolphins) and dugongs are known to reside or frequent nearshore waters, including the Ningaloo Coast, Muiron Islands, Montebello/Barrow/Lowendal Islands, Pilbara Southern Island Groups, and a number of other nearshore and coastal locations (see **Table 6-12** and **Table 6-13**), which may be potentially impacted by entrained hydrocarbons exceeding threshold concentrations in the event of a loss of well integrity. Refer to **Section 4.5.2** and **Table 4-2** for the full list of EPBC Act listed cetacean species identified by the Protected Matters Search Tool with potential to occur within the EMBA. BIAs for dugong and cetaceans that overlap with the wider EMBA are outlined in **Section 4.5.2**. The predicted EMBA for entrained hydrocarbons extends past Exmouth Gulf. Exmouth Gulf is a known humpback whale aggregation area during their annual southern migration (September to December); therefore, humpbacks moving into this area may be exposed to hydrocarbons above threshold levels. Surface hydrocarbon concentrations above thresholds are not expected anywhere near the coast, including Exmouth Gulf. No hydrocarbon contact at or above threshold concentrations for surface, dissolved or entrained hydrocarbons is expected for Camden Sound, an important calving area for humpback whales. The potential impacts of exposure are as discussed above in *Offshore – Cetaceans*. However, nearshore populations of cetaceans and dugongs are known to exhibit site fidelity and are often resident populations. Therefore, the potential for sustained exposure may be greater; however, hydrocarbons reaching these environments will be highly weathered, with volatile and water soluble (often the most toxic) components expected to have dissipated before reaching nearshore waters. In the Gulf of Mexico, nearshore bottlenose dolphins experienced mortality, reproductive failure and adverse health effects at higher levels than those of oceanic stocks (DWH Natural Resource Damage Assessment Trustees, 2016) during the DWH spill. Additional possible environment impacts may also include the potential for dugongs and dolphins to ingest hydrocarbons when feeding on oiled seagrass stands or contaminated sediments. There are also potential indirect impacts to dugongs due to loss of this food source due to dieback in worst-affected areas. Therefore, a hydrocarbon spill may have an impact on feeding habitats and disrupt a considerable portion of the local population. Potential impacts on coastal cetaceans and dugong in the area affected by a spill are expected to be major and long-term in the unlikely event of a loss of well control.
Setting	**Marine Reptiles** *The sections below describe potential impacts to marine turtles and sea snakes in offshore, submerged shoals and nearshore settings from exposure to hydrocarbons from an accidental loss of well integrity*.
Offshore, Oceanic Reefs and Islands	**Marine Turtles:** Adult turtles exhibit no avoidance behaviour when they encounter hydrocarbon slicks (NOAA, 2010). Contact with surface slicks, or entrained hydrocarbon, can therefore result in hydrocarbon adherence to body surfaces (Gagnon and Rawson, 2010) irritating mucous membranes in the nose, throat and eyes leading to inflammation and infection (NOAA, 2010). Oiling can result in ingestion of hydrocarbons; indicators of PAHs were higher in tissues, stomach content, colon content and faeces of visibly oiled turtles compared to non-visibly oiled turtles (Ylitalo et al., 2017). A stress response associated with this exposure pathway includes an increase in the production of white blood cells, and even a short exposure to hydrocarbons may affect the functioning of their salt gland (Lutcavage et al., 1995). Oiling can result in mortality depending on the extent of oiling and the size of the marine turtle (DWH Natural Resource Damage Assessment Trustees, 2016). Hydrocarbons in surface waters may also impact turtles when they surface to breathe and inhale toxic vapours. Their breathing pattern, involving large ‘tidal’ volumes and rapid inhalation before diving, results in direct exposure to petroleum vapours which are the most toxic component of the hydrocarbon spill (Milton and Lutz, 2003). This can lead to lung damage and congestion, interstitial emphysema, inhalant pneumonia and neurological impairment (NOAA, 2010). Contact with entrained hydrocarbons can result in hydrocarbon adhering to body surfaces (Gagnon and Rawson, 2010), irritating mucous membranes in the nose, throat and eyes leading to inflammation and infection (Gagnon and Rawson, 2010). Given the nature of the hydrocarbon, the surface slick above the potential impact threshold

	concentration of 10 g/m^2 is expected to be limited to offshore waters extending up to 81 km from the release site. Due to the absence of potential nesting habitat within the Operational Area and its location offshore, the Operational Area is unlikely to represent important habitat for marine turtles. However, turtles will be present during the nesting season within the EMBA as the EMBA overlaps habitat critical to the survival of the flatback, loggerhead, hawksbill and green turtle, as well as the BIAs identified in **Section 4.5.2.**, It is noted that the Petroleum Activities Program does take place within the nesting season for marine turtle species in the region. In the event of a loss of well integrity, there is a potential that surface, entrained and dissolved hydrocarbons exceeding impact threshold concentrations (10 g/m^2, 100 ppb and 50 ppb respectively) are present in offshore waters extending up to 90 km, 804 km and 747 km, respectively, from the release site. However, toxicity of hydrocarbons is significantly reduced by weathering at such distances, with the volatile and water soluble (often the most toxic) components expected to have dissipated. A hydrocarbon spill has the potential to result in sub-lethal and lethal impacts to turtles in offshore waters over a wide area in the unlikely event of a loss of well control. However, based on the assessment above and given the volatile and non-persistent nature of the hydrocarbons, the extent of impacts is not expected to result in a threat to the overall viability of marine turtle populations in the broader region. Potential impacts to internesting marine turtles are discussed in the *Mainland and Islands (nearshore)* impacts discussion below. **Sea snakes:** Impacts to sea snakes from direct contact with hydrocarbons are likely to result in similar physical effects to those recorded for marine turtles and may include potential damage to the dermis and irritation to mucus membranes of the eyes, nose and throat (International Tanker Owners Pollution Federation (ITOPF), 2011). They may also be impacted when they return to the surface to breathe and inhale the toxic vapours associated with the hydrocarbons, damaging their respiratory system. In general, sea snakes frequent the waters of the continental shelf area around offshore islands and potentially submerged shoals (water depths <100 m; see *Submerged Shoals* below). While individuals may be present in the offshore oceanic waters, their abundance is not expected to be high, given the deep water and offshore location of the activity. Therefore, a hydrocarbon spill may have a minor disruption to a portion of the population in offshore oceanic waters.
Submerged Shoals	**Marine Turtles:** There is the potential for marine turtles to be present at submerged shoals such as Rankin Bank, Glomar Shoal and Rowley Shoals. These shoals may be contacted by dissolved and/or entrained hydrocarbons above impact thresholds. The predicted minimum time to contact is at Rankin Bank in 21 hours (entrained) from a blow-out at GDA-05. Due to nature of the GWF-3 condensate it is expected that the entrained hydrocarbons will be weathered, with the majority of the volatile and water soluble (often most toxic) components expected to have dissipated. This is also true at Glomar Shoal and Rowley Shoals were contact is predicted to occur a number of days to weeks after the release and therefore the condensate will be more heavily weathered. These shoals and banks may, at times, be a foraging habitat for marine turtles, given the coral and filter feeding biota associated with these areas. However, these areas are not known foraging locations and satellite tracking of individual green turtles in the nearshore environment of the NWS did not indicate any overlap of the tracked post-nesting migratory routes and the Operational Area. It is, however, acknowledged that individual marine turtles may be present at these shoals and surrounding areas. However, given the the volatile and non-persistent nature of the hydrocarbons, a hydrocarbon spill is expected to result in sub-lethal effects with a minor disruption to a portion of the population (see *Offshore* section above). **Sea snakes:** There is the potential for sea snakes to be present at submerged shoals such as Rankin Bank and Glomar Shoal. The potential impacts of exposure are as discussed previously in *Offshore – Sea snakes*. A hydrocarbon spill may cause a minor disruption to a portion of the population.
Mainland and Islands (Nearshore Waters)	**Marine Turtles:** Several marine turtle species use nearshore waters and shorelines for foraging and breeding (including internesting), with significant nesting beaches along the mainland coast and islands in potentially impacted locations such as the Ningaloo Coast, Muiron Islands, Montebello/Barrow/ Lowendal Islands and Pilbara Islands (Southern Island Groups). There are distinct breeding seasons as detailed in **Section 4.5.2**. The nearshore waters of these turtle habitat areas may be exposed to entrained hydrocarbons exceeding threshold concentrations, and accumulated hydrocarbons above threshold concentrations. The potential impacts of exposure are as discussed previously in *Offshore – Marine Turtles*. In the nearshore environment, turtles can ingest hydrocarbons when feeding (e.g. on oiled seagrass stands/macroalgae) or can be indirectly affected by loss of food source (e.g. seagrass due to dieback from hydrocarbon exposure) (Gagnon and Rawson, 2010). In addition, hydrocarbon exposure can impact turtles during the breeding season at nesting beaches. Contact with gravid adult females or hatchlings may occur on nesting beaches (accumulated hydrocarbons) or in nearshore waters

	(entrained hydrocarbons) where hydrocarbons are predicted to make shoreline contact. If accumulated hydrocarbons or entrained hydrocarbons reach the shoreline or internesting coastal waters (refer to **Table 6-12** and **Table 6-13 f**or receptor locations), there is the potential for impacts to turtles using the affected area. Animals that lay eggs such as adult female turtles can pass metabolised oil and related products to their eggs, thereby potentially impairing the development and survival of their embryos (DWH Natural Resource Damage Assessment Trustees, 2016). During the breeding season, turtle aggregations near nesting beaches within the EMBA are most vulnerable due to greater turtle densities and potential impacts may occur at the population level. Potential impacts on marine turtles may be major and long-term in the unlikely event of a loss of well control. However, based on the assessment above and given the volatile and non-persistent nature of the hydrocarbons and low levels of shoreline accumulation, the extent of impacts is not expected to result in a threat to the overall viability of marine turtle populations in the wider region. **Sea snakes:** As discussed previously (see '*Submerged Shoals – Sea snakes*') impacts to sea snakes for the mainland and island nearshore waters (including the Ningaloo Coast, Muiron Islands, Montebello/Barrow/Lowendal Islands and Southern Pilbara Island Groups) from direct contact with hydrocarbons may occur but there is expected to be no threat to overall population viability.
Setting	**Sharks and Rays** *The sections below describe potential impacts to sharks and rays in offshore, submerged shoals and nearshore settings from exposure to hydrocarbons from an accidental loss of well integrity*.
Offshore, Oceanic Reefs and Islands	**Sharks (including Whale Sharks) and Rays:** Hydrocarbon contact may affect whale sharks through ingestion (entrained/dissolved hydrocarbons), particularly if feeding. Whale sharks may transit offshore open waters, including the Operational Area, when migrating to and from Ningaloo Reef (**Figure 4-12**), where they aggregate for feeding from March to July (see *Mainland and Islands (Nearshore Waters)* below). Whale sharks may also opportunistically feed in offshore waters and the EMBA overlaps the whale shark foraging BIA identified in **Section 4.5.2** where whale sharks are seasonally present between April and October. Furthermore, the wider EMBA overlaps an aggregation area at Ningaloo. Whale sharks are versatile feeders, filtering large amounts of water over their gills, catching planktonic and nektonic organisms (Jarman and Wilson, 2004). Therefore, individual whale sharks that have direct contact with hydrocarbons within the spill-affected area may be impacted. Impacts to sharks and rays (including giant manta rays) may occur through direct contact with hydrocarbons and contaminate the tissues and internal organs, either through direct contact or via the food chain (consumption of prey). As gill breathing organisms, sharks and rays may be vulnerable to toxic effects of dissolved hydrocarbons (entering the body via the gills) and entrained hydrocarbons (coating of the gills, inhibiting gas exchange). The potential impacts are expected to vary depending on the weathered state of the hydrocarbon. In the offshore environment, it is probable that pelagic shark species are able to detect and avoid surface waters underneath hydrocarbon spills by swimming into deeper water or away from the affected areas. Therefore, any impact on sharks and rays is predicted to be minor and localised.
Submerged Shoals	**Sharks and Rays:** There is the potential for resident shark and ray populations to be impacted directly by hydrocarbon contact or indirectly through contaminated prey or loss of habitat. Spill model results indicate potential impacts to the benthic communities of Rankin Bank, Glomar Shoal and Rowley Shoals, which may host shark and ray populations. Pelagic and transient sharks and rays are expected to move away from areas affected by spilled hydrocarbons. Impacts to such species are expected to be limited to behavioural responses/ displacement. Shark and ray species that have associations with submerged shoals and oceanic atolls may not move in response to such habitat being contacted by spilled hydrocarbons. Such species may be more susceptible to a reduction in habitat quality resulting from a hydrocarbon spill. Impacts to sharks and rays at Rankin Bank, Glomar Shoal and Rowley Shoals are likely to be localised, as entrained/dissolved hydrocarbons are expected to have experienced weathering.
Mainland and Islands (Nearshore Waters)	**Sharks and Rays:** Whale sharks and manta rays are known to frequent the Ningaloo Reef system and the Muiron Islands (and form feeding aggregations in late summer/autumn). Whale sharks and manta rays generally transit along the nearshore coastline and are vulnerable to surface, entrained and dissolved aromatic hydrocarbon spill impacts, with both taxa having similar modes of feeding. Whale sharks are versatile feeders, filtering large amounts of water over their gills, catching planktonic and nektonic organisms (Jarman and Wilson, 2004). Whale sharks at Ningaloo Reef have been observed using two different feeding strategies, including passive sub-surface ram-feeding and active surface feeding (Taylor, 2007). Passive feeding consists of swimming slowly at the surface with the mouth wide open. During active feeding, sharks swim high in the water with the upper part of the body above the surface and the mouth partially open (Taylor, 2007). These feeding methods would result in the potential for individuals that are present in worst-affected spill areas to ingest potentially toxic amounts of surface, entrained or dissolved aromatic hydrocarbons into their

	body. Large amounts of ingested hydrocarbons may affect their endocrine and immune system in the longer term. The presence of hydrocarbons may displace whale sharks from the area where they normally feed and rest, and potentially disrupt migration and aggregations to these areas in subsequent seasons. Whale sharks may also be affected indirectly by surface, entrained or dissolved aromatic hydrocarbons through the contamination of their prey. The preferred food of whale sharks are fish eggs and phytoplankton which are abundant in the coastal waters of Ningaloo Reef in late summer/autumn, driving the annual arrival and aggregation of whale sharks in this area. If the spill event were to occur during the spawning season, this important food supply (in worse spill-affected areas of the reef) may be diminished or contaminated. The contamination of their food supply and the subsequent ingestion of this prey by the whale shark may also result in long-term impacts as a result of bioaccumulation. There is the potential for other resident shark and ray populations (**Section 4.5.2**) to be impacted directly from hydrocarbon contact or indirectly through contaminated prey or loss of habitat. However, it is probable that sharks move away from the affected areas, although sawfish may exhibit high habitat fidelity. **Table 6-12** and **Table 6-13** indicate the receptor locations predicted to be impacted from entrained and/or dissolved aromatic hydrocarbons to the benthic communities of nearshore, subtidal communities, and it is considered that there is the potential for habitat loss to occur. Shark populations displaced or no longer supported due to habitat loss would be expected to redistribute to other locations. Therefore, the consequences to resident shark and ray populations (if present) from loss of habitat may be the disruption of a considerable portion. Potential impacts on sharks and rays may be major and long term in the unlikely event of a loss of well control. However, based on the assessment above and given the volatile and non-persistent nature of the hydrocarbons, the extent of impacts is not expected to result in a threat to the overall viability of shark and ray populations in the wider region.
Setting	**Seabirds and Migratory Shorebirds** *The sections below describe potential impacts to seabirds and migratory shorebirds in offshore and nearshore settings from exposure to hydrocarbons from an accidental loss of well integrity*.
Offshore, Oceanic Reefs and Islands	**Seabirds and/or Migratory Shorebirds:** Offshore waters are potential foraging grounds for seabirds associated with coastal roosting and nesting habitat. There are confirmed foraging grounds off Ningaloo and the Barrow/Montebello/Lowendal Island Group. There are a number of BIAs for seabirds and migratory shorebirds that overlap the wider EMBA, as provided in **Section 4.5.2**. Seabirds generally do not exhibit avoidance behaviour to floating hydrocarbons. Physical contact of seabirds with surface slicks is by several exposure pathways, primarily immersion, ingestion and inhalation. Such contact with hydrocarbons may result in plumage fouling and hypothermia (loss of thermoregulation), decreased buoyancy and potential to drown, inability to fly or feed, anaemia, pneumonia and irritation of eyes, skin, nasal cavities and mouths (AMSA, 2013; International Petroleum Industry Environmental Conservation Association (IPIECA), 2004) and result in mortality due to oiling of feathers or the ingestion of hydrocarbons. Longer-term exposure effects that may potentially impact seabird populations include a loss of reproductive success (loss of breeding adults) and malformation of eggs or chicks (AMSA, 2013). The extent of the EMBA for surface hydrocarbon concentration of >10 g/m^2, as a result of a loss of well control, is simulated by stochastic modelling to extend about 81 km from the release location (at 1% probability and above). Therefore, a hydrocarbon spill is unlikely to disrupt a significant portion of the foraging habitat for seabirds.
Mainland and Islands (Nearshore Waters)	**Seabirds and/or Migratory Shorebirds:** In the unlikely event of a loss of well integrity, there is the potential for seabirds, and resident and non-breeding overwintering shorebirds that use the nearshore waters for foraging and resting, to be exposed to surface, entrained and dissolved hydrocarbons. This could result in lethal or sub-lethal effects. Although breeding oceanic seabird species can travel long distances to forage in offshore waters, most breeding seabirds tend to forage in nearshore waters near their breeding colony, resulting in intensive feeding by higher seabird densities in these areas during the breeding season and making these areas particularly sensitive in the event of a spill. Pathways of biological exposure that can result in impact may occur through ingesting contaminated fish (nearshore waters) or invertebrates (intertidal foraging grounds such as beaches, mudflats and reefs). Ingestion can also lead to internal injury to sensitive membranes and organs (IPIECA, 2004). Whether the toxicity of ingested hydrocarbons is lethal or sub-lethal depends on the weathering stage and its inherent toxicity (note: the shortest entrained hydrocarbon time to contact with a shoreline is seven days (North Ningaloo Coast)). Exposure to hydrocarbons may have longer-term effects, with impacts to population numbers due to decline in reproductive performance and malformed eggs and chicks, affecting survivorship and loss of adult birds. Migratory shorebirds may be exposed to stranded hydrocarbon when foraging or resting in intertidal habitats, however, direct oiling is typically restricted to a relatively small portion of birds, and such oiling is typically restricted to the birds' feet. Modelling predicts that shoreline accumulation above impact thresholds would be very unlikely (1-2% probability at limited locations along the North-west coast,

	Ningaloo coast, Barrow Island and Montebello Islands); the potential for impacts to migratory shorebirds by accumulated hydrocarbons on shorelines is considered to be very low. Important areas for foraging seabirds and migratory shorebirds are identified in **Section 4.7**. Refer to **Table 6-12 and Table 6-13** for locations within the predicted extent of the EMBA that are identified as habitat for seabirds/migratory shorebirds. Suitable habitat or seabirds and shorebirds are broadly distributed along the mainland and nearshore island coasts within the EMBA. Of note are important nesting and resting areas, including (refer to **Section 4.5.2** for additional information, including BIAs within the wider EMBA): • Muiron Islands • Ningaloo Coast • Montebello/Barrow/Lowendal Islands Group (including known nesting habitats on Boodie, Double and Middle Islands) • Pilbara Islands South Island Group. Therefore, a hydrocarbon spill may result in impacts on key feeding habitat and disruption to a significant portion of the habitat. Potential impacts on seabirds and shorebirds are expected to be major and long term in the unlikely event of a loss of well control. However, based on the assessment above and given the volatile and non-persistent nature of the hydrocarbons and low levels of shoreline accumulation predicted, the extent of impacts is not expected to result in a threat to the overall viability of seabird or shorebird populations in the wider region.
Summary of Potential Impacts to Other Species	
Setting	**Pelagic and Demersal Fish**
All Settings	**Pelagic and Demersal Fish:** Fish mortalities are rarely observed to occur as a result of hydrocarbon spills (ITOPF, 2011). This has generally been attributed to the possibility that pelagic fish are able to detect and avoid surface waters underneath hydrocarbon spills by swimming into deeper water or away from the affected areas. Fish that have been exposed to dissolved aromatic hydrocarbons are capable of eliminating the toxicants once placed in clean water, hence individuals exposed to a spill are likely to recover (King et al., 1996). Where fish mortalities have been recorded, the spills (resulting from the groundings of the tankers Amoco Cadiz in 1978 and the Florida in 1969) have occurred in sheltered bays. Laboratory studies have shown that adult fish are able to detect hydrocarbons in water at very low concentrations, and large numbers of dead fish have rarely been reported after oil spills (Hjermann et al., 2007). This suggests that juvenile and adult fish are capable of avoiding water contaminated with high concentrations of hydrocarbons. However, sub-lethal impacts to adult and juvenile fish may be possible, given long-term exposure (days to weeks) to PAH concentrations (Hjermann et al., 2007). While modelling of the loss of well integrity indicates the potential EMBA for dissolved hydrocarbons is extensive, no time-integrated exposure metrics were modelled. Given the oceanographic environment within the wider EMBA, PAH exposures in the order of weeks for pelagic fish are not considered credible. The effects of exposure to oil on the metabolism of fish appears to vary according to the organs involved, exposure concentrations and route of exposure (waterborne or food intake). Oil reduces the aerobic capacity of fish exposed to aromatics in the water and to a lesser extent affects fish consuming contaminated food (Cohen et al., 2005). The liver, a major detoxification organ, appears to be the organ where anaerobic activity is most impacted, probably increasing anaerobic activity to facilitate the elimination of ingested oil from the fish (Cohen et al., 2005). Fish are perhaps most susceptible to the effects of spilled oil in their early life stages, particularly during egg and planktonic larval stages, which can become entrained in spilled oil. Contact with oil droplets can mechanically damage feeding and breathing apparatus of embryos and larvae (Fodrie and Heck, 2011). The toxic hydrocarbons in water can result in genetic damage, physical deformities and altered developmental timing for larvae and eggs exposed to even low concentrations over prolonged timeframes (days to weeks) (Fodrie and Heck, 2011). More subtle, chronic effects on the life history of fish as a result of exposing early life stages to hydrocarbons include disruption to complex behaviour such as predator avoidance, reproductive and social behaviour (Hjermann et al., 2007). Prolonged exposure of eggs and larvae to weathered concentrations of hydrocarbons in water has also been shown to cause immunosuppression and allows expression of viral diseases (Hjermann et al., 2007). PAHs have also been linked to increased mortality and stunted growth rates of early life history (pre-settlement) of reef fishes, as well as behavioural impacts that may increase predation of post-settlement larvae (Johansen et al., 2017). However, the effect of a hydrocarbon spill on a population of fish in an area with fish larvae and/or eggs, and the extent to which any of the adverse impacts may occur, depends greatly on prevailing oceanographic and ecological conditions at the time of the spill and its contact with fish eggs or larvae.

	Demersal fish species are associated with the Continental Slope Demersal Fish Communities KEF (about 35 km west and south-west) and Ancient Coastline at 125 m Depth Contour KEF (which overlaps the Operational Area). Rankin Bank (about 19 km from the Operational Area, at the closest point) also hosts a diverse demersal fish assemblage. Fish associated with these features may be exposed to dissolved and entrained hydrocarbons above impact thresholds. Mortality and sub-lethal effects may impact populations located close to the well blowout and within the EMBA for entrained/dissolved aromatic hydrocarbons (≥100 ppb and 50 ppb respectively). Additionally, if prey (infauna and epifauna) surrounding the well location and within the EMBA is contaminated, this can result in the absorption of toxic components of the hydrocarbons (PAHs), potentially impacting fish populations that feed on these. These impacts may result in localised medium/long-term impacts on demersal fish habitat, such as the sea floor.
Summary of Potential Impacts to Marine Primary Producers	
Setting	***Receptor Group***
Submerged Shoals	The waters overlying the submerged Rankin Bank and Glomar Shoal have the potential to be exposed to entrained and dissolved hydrocarbons above threshold concentrations (at or greater than 100 ppb and 50 ppb respectively). Entrained hydrocarbons above the threshold value are also predicted to reach the Rowley Shoals. The permanently submerged habitats of Rankin Bank, Glomar Shoal and Rowley Shoals represent sensitive open water benthic community receptors, extending from deep depths to relatively shallow water. Given the depths of these habitats, it is likely the potential for biological impact is significantly reduced when compared to the upper water column layers. However, potential biological impacts could include sub-lethal stress and in some instances total or partial mortality of sensitive benthic organisms such as corals and the early life stages of resident fish and invertebrate species. The submerged shoals are areas associated with sporadic upwelling and associated primary productivity events. Impacts to plankton communities from exposure to entrained hydrocarbons above threshold concentrations may result in short-term changes in plankton community composition but recovery would occur. Hydrocarbon contact during the spawning seasons for resident shoal community benthos and fish (meroplankton), particularly exposure to in-water toxicity effects to biota, may result in the loss of a discrete cohort population but would not affect the longer-term viability of resident populations. Therefore, any impacts to resident shoal community benthos and fish (meroplankton) are likely to be localised at the shoals and temporary. Hydrocarbon exposure to offshore filter-feeding communities may occur depending on the depth of the entrained/dissolved hydrocarbons. Exposure to entrained (aromatic) hydrocarbons (≥50 ppb) has potential to result in lethal or sub-lethal toxic effects. Sub-lethal impacts, including mucus production and polyp retraction, have been recorded for gorgonians exposed to hydrocarbon (White et al., 2012). Shoals that are exposed to entrained and/or dissolved hydrocarbons are expected to result in localised long-term effects, depending on the exposure concentrations and degree of weathering.
Mainland and Islands (Nearshore Waters)	**Coral Reef:** The reef communities fringing the offshore Ningaloo Coast, Muiron Islands, Montebello/Barrow/Lowendal Islands Group and Pilbara Islands (Southern Island Group) may be exposed to entrained and/or dissolved hydrocarbons (at or above 100 ppb and 50 ppb respectively) that are considered to induce toxicity effects, particularly for reproductive and juvenile stages of invertebrate and fish species. Exposure to entrained and dissolved hydrocarbons above threshold concentrations has the potential to result in lethal or sub-lethal toxic effects to corals and other sensitive sessile benthos within the upper water column, including upper reef slopes (subtidal corals), reef flat (intertidal corals) and lagoonal (back reef) coral communities (with reference to Ningaloo Coast). Mortality in a number of coral species is possible and would result in the reduction of coral cover and change in the composition of coral communities. Sub-lethal effects to corals may include polyp retraction, changes in feeding, bleaching (loss of zooxanthellae), increased mucous production resulting in reduced growth rates and impaired reproduction (Negri and Heyward, 2000). This could impact the shallow water fringing coral communities/reefs of the offshore islands (e.g. Muiron Islands, Barrow/Montebello/Lowendal Islands and Pilbara Southern Island Groups) and also the mainland coast (e.g. Ningaloo Coast). With reference to Ningaloo Reef, wave-induced water circulation flushes the lagoon and may promote removal of entrained hydrocarbons from this particular reef habitat. Under typical conditions, breaking waves on the reef crest induce a rise in water level in the lagoon, creating a pressure gradient that drives water in a strong outward flow through channels. In the unlikely event of a spill occurring at the time of coral spawning at potentially affected coral locations or in the general peak period of biological productivity, there is potential for a significant reduction in successful fertilisation and coral larval survival due to the sensitivity of coral early life stages to hydrocarbons (Negri and Heyward, 2000). Such impacts are likely to result in the failure of recruitment and settlement of new population cohorts. In addition, some non-coral species may be

	affected via direct contact with entrained and dissolved aromatic hydrocarbons, resulting in sub-lethal impacts and in some cases mortality. This is with particular reference to the early life stages of coral reef animals (reef attached fishes and reef invertebrates), which can be relatively sensitive to hydrocarbon exposure. Coral reef fish are site-attached, have small home ranges and as reef residents they are at higher risk from hydrocarbon exposure than non-resident, more wide-ranging fish species. The exact impact on resident coral communities (which may include fringing reefs of the offshore islands and/or the Ningaloo reef system) are entirely dependent on actual hydrocarbon concentration, duration of exposure and water depth of the affected communities. Over the worst affected sections of reef habitat, coral community live cover, structure and composition is predicted to reduce, manifested by loss of corals and associated sessile biota. Recovery of these impacted reef areas relies on coral larvae from neighbouring coral communities that have either not been affected or only partially impacted. For example, there is evidence that Ningaloo Reef corals and fish are partly self-seeding (Underwood, 2009), with the supply of larvae from locations within Ningaloo Reef of critical importance to the healthy maintenance of the coral communities. Recovery at other coral reef areas, including Scott Reef, may not be aided by a large supply of larvae from other reefs, with levels of recruits after a disturbance event only returning to previous levels after the numbers of reproductive corals had also recovered (Gilmour et al., 2013). Therefore, a hydrocarbon spill may result in large-scale impacts to coral reefs, with long-term effects (recovery >10 years) possible. The extent of impacts depends on exposure concentration, duration and degree of weathering of hydrocarbons.
	Seagrass Beds/Macroalgae and Mangroves: Spill modelling has predicted entrained hydrocarbons ≥100 ppb have the potential to contact a number of shoreline sensitive receptors such as those supporting biologically diverse, shallow subtidal and intertidal communities. The variety of habitat and communities types, from the upper subtidal to the intertidal zones, support a high diversity of marine life and are used as important foraging and nursery grounds by a range of invertebrate and vertebrate species. Depending on the trajectory of the entrained plume, macroalgal/seagrass communities including the Ningaloo Coast (patchy and low cover associated with the shallow limestone lagoonal platforms), Muiron Islands (associated with limestone pavements), the Barrow/Montebello/Lowendal Islands Group and the Pilbara Southern Island Group (documented as low and patchy cover) have the potential to be exposed (see **Table 6-12** and **Table 6-13 f**or a full list of receptors within the EMBA). Seagrass in the subtidal and intertidal zones have different degrees of exposure to hydrocarbon spills. Subtidal seagrass is generally considered much less vulnerable to hydrocarbon spills than intertidal seagrass, primarily because freshly spilled hydrocarbons float under most circumstances. (Dean et al. 1998) found that oil mainly affects flowering; therefore, species that are able to spread through apical meristem growth are not as affected (such as *Zostera*, *Halodule* and *Halophila* species). Seagrass and macroalgal beds occurring in the intertidal and subtidal zone may be susceptible to impacts from entrained hydrocarbons. Toxicity effects can also occur due to absorption of soluble fractions of hydrocarbons into tissues (Runcie et al., 2010). The potential for toxicity effects of entrained hydrocarbons may be reduced by weathering processes that should serve to lower the content of soluble aromatic components before contact occurs. Exposure to entrained aromatic hydrocarbons may result in mortality, depending on actual entrained aromatic hydrocarbon concentration received and duration of exposure. Physical contact with entrained hydrocarbon droplets could cause sub-lethal stress, causing reduced growth rates and a reduction in tolerance to other stress factors (Zieman et al., 1984). Impacts on seagrass and macroalgal communities are likely to occur in areas where hydrocarbon threshold concentrations are exceeded. Mangrove habitat and associated mud flats and salt marsh at Ningaloo Coast (small habitat areas) and the Montebello Islands have the potential to be exposed (see **Table 6-12 and Table 6-13** for the full list of receptors). Mangroves can be impacted by entrained aromatic hydrocarbons that may adhere to the sediment particles. In low energy environments such as in mangroves, deposited sediment-bound hydrocarbons are unlikely to be removed naturally by wave action and may be deposited in layers by successive tides (NOAA, 2014). Given the non-persistent nature of the hydrocarbons, no significant effects to mangroves are expected to occur. Entrained hydrocarbon impacts may include sub-lethal stress and mortality to certain sensitive biota in these habitats, including infauna and epifauna. Larval and juvenile fish, and invertebrates that depend on these shallow subtidal and intertidal habitats as nursery areas, may be directly impacted due to the loss of habitats and/or lethal and sub-lethal in-water toxic effects. This may result in mortality or impairment of growth, survival and reproduction (Heintz et al., 2000). In addition, there is the potential for secondary impacts on shorebirds, fish, sea turtles, rays and crustaceans that use these intertidal habitat areas for breeding, feeding and nursery habitat purposes.

Summary of Potential Impacts to Other Habitats and Communities	
Setting	***Receptor Group***
Offshore	**Benthic Fauna Communities:** In the event of a major release at the seabed, the stochastic spill model predicted hydrocarbon droplets would be entrained, transporting them to the sea surface. As a result, the low sensitivity benthic communities associated with the unconsolidated, soft sediment habitat and any epifauna (filter feeders) associated with the consolidated sediment habitat within and outside the Operational Area are not expected to have widespread exposure to released hydrocarbons. A localised area relating to the hydrocarbon plume at the point of release is predicted, which would result in a small area of seabed and associated epifauna and infauna exposed to hydrocarbons.
	Open Water – Productivity/Upwelling: Primary production by plankton (triggered by sporadic upwelling events in the offshore waters of the NWS) is an important component of the primary marine food web. Planktonic communities are generally mixed including phytoplankton (cyanobacteria and other microalgae) and secondary consuming zooplankton (crustaceans (e.g. copepods) and the eggs and larvae of fish and invertebrates (meroplankton). Exposure to hydrocarbons in the water column can change species composition, with declines or increases in one or more species or taxonomic groups (Batten et al., 1998). Phytoplankton may also experience decreased rates of photosynthesis (Tomajka, 1985). For zooplankton, direct effects of contamination may include suffocation, changes in behaviour, or environmental changes that make them more susceptible to predation. Impacts on plankton communities are likely to occur in areas where surface, entrained or dissolved aromatic hydrocarbon threshold concentrations are exceeded, but communities are expected to recover relatively quickly (within weeks or months). This is due to high population turnover with copious production within short generation times that also buffers the potential for long-term (i.e. years) population declines (ITOPF, 2011). Therefore, any impacts are likely to be on exposed planktonic communities present in the EMBA and temporary.
	Open Water – Physical Displacement of Fauna from Gas Plume: The effect of the physical extent of the gas plume in the environment is expected to have a limited and localised effect on identified receptors such as the physical barrier created by the gas plume, which may displace transient and/or mobile biota such as pelagic fish, megafauna species (migratory whales) and plankton. It is acknowledged that the physical extent of the plume may displace some open water species transiting the offshore waters of this area of the NWS. The extent of the plume is relatively small in comparison to the surrounding offshore environment but the overall impact to the in-water biota and the marine environment in general is expected to be slight to minor short-term impact to communities in the EMBA.
Mainland and Islands (Nearshore Waters)	**Open Water – Productivity/Upwelling:** Nearshore waters and adjacent offshore waters surrounding the offshore islands (e.g. Barrow and Montebello Islands) and to the west of the Ningaloo reef system are known locations of seasonal upwelling events and productivity. The seasonal productivity events are critical to krill production, which supports megafauna aggregations such as whale sharks and manta rays in the region. This has the potential to result in lethal and sub-lethal impacts to a certain portion of plankton in affected areas, depending on concentration and duration of exposure and the inherent toxicity of the hydrocarbon. However, recovery would occur (see *Offshore* description above). Therefore, any impacts are likely to be on exposed planktonic communities present in the EMBA and temporary in nature.
	Spawning/Nursery Areas: Fish (and other commercially targeted taxa) in their early life stages (eggs, larvae and juveniles) are at their most vulnerable to lethal and sub-lethal impacts from exposure to hydrocarbons, particularly if a spill coincides with spawning seasons or if a spill reaches nursery areas close to the shore (e.g. seagrass and mangroves) (ITOPF, 2011). Fish spawning (including for commercially targeted species such as snapper and mackerel) occurs in nearshore waters at certain times of the year. Nearshore waters are also inhabited by higher numbers of juvenile fishes than offshore waters. Modelling indicated that in the unlikely event of a major spill, there is potential for entrained and dissolved hydrocarbons to occur in the surface water layers above threshold concentrations in nearshore waters, including the Muiron Islands, Ningaloo Coast, Montebello/Barrow/Lowendal Islands Group and Pilbara Southern Islands Group. This has the potential to result in lethal and sub-lethal impacts to a certain portion of fish larvae in affected areas, depending on concentration and duration of exposure and the inherent toxicity of the hydrocarbon. Although there is the potential for spawning/nursery habitat to be impacted (e.g. mangroves and seagrass beds, discussed above), losses of fish larvae in worse affected areas are unlikely to be of major consequence to fish stocks compared with significantly larger losses through natural predation, and the likelihood that most nearshore areas would be exposed is low (i.e. not all areas in the region would be affected). This is supported by a recent study in the Gulf of Mexico which used juvenile abundance data, from shallow-water seagrass meadows, as indices of the acute, population-level responses of young fishes to the DWH spill. Results indicated there was no change to the juvenile cohorts following the DWH

	spill. Additionally, there were no significant post-spill shifts in community composition and structure, nor were there changes in biodiversity measures (Fodrie and Heck, 2011). Any impacts to spawning and nursery areas are expected to be minor and short term, as would flow-on effects to adult fish stocks into which larvae are recruited.
	Filter Feeders: Hydrocarbon exposure to offshore, filter-feeding communities (e.g. deepwater communities of Ningaloo Coast and the Muiron Islands in 20–200 m) may occur depending on the depth of the entrained and dissolved aromatic hydrocarbons. See discussion above on potential impacts.
	Sandy Shores/Estuaries/Tributaries/Creeks (including Mudflats)/Rocky Shores: Shoreline exposure for the upper and lower areas differ. The upper shore has the potential to be exposed to surface slicks, while the lower shore is potentially exposed to entrained hydrocarbon. Potential impacts may occur due to hydrocarbon contact with intertidal areas, including sandy shores, mudflats and rocky shores, listed **in Table 6-12** and **Table 6-13.** Hydrocarbon at sandy shores is incorporated into fine sediments through mixing in the surface layers from wave energy, penetration down worm burrows and root pores. Hydrocarbon in the intertidal zone can adhere to sand particles; however, high tide may remove some or most of the hydrocarbon back of the sediments. Typically, hydrocarbon is only incorporated into the surface layers to a maximum of 10 cm. As described earlier, accumulated hydrocarbons ≥100 g/m² could impact the survival and reproductive capacity of benthic epifaunal invertebrates living in intertidal habitat (French-McCay, 2009). Note that shoreline accumulation above impact thresholds was identified by the stochastic modelling as potentially occurring at the Montebello Islands and Ningaloo Coast. The impact of hydrocarbon on rocky shores largely depends on the incline and energy environment. On steep/vertical rock faces on wave exposed coasts, there is likely to be no impact from a spill event. However, a gradually sloping boulder shore in calm water can potentially trap large amounts of hydrocarbon (IPIECA, 2000). The impact of the spill on marine organisms along the rocky coast depends on the toxicity and weathering of the hydrocarbon. Similar to sandy shores, accumulated hydrocarbons ≥100 g/m² could coat the epifauna along rocky coasts and impact the reproductive capacity and survival. The locations of rocky shores where impacts are predicted are at the Montebello Islands. Intertidal mudflats are susceptible to potential impacts from hydrocarbons, as they are typically low energy environments and therefore trap hydrocarbons. The extent of oiling is influenced by the neap and spring tidal cycle and seasonal highs and lows affecting mean sea level. Potential impacts to tidal flats include heavy accumulations covering the flat at low tide; however, it is unlikely that hydrocarbons penetrate the water-saturated sediments. However, hydrocarbon can penetrate sediments through animal burrows and root pores. It has been demonstrated that infaunal burrows allow hydrocarbons to access subsurface sediments where it can be retained for months. Potential impacts may occur due to entrained contact with shallow, subtidal and intertidal zones of the Ningaloo Coast and Barrow Island, Montebello Islands and Muiron Islands, albeit at low probabilities. In-water toxicity of the dissolved and entrained hydrocarbons reaching these shores will determine impacts to the marine biota, such as sessile barnacle species and/or mobile gastropods, and crustaceans such as amphipods. Lethal and sub-lethal impacts may be expected where the entrained hydrocarbon concentration threshold is >100 ppb. Impacts may result in localised changes to the community structure of these shoreline habitats which would be expected to recover in the medium term (two to five years).
Key Ecological Features	**KEFs** potentially impacted by the hydrocarbon spill from a loss of well integrity are: • ancient coastline at 125 m depth contour • continental slope demersal fish communities • Exmouth Plateau • Glomar Shoal • canyons that link the Cuvier Abyssal Plan with the Cape Range Peninsula • Commonwealth waters adjacent to Ningaloo Reef • Mermaid Reef and Commonwealth Waters Surrounding Rowley Shoals • western demersal slope and associated fish communities. Although these KEFs are primarily defined by seabed geomorphological features, they are described to identify the potential for increased biological productivity and, therefore, ecological significance. The consequences of a hydrocarbon spill from a loss of well integrity event are predicted to result in moderate impacts with values of the KEF areas affected (for the values of each KEF see **Section 4.7.5**). Potential impacts include: the contamination of sediments, impacts to benthic fauna/habitats, associated impacts to demersal fish populations, and reduced biodiversity as described

	above and below. Most of the KEFs within the EMBA have relatively broad-scale distributions and are unlikely to be significantly impacted.
Summary of Potential Impacts to Water Quality	
Setting	***Aspect***
Offshore	**Open Water – Water Quality:** Water quality would be affected due to hydrocarbon contamination which is described in terms of the biological effect concentrations. These are defined by the EMBA descriptions for entrained and dissolved hydrocarbons and their predicted extent (refer to **Table 6-12** and **Table 6-13**). Furthermore, given the volatile nature and rapid weathering and dispersal of condensate, water quality is predicted to have only minor long-term and/or significant short-term hydrocarbon contamination above background and/or national/international quality standards.
Submerged Shoals	**Open Water – Water Quality:** Water quality would be reduced due to hydrocarbon contamination that is predicted to be at or above biological effect concentrations for the surrounding marine waters over Rankin Bank, Glomar Shoal and Rowley Shoals. The submerged Rankin Bank and Glomar Shoal have the potential to be exposed to entrained hydrocarbons and dissolved aromatics at or greater than 100 ppb and 50 ppb respectively. Entrained hydrocarbons above the threshold value are also predicted to reach the Rowley Shoals. Entrained hydrocarbons reaching these shoals will be weathered, with the majority of the volatile and water soluble (often the most toxic) components expected to have dissipated. The waters surrounding the permanently submerged habitat of Rankin Bank, Glomar Shoal and Rowley Shoals would show a reduction in quality due to hydrocarbon contamination above background and/or national/international quality standards.
Mainland and Islands (Nearshore Waters)	**Open Water – Water Quality:** Water quality would be affected/reduced due to hydrocarbon contamination, with modelling predictions indicating that hydrocarbon contact is at or above biological effect concentrations for entrained and dissolved hydrocarbons in nearshore waters of identified islands and the mainland coast (refer to **Table 6-12** and **Table 6-13**). Such reduction in water quality is predicted to have minor long-term or significant short-term hydrocarbon contamination above background and/or national/international quality standards.
Summary of Potential Impacts to Marine Sediment Quality	
Setting	***Receptor Group***
Offshore	**Marine Sediment Quality:** In the event of a major hydrocarbon release at the seabed, modelling indicates that a pressurised release of condensate would atomise into droplets that would be rapidly transported into the water column to the surface. As a result, the extent of potential impacts to the seabed area at and surrounding the release site would be confined to a localised footprint. Marine sediment quality would be reduced (contamination above national/international quality standards) as a consequence of hydrocarbon contamination for a small area within the immediate release site for a long to medium term. With increased distance from the release site, seabed sediments may be exposed to entrained hydrocarbons and dissolved aromatics at or exceeding the respective 100 ppb and 50 ppb threshold concentrations at depths up to about 100 to 120 m. Therefore, there is the potential for the seabed to be exposed to low hydrocarbon concentrations in offshore continental shelf waters. However, hydrocarbon contact may only lead to reduced marine sediment quality through processes, such as deposition on the seabed and adherence. Given the nature and weathering of the hydrocarbon, long-term or widespread contamination above national/international quality standards is not expected in seabed sediments at distance from the release site.
Submerged Shoals	**Marine Sediment Quality:** There is potential for the reduction of marine sediment quality due to contact and adherence of entrained and dissolved hydrocarbons with seabed sediments of the submerged shoals such as Rankin Bank and Glomar Shoal. Entrained hydrocarbons above the threshold value are also predicted to reach the Rowley Shoals. There is potential for marine sediment quality to be reduced (contamination above national/international quality standards). However, given the nature of the hydrocarbon and weathering that is expected prior to contact with the shoals, any contamination of sediments at submerged shoals is expected to be limited and short term.
Mainland and Islands (Nearshore Waters)	**Marine Sediment Quality:** Entrained and dissolved hydrocarbons (at or above the defined thresholds) are predicted to potentially contact shallow, nearshore waters of identified islands and mainland coastlines. Hydrocarbons may occur (at or above the ecological impact thresholds) at the Montebello Islands, islands along the Pilbara coast and near Exmouth Gulf, the Ningaloo Coast and near the Rowley Shoals, and the North-west coast (refer to **Table 6-12** and **Table 6-13**). However, given the nature of the hydrocarbon and degree of weathering that is expected prior to contact with nearshore seabed habitats, contamination of sediments is expected to be limited and short term.

<table>
<tr><td colspan="2">Summary of Potential Impacts to Air Quality</td></tr>
<tr><td colspan="2">A hydrocarbon release during a loss of well integrity has the potential to result in a localised, temporary reduction in air quality, primarily associated with methane, volatile organic compound (VOC) vapours released from fresh surface hydrocarbons near the release site. Potential impacts are expected to be a slight and temporary localised effect to ecosystems, species and/or habitats in the area.

There is potential for effects to air-breathing marine fauna and avifauna (as assessed above). There is also the potential for human health effects for workers in the immediate vicinity of atmospheric emissions. The ambient concentrations of methane and VOCs released from diffuse sources is difficult to accurately quantify, although their behaviour and fate is predictable in open offshore environments as it is dispersed rapidly by meteorological factors such as wind and temperature. Methane and VOC emissions from a hydrocarbon release in such environments are rapidly degraded in the atmosphere by reaction with photo-chemically-produced hydroxyl radicals.

In the unlikely occurrence of a loss of well integrity, the temporary nature of any methane or VOC emissions (from either gas surfacing or weathering of liquid hydrocarbons); the predicted behaviour and fate of methane and VOCs in open offshore environments; and the significant distance from the Operational Area to the nearest sensitive air shed (town of Dampier about 128 km away), the potential impacts are expected to be minor and temporary.</td></tr>
<tr><td colspan="2">Summary of Potential Impacts to Protected Areas (Including AMPs)</td></tr>
<tr><td colspan="2">The quantitative spill risk assessment results indicate that the open water environment protected within the marine parks (including AMPs) listed in Table 6-12 and Table 6-13 may be affected by the released hydrocarbons. In the unlikely event of a major spill, entrained hydrocarbons and/or dissolved hydrocarbons may contact the identified key receptor locations of islands and mainland coastlines, resulting in the actual or perceived contamination of the protected areas, identified in Table 6-12 and Table 6-13.

The Montebello AMP has the greatest potential to be contacted by surface hydrocarbons, dissolved aromatic hydrocarbons and entrained hydrocarbons at or above the defined ecological effect concentrations. Hydrocarbons at or exceeding impact thresholds also have the potential to contact other protected areas, including the Argo-Rowley Terrace AMP, Gascoyne AMP and Ningaloo AMP and WHA. In most cases, the hydrocarbons that are predicted to reach these protected areas will be in an advanced state of weathering and at concentrations typically associated with lethal and sub-lethal impacts to only the most sensitive marine organisms. The potential (albeit low probability) of visible surface hydrocarbons exceeding 1 g/m^2 reaching these protected areas may result in a perception from stakeholders and the public of more significant impacts than actually occur.

Objectives in the management plans for protected areas within the EMBA, including AMPs (Appendix B) require consideration of a number of physical, ecological, socioeconomic and heritage values identified in these areas (Section 4.7). Impact on the values of these protected areas are discussed in the relevant sections above for ecological and physical values and below for socioeconomic and heritage values.

Additionally, such hydrocarbon contact may alter stakeholder understanding and/or perception of the protected marine environment, given these represent areas largely unaffected by anthropogenic influences and contain biological diverse environments.</td></tr>
<tr><td colspan="2">Summary of Potential Impacts to Socioeconomic Values (including AMPs)</td></tr>
<tr><td>Setting</td><td>Receptor Group</td></tr>
<tr><td>Offshore</td><td>Fisheries – Commercial: Spill scenarios modelled are unlikely to cause significant direct impacts on the target species of Commonwealth and offshore State fisheries within the defined EMBA, except for those occurring in close proximity to the release location. Indirect impacts may occur through the contamination of prey organisms near the release site and the subsequent ingestion of this prey, which could result in long-term impacts to fish as a result of bioaccumulation. Further details are provided below (impact assessment relating to spawning is discussed above under Summary of Potential Impacts to Other Habitats and Communities).

General Fisheries: Fish exposure to hydrocarbon can result in ‘tainting’ of their tissues. Even very low levels of hydrocarbons can impart a taint or ‘off’ flavour or smell in seafood. Tainting is reversible through the process of depuration which removes hydrocarbons from tissues by metabolic processes, although it is dependent upon the magnitude of the hydrocarbon contamination. Fish have a high capacity to metabolise these hydrocarbons while crustaceans (such as prawns) have a reduced ability (Yender et al., 2002). Seafood safety is a major concern associated with spill incidents. Therefore, actual or potential contamination of seafood can affect commercial and recreational fishing, and can impact seafood markets long after any actual risk to seafood from a spill has subsided (Yender et al., 2002). A major spill may result in the establishment of a fishing exclusion zone around the spill-affected area. There would be a temporary prohibition on fishing activities for a period of time and subsequent potential for economic impacts to affected commercial fishing operators. Additionally, hydrocarbons can foul fishing equipment such as traps and trawl nets, requiring cleaning or replacement.

Western Tuna and Billfish, Southern Bluefin Tuna, Western Skipjack and West Australian Mackerel Fisheries: The Commonwealth-managed tuna and billfish fisheries (Western Tuna and</td></tr>
</table>

	Billfish, Western Skipjack, Southern Bluefin Tuna fisheries, for which limited fishing activity has occurred in this area in recent years) and the Western Australian Mackerel Fishery target pelagic fish species. Adult fish are highly mobile and able to move away from the spill-affected area or avoid the surface waters; however, hydrocarbon concentrations in the upper water column could lead to potential exposure through direct absorption of hydrocarbons and indirectly by the consumption of contaminated prey (Merkel et al., 2012). Given these pelagic species are distributed over a wide geographical area, the impacts at the population or species level are considered minor in the unlikely event of a spill. The Western Tuna and Billfish Fishery targets waters near Carnarvon, and the WA Mackerel Managed Fishery targets nearshore waters. In both cases, in the event that these waters are exposed to hydrocarbons, they will be in an advanced state of weathering and at concentrations typically associated with lethal and sub-lethal impacts to only the most sensitive marine organisms. Therefore, there is limited potential for impacts or tainting to target fish species in these waters. ***Western Deep Trawl and Northwest Slope Trawl Fisheries:*** The predicted EMBA resulting from an uncontrolled loss of hydrocarbon from a loss of well integrity overlaps with waters fished by the Commonwealth-managed Northwest Slope Trawl Fishery and Western Deep Trawl Fishery. These fisheries target demersal and benthic species (demersal finfish and crustaceans) in greater than 200 m water depth. Hydrocarbons are not predicted to occur in these water depths and so target species are not expected to be impacted. The North West Slope Trawl Fishery may be temporarily affected by the establishment of a fishing exclusion zone for an extended period, however, the fishery typically comprises one or two vessels that target waters along more than 1000 km of the continental slope. Any fishing exclusion zone would apply to a more localised area, therefore, fishing vessels may initially need to move to alternative fishing grounds but fishing would not be prevented completely. ***Other State-Managed Fisheries*:** The predicted EMBA resulting from a major spill may impact the area fished by a number of State fisheries (refer **Table 4-9**). These fisheries generally use a range of gear types (trawl, trap and line) and operate from shallow inshore water to water depths up to 200 m, targeting demersal and pelagic finfish species and prawns. In the unlikely event of a major hydrocarbon spill, there is the potential for the targeted fish species to be exposed to entrained and/or dissolved aromatic hydrocarbons in the water column. However, the potential for direct impact would be reduced, as target species such as mackerel and snapper are likely to avoid the surface water layer underneath oil slicks. Demersal and benthic species (such as finfish and crustaceans) have limited mobility and therefore will not be able to easily move away from a spill. Mortality/sub-lethal effects may impact populations located close to the loss of well integrity location. A major loss of hydrocarbons from the Petroleum Activities Program may lead to an exclusion of fishing from the spill-affected area for an extended period. A number of other State and Commonwealth fisheries, further afield in the EMBA (refer **Section 4.6.3**), may also be affected by a major spill. However, the impacts to these far field fisheries will be similar to that described above for 'General Fisheries Impacts'.
	Offshore Oil and Gas Infrastructure: In the unlikely event of a major spill, surface hydrocarbons may affect production from existing petroleum facilities (platforms and floating production, storage and offtake vessels). For example, facility water intakes for cooling and fire hydrants could be shut off which could in turn lead to the temporary cessation of production activities. Spill exclusion zones established to manage the spill could also prohibit support vessel access as well as offtake tankers approaching facilities off the North West Cape. The impact on ongoing operations of regional production facilities would be determined by the nature and scale of the spill and metocean conditions. Furthermore, decisions on the operation of production facilities in the event of a spill would be based primarily on health and safety considerations. The closest production is at the Angel and GWA Platforms (operated by Woodside). Other nearby facilities include the NRC Platform. Operation of these facilities is likely to be affected in the event of a loss of well integrity spill.
Submerged Shoals	**Tourism and Recreation:** In the unlikely event of a major spill, a temporary prohibition on charter boat recreational fishing trips and any other marine nature-based tourism trips to Rankin Bank, Glomar Shoal and Rowley Shoals may be put into effect, depending on the trajectory of the plume, resulting in a loss of revenue for operators.
Mainland and Islands (Nearshore Waters)	**Fisheries – Commercial:** ***Nearshore Fisheries and Aquaculture:*** In the unlikely event of a loss of well integrity, there is the possibility that target species in some areas used by a number of State fisheries in nearshore waters of the mainland coast and islands that are within the EMBA could be affected. Targeted fish, prawn, mollusc and lobster species could experience sub-lethal stress, or in some instances mortality, depending on the concentration and duration of hydrocarbon exposure and its inherent toxicity. The hydrocarbons predicted to reach these nearshore water locations will be in an advanced state of weathering and at concentrations typically associated with lethal and sub-lethal impacts to only the most sensitive marine organisms. Therefore, direct impacts may be limited to sub-lethal impacts only. However, there is also the potential for tainting of target species and for negative public perception.

	Prawn Managed Fisheries: In a major spill, the modelling indicated the entrained EMBA may extend to nearshore waters closest to the mainland Pilbara and Gascoyne coasts, including the actively fished areas of the designated Onslow Prawn Managed Fishery, Exmouth Gulf Prawn Managed Fishery, Nickol Bay Prawn Managed Fishery and the Shark Bay Prawn and Scallop Managed Fishery, and managed prawn nursery areas. Note that the majority of the demarcated area for the prawn managed fishery in the Exmouth Gulf (proper) is outside the EMBA. Those fisheries that occur within the EMBA occur in shallow, nearshore waters where limited hydrocarbon exposures are predicted to occur. Prawn habitat utilisation differs between species in the post-larval, juvenile and adult stages (Dall et al., 1990). Direct impacts to benthic habitat due to a major spill has the potential to impact prawn stocks. For example, juvenile banana prawns are found almost exclusively in mangrove-lined creeks (Rönnbäck et al., 2002), whereas juvenile tiger prawns are most abundant in areas of seagrass (Masel and Smallwood, 2000). Adult prawns also inhabit coastline areas but tend to move to deeper waters to spawn. In a major spill, the model predicted shallow subtidal and intertidal habitats at the Muiron Islands, Montebello Islands, Barrow Island, Lowendal Islands, Pilbara Southern Islands Group, Exmouth Gulf, and mangrove and seagrass habitats of the Ningaloo Coast are located within the EMBA and could be exposed to hydrocarbon concentrations above threshold concentrations, depending on the trajectory of the plume. Localised loss of juvenile prawns in worse spill affected areas is possible. Whether lethal or sub-lethal effects occur depends on duration of exposure, hydrocarbon concentration, weathering stage of the hydrocarbon and its inherent toxicity. Furthermore, seafood consumption safety concerns and a temporary prohibition on fishing activities may lead to subsequent potential for economic impacts to affected commercial fishing operators.
	Fisheries – Traditional: Although no designated traditional fisheries have been identified, it is recognised that Aboriginal communities fish in the shallow coastal and nearshore waters of Barrow Island, Montebello Islands and Ningaloo Reef, and therefore may be potentially impacted if a hydrocarbon spill from a loss of well integrity were to occur. Impacts would be similar to those identified for commercial fishing in the form of a potential exclusion zone and contamination/tainting of fish stocks.
	Tourism and Recreation: Within the EMBA, tourism is one of the major industries of the region and contributes significantly to the local economy in terms of both income and employment. Nature based tourist activities include activities such as recreational fishing, snorkelling and scuba diving. Recreational fishers predominantly target tropical species such as emperor, snapper, grouper, mackerel, trevally and other game fish. Recreational angling activities include shore-based fishing, private boat and charter boat fishing, with the peak in activity between April and October (Smallwood et al., 2011). In the unlikely event of a major spill, the nearshore waters of island groups including the Muiron Islands, Barrow/Lowendal/Montebellos, Pilbara islands (Southern Island and Northern Island groups) and the Dampier Archipelago and mainland coasts, could be reached by entrained and surface oil (visible sheen ≥1 g/m^2), depending on prevailing wind and current conditions. Shoreline accumulation above threshold concentrations is also predicted for the Ningaloo Coast and Barrow/Montebello Islands. These locations offer a number of amenities such as fishing and swimming. Utilisation of beaches and surrounds have a recreational value for local residents and visitors (regional, national and international). If a major spill resulted in hydrocarbon contact, there could be restricted access to beaches for a period of days to weeks, until natural weathering or tides and currents remove the hydrocarbons. In a major spill, tourists and recreational users may also avoid areas due to perceived impacts, including after the hydrocarbon spill has dispersed. A major loss of hydrocarbons may lead to exclusion of recreational fishing and marine nature-based tourist activities for an extended period, resulting in a loss of revenue for operators. There is potential for stakeholder perception that this remote environment will be contaminated over a large area and for the longer term, resulting in a prolonged period of tourism decline. Oxford Economics (2010) assessed the duration of hydrocarbon spill related tourism impacts and found that on average, it took 12 to 28 months to return to baseline visitor spending. There is likely to be significant impacts to the tourism industry, wider service industry (hotels, restaurants and their supply chain) and local communities in terms of economic loss as a result of spill impacts to tourism. Recovery and return of tourism to pre-spill levels depends on the size of the spill, effectiveness of the spill clean-up and change in any public misconceptions regarding the spill (Oxford Economics, 2010).
	Cultural Heritage: There are a number of historic shipwrecks identified in the vicinity of the Operational Area (**Table 4-8**). The closest known wrecks are those of the *McDermott Derrick Barge No. 20*, and the *McCormack*, near the Montebello Islands and about 43 km from the Operational Area, at the closest point. The modelling results do not predict surface slicks contacting the identified wrecks, and the majority of entrained hydrocarbons are expected to occur close to the surface. However, shipwrecks in the subtidal zone could be exposed to entrained and dissolved hydrocarbons. Marine life that shelter and take refuge in and around these wrecks may be affected by in-water toxicity of dispersed hydrocarbons. The consequences of such hydrocarbon exposure may include large fish species

	moving away and resident fish species and sessile benthos such as hard corals exhibiting sub-lethal and lethal impacts (which may range from physiological issues to mortality). Accumulated hydrocarbons above threshold concentrations (> 100 g/m²) are predicted at the Ningaloo Coast. It is acknowledged that the area contains numerous Aboriginal sites such as burial grounds, middens and fish traps that provide a historical account of the early habitation of the area and a tangible part of the culture of local Aboriginal groups (CALM, 1990). Additionally, artefacts, scatter and rock shelter are contained on Barrow and Montebello islands. Within the wider EMBA, a number of places are designated on the National Heritage List (**Section 4.6.1**). These places are also covered by other designations such as WHA, marine parks and listed shipwrecks. Potential impacts have therefore been discussed in the sections above.

Worst case Potential Impacts to Social and Environmental Values
In the unlikely event of a major hydrocarbon spill due to a loss of well integrity, the EMBA (including the Social EMBA) includes the areas listed in **Table 6-12** and **Table 6-13.** This incorporates AMPs as well as other sensitive marine environments and associated receptors of the Muiron Islands, Ningaloo Coast, Exmouth Gulf, Rankin Bank, Glomar Shoal, Rowley Shoals, Montebello/Barrow/Lowendal Islands Group, and the Pilbara Southern and Northern Islands Group. Long-term impacts may occur at these locations, including socio cultural effects as a result of a major spill of condensate from drilling activities within the Operational Area. Potential impacts on species and habitats may also be major and long term. However, based on the assessment above and given the volatile and non-persistent nature of the hydrocarbons, the extent of impacts is not expected to result in a threat to the overall viability of species populations in the wider region. As such, the overall environmental consequence is defined as B 'Major, long-term impact (10-50 years) on highly valued ecosystem, species, habitat, physical or biological attributes' (**Table 2-3**). The likelihood of the event is defined as a 1 'Highly Unlikely', resulting in a risk rating of moderate.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[28]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: accepted Well Operations Management Plan (WOMP), which describes the well design and barriers to be used to prevent a loss of well integrity, specifically: • all permeable zones penetrated by the well bore, containing hydrocarbons or over-pressured water, shall be isolated from the surface environment by a minimum of two barriers (primary and secondary) (a single fluid barrier may be implemented during the initial stages of well construction if appropriateness is confirmed by a shallow hazard study)	F: Yes. CS: Minimal cost. Standard practice.	Compliance with an accepted WOMP will ensure a number of barriers are in place and verified, reducing the likelihood of loss of well integrity event occurring. Although the consequence of a blowout would not be reduced, the reduction in likelihood reduces the overall risk.	Benefits outweigh cost/sacrifice.	Yes **C 10.1**

[28] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[28]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
• discrete hydrocarbon zones shall be isolated from each other (to prevent cross flow) by a minimum of one barrier where deemed required • all normally pressured permeable water-bearing formations shall be isolated from the surface by a minimum of one barrier. The barriers shall: • be effective over the lifetime of well construction. • Fluid barriers shall remain monitored and provide sufficient pressure to counter pore pressure during well construction. • Cementing barriers (including conductor, casing and liners) shall conform to the relevant minimum standards set out in the Woodside Engineering Standard – Well Cementation. Verification: • Effectiveness of primary and secondary barriers shall be verified (physical evidence of the correct placement and performance) during the drilling of the well.				
Implement requirements for permanent well abandonment: • well barrier as per the internal Woodside Standard and Procedure • placement, length, material and verification of a permanent barrier.	F: Yes. CS: Minimal cost. Standard practice.	This procedure will reduce the likelihood of a spill occurring from a suspended well. Although changes in consequence would occur, the reduction in likelihood results in a reduction in overall risk.	Benefits outweigh cost/sacrifice.	Yes **C 13.1**
An approved Blowout Contingency Plan shall exist prior to drilling each well, including feasibility and any specific considerations for relief well kill.	F: Yes. CS: Minimal cost. Standard practice.	Assessment of the feasibility considerations for relief well kill and well capping will reduce the duration of a spill resulting in a	Benefits outweigh cost/sacrifice.	Yes **C 13.2**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[28]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
		reduction in consequence and overall risk.		
Good Practice				
Subsea BOP installed and function-tested during drilling operations. The BOP shall include: • one annular preventer • two pipe rams (excluding the test rams) • a minimum of two sets of shear rams, one of which must be capable of sealing • deadman functionality • the capability of ROV intervention • independent power systems.	F: Yes. CS: Standard practice. Required by Woodside standards.	Testing of the BOP will reduce the likelihood of a blowout resulting in release of hydrocarbons to the marine environment. In the event of a blowout, this control would not reduce the consequence, although the reduction in likelihood reduces the overall risk ranking.	Benefits outweigh cost/sacrifice.	Yes **C 10.3**
Project-specific Mooring Design Analysis.	F: Yes. CS: Standard practice. Required by Woodside standards.	Ensure adequate MODU station holding capacity to prevent loss of station. This will reduce the likelihood of a blowout resulting in release of hydrocarbons to the marine environment.	Benefits outweigh cost/sacrifice.	Yes **C 3.2**
Professional Judgement – Eliminate				
Do not drill well.	F: No. CS: Inability to produce hydrocarbons. Loss of the project.	All risk would be eliminated.	Disproportionate. Given the extremely low likelihood of a loss of well integrity due to the systematic implementation of Woodside's policies, standards, procedures and processes relating to drilling activities, the cost/sacrifice outweighs the benefit gained.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
Risk Based Analysis				
A quantitative spill risk assessment was undertaken (refer **Section 6.7.1**).				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[28]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type C), Woodside considers the adopted controls appropriate to manage the risks of an extremely low likelihood unplanned hydrocarbon release as a result of a loss of well integrity. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability		
Acceptability Criteria and Assessment	***Acceptable Level of Residual Risk***	***Statement of Acceptability***
Principles of ESD The Petroleum Activities Program is consistent with the relevant principles of ESD: • decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations • the principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations • the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. **Internal Context** The Petroleum Activities Program is consistent with Woodside corporate policies, culture, processes, standards, structure and systems as outlined in the Demonstration of ALARP and Environmental Performance Outcomes, including: • Woodside Health, Safety, Environment and Quality Policy (**Appendix A**) • Woodside Risk Management Policy (**Appendix A**) • Engineering Standards – Well Barriers • Well Acceptance Criteria Procedure • Drilling and Completions – Well Control Procedure • Woodside Engineering Standard – Rig Equipment • Woodside's Well Blowout Contingency Planning Procedure • Oil spill preparedness and response strategies are considered applicable to the nature and scale of the risk and associated impacts of the response are reduced to ALARP (**Appendix D**). **External Context** Woodside has consulted with AMSA and WA DoT on spill response strategies (**Section 5**). In accordance with the MoU	The Petroleum Activities Program is undertaken in a manner that employs all reasonably practicable controls to effectively reduce the likelihood of a loss of well integrity occurring and to mitigate potential impacts should the event occur	The controls implemented effectively reduce the likelihood of a loss of well integrity to 1 – Highly Unlikely to result in a B – Major consequence. Therefore, the predicted level of residual risk (Moderate) is considered to be at or below the defined acceptable level. **Environmental Performance Consideration** To manage residual risk from a loss of well integrity to at or below the defined acceptable levels the following EP has been applied: **EPO 13:** No loss of well integrity resulting in loss of hydrocarbons to the marine environment during the Petroleum Activities Program.

between Woodside and AMSA, a copy of the Oil Pollution First Strike Plan was provided to AMSA and WA DoT. No additional queries or concerns relating to a loss of well integrity hydrocarbon spill risk were raised during stakeholder engagement. **Other Requirements** Impact assessment has been informed by risk-based analysis, including hydrocarbon spill modelling. The proposed control measures are consistent with industry legislation, codes and standards, good practice and professional judgement including: • API Standard 53 for subsea BOP function testing • NOPSEMA will be notified of reportable and recordable incidents, if required, in accordance with **Section 7.7.** • A mutual aid MoU for relief well drilling is in place and the Drilling Engineering Manager maintains a list of rigs that are currently operating in WA. The EMBA overlaps a number of BIAs for threatened and migratory species and habitat critical for marine turtles, as well as a number of State and Commonwealth MPAs and the Ningaloo Coast WHA. Relevant management plans and species recovery plans and conservation advice have been considered during the impact assessment and, given the adopted controls, the Petroleum Activities Program is not considered to be inconsistent with the overall objectives and actions of these plans.		

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 13 No loss of well integrity resulting in loss of hydrocarbons to the marine environment during Petroleum Activities Program.	**C 10.1** Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: accepted Well Operations Management Plan (WOMP), which describes the well design and barriers to be used to prevent a loss of well integrity, specifically: • all permeable zones penetrated by the well bore, containing hydrocarbons or over-pressured water, shall be isolated from the surface environment by a minimum of two barriers (primary and secondary) (a single fluid barrier may be implemented during the initial stages of well construction if appropriateness is confirmed by a shallow hazard study) • discrete hydrocarbon zones shall be isolated from each other (to prevent cross flow) by a minimum of one barrier where deemed required • all normally pressured permeable water-bearing formations shall be isolated	**PS 10.1** Wells drilled in compliance with the accepted WOMP, including implementation of barriers to prevent a loss of well integrity.	**MC 10.1.1** Acceptance letter from NOPSEMA demonstrates the WOMP and application to drill were accepted by NOPSEMA prior to the drilling activity commencing. **MC 10.1.2** Records demonstrate minimum of two verified barriers (a single fluid barrier may be implemented during the initial stages of well construction if appropriateness is confirmed by a shallow hazard study) were in place for all permeable zones penetrated by the wellbore.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	from the surface by a minimum of one barrier. The barriers shall: • be effective over the lifetime of well construction. • Fluid barriers shall remain monitored and provide sufficient pressure to counter pore pressure during well construction. • Cementing barriers (including conductor, casing and liners) shall conform to the relevant minimum standards set out in the Woodside Engineering Standard – Well Cementation. Verification: • Effectiveness of primary and secondary barriers shall be verified (physical evidence of the correct placement and performance) during the drilling of the well.		**MC 10.1.3** Records demonstrate composition and weight of drilling fluids were applicable to down hole conditions.
	C 13.1 In the event that a well requires permanent abandonment, implement requirements for permanent well abandonment: • well barrier as per the internal Woodside Standard and Procedure • placement, length, material and verification of a permanent barrier.	**PS 13.1** Woodside abandons the wells according to internal Woodside Procedure.	**MC 13.1.1** Records demonstrate Well Acceptance Criteria have been met.
	C 13.2 An approved Blowout Contingency Plan shall exist prior to drilling each well, including feasibility and any specific considerations for relief well kill.	**PS 13.2** Feasibility of performing a well kill operation confirmed in approved blowout contingency plan.	**MC 13.2.1** An approved Well Blowout Contingency Plan.
	C 10.3 Subsea BOP installed and function-tested during drilling operations. The BOP shall include: • one annular preventer • two pipe rams (excluding the test rams) • a minimum of two sets of shear rams, one of which must be capable of sealing • deadman functionality	**PS 10.3** Subsea BOP specification, installation and function testing compliant with internal Woodside Standards and international requirements (API Standard 53 4th Edition) as agreed by Woodside and MODU contractor.	**MC 10.3.1** Records demonstrate that BOP and BOP control system specifications and function testing were in accordance with minimum standards for the expected drilling conditions as agreed by Woodside and MODU contractor.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	• the capability of ROV intervention • independent power systems.		
	C 3.2 Project-specific Mooring Design Analysis.	**PS 3.2.1** Seabed disturbance from MODU mooring limited to that specified in the project-specific mooring design analysis and as required to ensure adequate MODU station keeping capacity.	**MC 3.2.1** Records demonstrate Mooring Design Analysis completed and implemented during anchor deployment.
For oil spill response outcomes, standards and measurement criteria refer to **Appendix D**.			

6.7.3 Accidental Hydrocarbon Release: Vessel Collision

Context		
Project Vessels – **Section 3.5**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5** Socioeconomic Environment – **Section 4.6** Values and Sensitivities – **Section 4.7**	Stakeholder Consultation – **Section 5**

Risk Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and groundwater	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence/impact***	***Likelihood***	***Risk rating***	***ALARP tools***	***Acceptability***	***Outcome***
Loss of hydrocarbons (diesel) to marine environment due to a vessel collision (e.g. with support vessels or other marine users)			X		X	X	X	A	D	1	M	LCS GP PJ	Broadly acceptable	EPO 14

Description of Source of Risk

Background

The temporary presence of the MODU and project vessels in the Operational Area may result in a navigational hazard for commercial shipping within the immediate area (as discussed in **Section 6.6.1**). This navigational hazard could result in a third-party vessel colliding with the MODU and other vessels.

A moored MODU has a total marine diesel capacity of about 966–1400 m^3, that is distributed through a number of isolated tanks. MODU fuel tanks are located in the MODU pontoons, which are typically located on the inner sides of pontoons, and can be more than 10 m below the water line.

The marine diesel storage capacity of a support vessel can also be in the order of 1000 m^3 (total) which is distributed through multiple isolated tanks typically located midships and can range in typical size from 22 to 105 m^3.

A typical installation vessel is likely to have multiple isolated fuel tanks distributed throughout the hull of the vessel. Individual fuel tanks are typically 500 m^3 but can be up to 1000 m^3 in volume. In the highly unlikely event of a collision involving an installation vessel during the Petroleum Activities Program, the vessels have the capability to pump fuel from a ruptured tank to a tank with spare volume in order to reduce the potential volume of fuel released to the environment.

Industry Experience

Registered vessels or foreign flag vessels in Australian waters are required to report events to the Australian Transport Safety Bureau (ATSB), AMSA or Australian Search and Rescue (AusSAR).

From a review of the ATSB marine safety and investigation reports, one vessel collision occurred in 2011–12 that resulted in a spill of 25 – 30 L of oil into the marine environment as a result of a collision between a tug and support vessel off Barrow Island. Two other vessel collisions occurred in 2010; one in the port of Dampier, where a support vessel collided with a barge being towed. Minor damage was reported and no significant injury to personnel or pollution occurred; the second collision involved a vessel under pilot control in port connected with a vessel alongside a wharf, causing it to sink. No reported pollution resulted from the sunken vessel. These incidents demonstrate the likelihood of only minor volumes of hydrocarbons being released during the highly unlikely event of a vessel collision occurring.

From 2010 to 2011, the ATSB's annual publication identifies the individual safety action factors identified in marine accidents and incidents; 42% related to navigation action (2011). Of those, 15% related to poor communication and

42% related to poor monitoring, checking and documentation. The majority of these related to the grounding instances.

Credible Scenario

For a vessel collision to result in the worst-case scenario of a hydrocarbon spill potentially impacting an environmental receptor, several factors must align as follows:

- The identified causes of vessel interaction must result in a collision
- The collision must have enough force to penetrate the vessel hull
- The collision must be in the exact location of the fuel tank
- The fuel tank must be full, or at least of volume which is higher than the point of penetration.

The environmental risk analysis and evaluation identified and assessed a range of potential scenarios that could result in a loss of vessel structural integrity resulting in damage to fuel storage tank(s) and a loss of marine diesel to the marine environment (summarised in **Table 6-14**). The scenarios considered damage to single and multiple fuel storage tanks in the support vessel, installation vessel and MODU due to various combinations of vessel to vessel and vessel to MODU collisions.

The worst case scenario considered was a collision between the installation vessel with a third-party vessel (i.e. commercial shipping, other petroleum-related vessels and commercial fishing vessels). This was assessed as being credible, although this is unlikely given the standard vessel operations and equipment in place to prevent collision at sea, the short duration of installation vessel operations in the Operational Area, the standby role of a support vessel (low vessel speed) and its operation in close proximity to the MODU (petroleum safety zone), and the construction and placement of storage tanks. The largest tank volume of an installation vessel is unlikely to exceed 1000 m^3.

Table 6-14: Summary of credible hydrocarbon spill scenarios as a result of vessel collision

Hydrocarbon release at the surface caused by vessel collision - scenarios	Hydrocarbon release rate / volumes	Preventative and Mitigation Controls	Credibility
Breach of MODU fuel tanks due to support vessel collision.	MODU has a fuel oil storage capacity of about 966–1400 m^3, distributed through multiple tanks.	Fuel tanks are located on the inside of pontoons and protected by location below water line, protection from other tanks, e.g. bilge tanks. The draught of vessel and location of tanks in terms of water line prevent the tanks from being breached.	**Not credible** Due to location of tanks.
Breach of support vessel fuel tanks due to collision with MODU.	Activity support vessel has multiple marine diesel tanks typically ranging between 22–105 m^3 each.	Typically, double-wall tanks which are located midships (not bow or stern). Slow support vessel speeds when in close proximity to MODU.	**Not credible** Collision with MODU at slow speeds is highly unlikely and if did occur is highly unlikely to result in a breach of support vessel (low energy contact from slow-moving vessel).

3(a) Hydrocarbon release caused by vessel collision (supply vessel) **Event:** breach of activity support vessel fuel tanks due to support vessel – third-party vessel collision including commercial shipping / fisheries.	Activity support vessel has multiple marine diesel tanks typically ranging between 22–105 m³ each.	Typically, double-wall tanks which are located midships (not bow or stern). Vessels are not anchored and steam at low speeds when relocating within the Permit Area or providing stand-by cover. Normal maritime procedures would apply during such vessel movements.	**Credible, but highly unlikely** Scenario 3 (a) was assessed as being credible but highly unlikely, given the standard vessel operations and equipment in place to prevent collision at sea, the short duration of installation vessel operations in the Permit Area, the standby role of a support vessel (low vessel speed) and its operation in close proximity to the MODU (petroleum safety zone), and the construction and placement of storage tanks.
3 (b) Hydrocarbon release caused by vessel collision (PIV) Event: breach of installation vessel fuel tanks due to collision with third-party vessel, including commercial shipping/ fisheries.	Installation vessel has multiple marine diesel isolated tanks; largest volume of a single tank is likely to be <1000 m³.	Typically, double-wall tanks which are located midships (not bow or stern). Slow support vessel speeds when in close proximity to MODU.	**Credible** Scenario 3 (b) was assessed as being credible but highly unlikely, as per scenario 3 (a), and is to be used as a surrogate for all vessel collision scenarios listed in **Table 6-14**, as it represents the worst case.
3 (c) Installation vessel, supply vessel and fuel tanker A third credible scenario was identified as follows: • breach of fuel tanker single tank due to collision with installation vessel.	Installation vessel has multiple marine diesel isolated tanks; largest volume of a single tank is likely to be <1000 m³.	Typically, double-wall tanks which are located midships (not bow or stern). Slow support vessel speeds when in close proximity to MODU.	**Credible** Scenario 3 (c) was assessed as being credible but highly unlikely as per scenario 3 (a).

Quantitative Hydrocarbon Risk Assessment

Modelling was undertaken by RPS (2019c), on behalf of Woodside, to determine the fate of marine diesel released from a collision at a location within the Operational Area. The modelling assessed the extent of marine diesel spill volume of 1000 m³ (largest fuel tank on installation vessel) for all seasons, using an historic sample of wind and current data for the region.

This modelling was deemed relevant to both the GWF-3 and LD Operational Areas (see **Section 3.3**) due to their similar open ocean environments and proximity, and subsequently similar metocean environment. The volume of 1000 m^3 being the largest fuel tank on an installation vessel and, therefore, the worst-case scenario volume that may be released during a vessel collision for the activities undertaken as part of the Petroleum Activities Program.

Hydrocarbon Characteristics

Diesel characteristics are described in **Table 6-15**.

Table 6-15: Marine diesel characteristics

Density (g/cm^3)	Viscosity (cP)	Component	Volatile	Semi-volatile	Low volatility	Residual	Aromatics
		Boiling Point °C	**<180 C4 to C10**	**180-265 C11 to C15**	**265-380 C16 to C20**	**>380 >C20**	**Of whole oil <380 Boiling Point**
0.829 at 25°C	4.00 at 25°C	% of total	6.0	34.6	54.4	5.0	3.0
		% of aromatics	1.8	1.0	0.2	-	-

Marine diesel is a mixture of volatile and persistent hydrocarbons with low proportions of highly volatile and residual components. In general, about 6% of the oil mass should evaporate within the first 12 hours (boiling point < 180°C); a further 35% should evaporate within the first 24 hours (180°C < boiling point < 265°C); and a further 54% should evaporate over several days (265°C < boiling point < 380°C). About 5% of the oil is shown to be persistent. The aromatic content of the oil is about 3%.

The mass balance forecast for the constant-wind case for marine diesel shows that about 41% of the oil is predicted to evaporate within 24 hours. Under these calm conditions the majority of the remaining oil on the water surface weathers at a slower rate due to comprising the longer-chain compounds with higher boiling points. Evaporation of the residual compounds slows significantly, and is then subject to more gradual decay through biological and photochemical processes.

Under the more realistic variable-wind case **Figure 6-4**, where the winds are of greater strength, entrainment of marine diesel into the water column is indicated to be significant. About 24 hours after the spill, around 72% of the oil mass is forecast to have entrained and a further 24% is forecast to have evaporated, leaving only a small proportion of the oil floating on the water surface (<1%). The residual compounds tend to remain entrained beneath the surface under conditions that generate wind waves (about >6 m/s).

The increased level of entrainment in the variable-wind case results in a higher percentage of biological and photochemical degradation, where the decay of the floating slicks and oil droplets in the water column occurs at an approximate rate of 2.4% per day with an accumulated total of ~16% after seven days, in comparison to a rate of ~0.2% per day and an accumulated total of 1.3% after seven days in the constant-wind case. Given the large proportion of entrained oil and the tendency for it to remain mixed in the water column, the remaining hydrocarbons decay and/or evaporate over time scales of several weeks to a few months. This long weathering duration extends the area of potential effect.

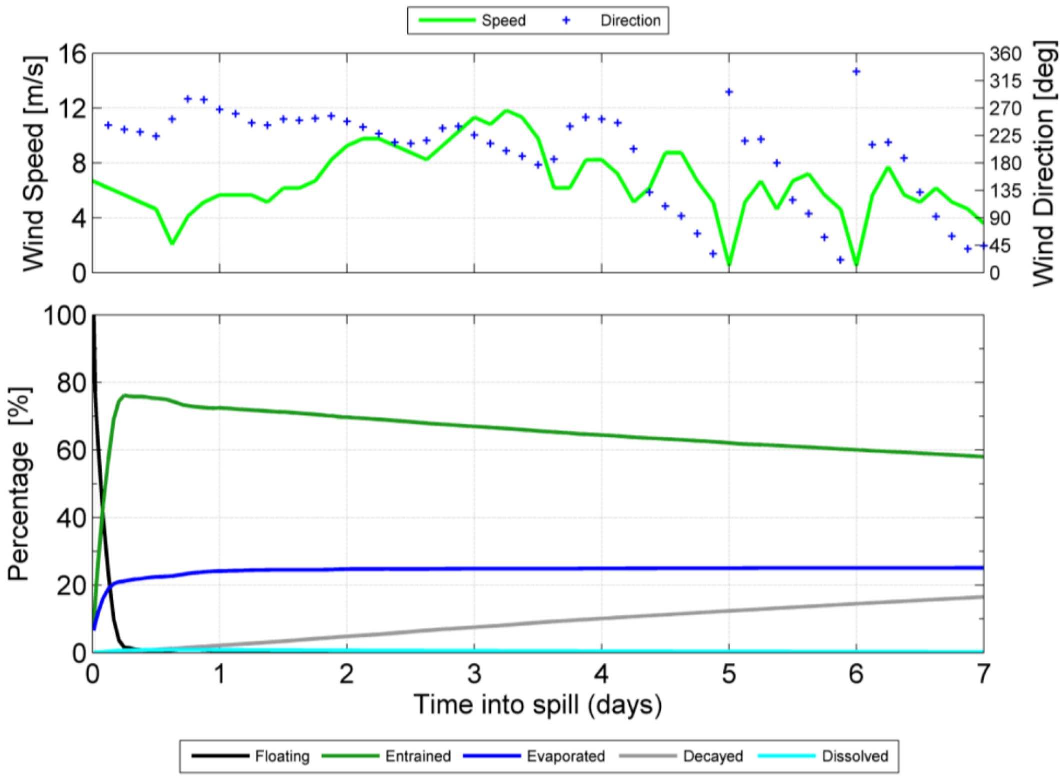


Figure 6-4: Proportional mass balance plot representing the weathering of marine diesel spilled onto the water surface as a one-off release (50 m³ over one hour) and subject to variable wind at 27°C water temperature and 25°C air temperature.

Impact Assessment

Potential Consequence Overview

Environment that May Be Affected

The overall EMBA for the Petroleum Activities Program is based on stochastic modelling which compiles data from 100 hypothetical worst-case spills under a variety of weather and metocean conditions (as described in **Section**

6.7.1). The EMBA, therefore, covers a larger area than the area that would be affected during any one single spill event, and therefore represents the total extent of all the locations where hydrocarbon thresholds could be exceeded from all modelling runs. The trajectory of a single spill would have a considerably smaller footprint.

As the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean mechanism of transportation, a different EMBA is discussed for each fate.

Surface Hydrocarbons

The probability contour figures for floating hydrocarbons indicate that concentrations equal to or greater than the 1 g/m^2 and 10 g/m^2 thresholds could potentially be found, in the form of slicks, up to 67 km and 54 km from the spill site, respectively. Floating hydrocarbons at concentrations equal to or greater than 10 g/m^2 is not forecast to contact any of the assessed shoreline receptors. (**Table 6-16**).

Entrained Hydrocarbons

Entrained oil at concentrations equal to or greater than the 500 ppb threshold is predicted to be found up to around 354 km from the spill site. Contact by entrained hydrocarbons at concentrations equal to or greater than 500 ppb is predicted at Montebello AMP (14%) as well as a few other sensitive receptors with probabilities of less than 2% (**Table 6-16**). The maximum entrained oil concentration forecast for any receptor is predicted to be 6,252 ppb at Montebello AMP.

Dissolved Hydrocarbons

Dissolved aromatic hydrocarbons at concentrations equal to or greater than the 500 ppb threshold are predicted to be localised to around 10 km from the spill site.

Accumulated Hydrocarbons

No receptors are predicted to be contacted by shoreline hydrocarbons at concentrations equal to or greater than 100 g/m^2 (**Table 6-16**).

Summary of Potential Impacts

Table 6-16 presents the full extent of the EMBA by a worst-case marine diesel spill, i.e. the sensitive receptors and their locations that may be exposed to condensate (surface, entrained, dissolved and accumulated) at or above the set threshold concentrations in the highly unlikely event of a diesel spill during the Petroleum Activities Program. Details of these receptors are outlined in **Section 4**. The potential biological and ecological impacts of an unplanned diesel release as a result of a vessel collision during the Petroleum Activities Program are presented below.

Table 6-16: Environment that May Be Affected – Key receptor locations / sensitivities that are predicted to be contacted by an instantaneous release of marine diesel under Scenario 3 (b)

Environmental Setting	Location/Name	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure (WM0000PG10055394))																												Hydrocarbon contact and fate of those receptors ≥1% probability				
		Physical		Biological																						Socioeconomic and Cultural									
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities/Habitats								Protected Species									Other Species											
		Open water – pristine	Marine Sediment – pristine	Coral reef	Seagrass beds/macroalgae	Mangroves	Spawning/nursery areas	Open water – productivity/upwelling	Non biogenic coral reefs	Offshore filter feeders and/or deepwater benthic communities	Nearshore filter feeders	Sandy shores	Estuaries/tributaries/creeks/lagoons (including mudflats)	Rocky shores	Cetaceans – migratory whales	Cetaceans – dolphins and porpoises	Dugongs	Pinnipeds (sea lions and fur seals)	Marine turtles (including foraging and internesting areas and significant nesting beaches)	Sea snakes	Whale sharks	Sharks and rays	Sea birds and/or migratory shorebirds	Pelagic fish populations	Resident/demersal fish	Fisheries – Commercial	Fisheries – Traditional	Tourism and Recreation	Protected Areas/Heritage – European and Indigenous/Shipwrecks	Offshore Oil & Gas Infrastructure (topside and subsea)	Surface hydrocarbon (≥1 g/m²)	Surface hydrocarbon (≥10 g/m²)	Entrained hydrocarbon (≥500 ppb)	Dissolved aromatic hydrocarbon (≥500 ppb)	Accumulated/Shoreline hydrocarbon (>100 g/m²)
Submerged Features	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			1				
Offshore	Montebello AMP	✓	✓	✓			✓	✓							✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓				14		
	Gascoyne AMP	✓	✓												✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			1		
	Montebello Islands (including State Marine Park)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓				1		
	Pilbara Islands (southern islands group)	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓				2		

Summary of Potential Impacts to Protected Species, Other Habitats and Communities, Water Quality and Socioeconomic Values

No receptors are contacted by dissolved aromatic hydrocarbons >500 ppb or floating oil concentrations equal to or greater than 10 g/m² (Rankin Bank and Glomar Shoal are submerged features) as a result of vessel loss of containment scenarios. Entrained hydrocarbons >500 ppb may contact receptors, with the greatest likelihood and concentrations predicted for the Montebello AMP (14% probability of contact at concentrations >500 ppb).

The potential impacts of floating, dissolved and entrained hydrocarbons to species (protected and otherwise), marine primary producers, other habitats and communities, water quality, marine sediment quality, air quality, protected areas and socioeconomic values are described in **Section 6.7.2**. The loss of containment EMBA and the diesel spill EMBA overlap and therefore the assessment provided in **Section 6.7.2** would also apply to the potential diesel spill scenario.

It is noted that the toxic components in marine diesel include alkylated naphthalenes which can be rapidly accumulated by marine biota including invertebrates such as marine oysters, clams, shrimp, as well as a range of vertebrates such as finfish. Marine diesel also contains additives that contribute to its toxicity.

Protected Species

As identified in **Section 4.5.2**, protected species including migrating EIO pygmy blue whale population may be seasonally transiting offshore areas to the west of the Operational Area, and therefore could be impacted in close proximity to the marine diesel spill location, where the volatile, water soluble and most toxic components of the diesel may be present. However, the window for exposure to hydrocarbons with the potential for any toxicity effects in these waters would be limited to a few days following the spill. Potential impacts may include behavioural impacts (e.g. avoidance of impacted areas), sub-lethal biological effects (e.g. skin irritation, irritation from ingestion or inhalation, reproductive failure) and, in rare circumstances, organ or neurological damage leading to death. Given the absence of critical habitats or aggregation areas, cetaceans in the area are expected to be transient, and impacts are expected to be limited to individuals or small groups of animals. Impact on the overall population viability of cetaceans is not predicted.

There is also the potential for migrating humpback whales and coastal dolphin populations to be exposed in nearshore waters, however, the low concentrations and advanced degree of weathering of hydrocarbons in these nearshore waters is not expected to result in any discernible sub-lethal or lethal impacts to cetaceans.

The EMBA overlaps with habitat critical to the survival of marine turtles as identified in **Section 4.5.2**. Turtle internesting habitat critical areas, such as those in waters adjacent to Barrow Island and the Montebello Islands, are predicted to have very limited or no exposure to surface or dissolved hydrocarbons above their respective impact threshold concentrations. Some marine turtles in these areas may be exposed to patchy occurrences of entrained hydrocarbons, which would be in an advanced state of weathering with reduced toxicity. Low concentrations are only capable of causing sub-lethal impacts to the most sensitive marine organisms and no lethal or sub-lethal impacts to marine turtles are expected in habitat critical to survival. The potential for lethal and sub-lethal impacts to marine turtles is limited to small numbers of transient individuals that may be present in offshore waters near the release location.

Seabirds may also be exposed to marine diesel on the sea surface or upper water column, if resting or foraging in waters near to the spill. A foraging BIA for wedge-tailed shearwaters overlaps the Operational Area, although other species of seabird may also be present in low numbers. Impacts may include mortality due to oiling of feathers or the ingestion of hydrocarbons. However, due to the limited spatial extent of a marine diesel spill and limited window for exposure, population level impacts are not expected.

Other protected species that may occasionally transit through the area and may potentially be exposed to a marine diesel spill, include shark and ray species such as whale sharks and manta rays. Should sharks or rays be present in offshore waters near the Operational Area during the spill, direct impacts may occur if foraging within surface slicks or in the upper 20 – 30 m of the water column containing entrained hydrocarbons and dissolved aromatics. Contamination of their prey and the subsequent ingestion of this prey may also result in long-term impacts as a result of bioaccumulation. Impacts are again predicted to be limited to a small number of animals given the absence of key habitat and the low numbers of animals that may transit through the area during the short period when spilled hydrocarbons are present.

Given the limited number of animals that may be impacted and the rapid dispersion of marine diesel, it is considered that any potential impacts are minor and not at the population or ecosystem level.

Other Habitats, Species and Communities

Within the EMBA for a marine diesel spill resulting from a vessel collision, there is the potential for plankton communities to be impacted where entrained hydrocarbon threshold concentrations are exceeded. A range of lethal and sub-lethal impacts may occur to plankton exposed to entrained or dissolved hydrocarbons within the EMBA. Communities are expected to recover quickly (weeks/months) due to high population turnover (ITOPF, 2011). It is therefore considered that any potential impacts would be low magnitude and temporary in nature.

Pelagic fish populations in the open water offshore environment of the EMBA are highly mobile and have the ability to move away from a marine diesel spill. The spill-affected area would be confined to the surface layer and upper 20 – 30 m of the water column. It is therefore unlikely that fish populations would be exposed to widespread hydrocarbon contamination. Pelagic fish populations are distributed over a wide geographical area so impacts at population or species level are considered to be negligible. Combined with these factors and the rapid dispersion of marine diesel, it is considered that any potential impacts are minor.

Other communities (e.g. demersal fish, benthic infauna and epifauna) and key sensitivities (e.g. KEFs identified in **Section 4.7.5**) occur within the EMBA, however are not be directly exposed or impacted by a marine diesel spill as hydrocarbons are confined to the upper layers of the water column.

Protected Areas

Entrained hydrocarbons at or exceeding the 500 ppb threshold have a probability of contacting the Montebello AMP Montebello State Marine Park and Gascoyne AMP. Entrained hydrocarbons are only predicted within the deep open waters of these protected areas, with no contact to seabed habitats, or shoreline contact. Potential impacts to water quality and the natural values (e.g. mobile protected species) in these areas would be temporary and localised in nature due to the rapid dispersion and weathering of the marine diesel, as described above. Dissolved and visible surface hydrocarbons (at or exceeding 1 g/m^2) are not predicted to reach any other protected areas.

Socioeconomic

A marine diesel spill is considered unlikely to cause significant direct impacts on the target species fished by Commonwealth and State fisheries (see **Section 4.6.3**) which overlap with the EMBA. The fisheries that operate within the EMBA predominantly target demersal fish species (demersal finfish and crustaceans) that inhabit waters in the range of >60 – 200 m depth, or pelagic species which are highly mobile. Therefore, a marine diesel spill is expected to only result in negligible impacts, considering that hydrocarbons are confined to the upper layers of the water column. Visible surface hydrocarbons at or exceeding 1 g/m^2 may occur up to 70 km from the release site, which may result in fouling of fishing gear and a perception of impacts to fish stocks by fisheries stakeholders and the public.

There is the potential that a fishing exclusion zone would be applied in the area of the spill, which would put a temporary ban on fishing activities and therefore potentially lead to subsequent economic impacts on commercial fishing operators if they were planning to fish within the area of the spill. Such measures would likely be in place for less than a week and would not result in widespread or long-term impacts to fishing activities.

Summary of Potential Impacts to Environmental Value(s)

In the highly unlikely event of an unplanned hydrocarbon release to the marine environment due to vessel collision, combined with the adopted controls, it is considered that any potential impact to water quality would be minor, localised and temporary in nature in comparison to background levels and/or international standards, with localised and temporary impacts to protected places, habitats, populations and commercial fisheries.

The highest environmental consequence identified for the assessment of an unplanned hydrocarbon release to the marine environment due to vessel collision, as classified in **Figure 2-6**, is defined as D, which equates to minor, short-term impact (one to two years) on species, habitat (but not affecting ecosystems), physical or biological attributes.

Demonstration of ALARP

Control Considered	*Control Feasibility (F) and Cost/Sacrifice (CS)*[29]	*Benefit in Impact/Risk Reduction*	*Proportionality*	*Control Adopted*
Legislation, Codes and Standards				
Marine Order 30 (Prevention of collisions) 2016, including: • adherence to steering and sailing rules including maintaining lookouts (e.g. visual, hearing, radar, etc.), proceeding at safe speeds, assessing risk of collision and taking action to avoid collision (monitoring radar) • adherence to navigation light display	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of interference with other marine users resulting in a collision.	Controls based on legislative requirements – must be adopted.	Yes **C 14.1**

[29] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[29]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
requirements, including visibility, light position/shape appropriate to activity • adherence to navigation noise signals as required.				
Marine Order 21 (Safety and emergency procedures) 2016, including: • adherence to minimum safe manning levels	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of interference with other marine users resulting in a collision.	Controls based on legislative requirements – must be adopted.	Yes **C 14.2**
Marine Order 27 (safety of navigation and radio equipment) 2016: • maintenance of navigation equipment in efficient working order (compass/radar) • navigational systems and equipment required are those specified in Regulation 19 of Chapter V of *Safety of Life at Sea* • Automatic Identification System that provides other users with information about the vessel's identity, type, position, course, speed, navigational status and other safety-related data.	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of interference with other marine users resulting in a collision.	Controls based on legislative requirements – must be adopted.	Yes **C 14.3**
Establishment of a 500 m PSZ around MODU and installation vessels and communicated to marine users.	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of a collision with a third-party vessel.	Controls based on legislative requirements – must be adopted.	Yes **C 14.4**
Good Practice				
Use of a transmitting RACON unit on MODU, when drilling in a shipping lane, as an additional navigation aid for commercial shipping traffic utilising shipping fairways.	F: Yes CS: Minimal cost.	Provides a small reduction in likelihood of a collision with a third-party vessel.	Benefits outweigh cost/sacrifice.	Yes **C 14.5**
A support vessel is on standby as required during drilling activities to assist in third-party	F: Yes. CS: Minimal cost – support vessels available routinely in Operational	Provides a small reduction in likelihood of a collision with a third-party vessel.	Benefits outweigh cost/sacrifice.	Yes **C 14.6**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[29]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
vessel interactions (including warning to vessels approaching the 500m petroleum safety zone).	Area during Petroleum Activities Program. Standard practice.			
When a support vessel is designated for standby it will undertake actions to prevent unplanned interactions, such as: • Maintain a 24-hour radio watch on designated radio channel(s). • Perform continuous surveillance and warn the MODU/ installation vessels of any approaching vessels reaching 500 m petroleum safety zone. Surveillance shall be conducted by a combination of: – visual lookout – radar watch – other electronic systems available including AIS – monitoring any additional/agreed radio communications channels – all other means available. • While complying with Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS), approach any vessel attempting to transit through the 500 m zone and contact vessel by all available means. • Monitor and advise the MODU if: – MODU navigation signals are defective – visibility becomes restricted.	F: Yes. CS: Minimal cost – support vessels available routinely in Operational Area during Petroleum Activities Program. Standard practice.	Provides a reduction in likelihood of a collision with a third-party vessel.	Benefits outweigh cost/sacrifice.	Yes **C 14.7**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[29]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Advise if any buoys in the area are not holding position or are not working as expected.				
Notify AHO of activities and movements no less than four working weeks prior to the scheduled activity commencement date.	F: Yes. CS: Minimal cost. Standard practice.	Notification to AHO will enable them to generate navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including AUSCOAST warnings where relevant)).	Benefits outweigh cost/sacrifice. Control is also Standard practice.	Yes **C 1.1**
Notify AMSA JRCC of activities and movements of the activity 24 - 48 hours before operations commence.	F: Yes. CS: Minimal cost. Standard practice.	Communication of the Petroleum Activities Program to other marine users ensures they are informed and aware, thereby reducing the likelihood of a collision with a third-party vessel.	Benefits outweigh cost/sacrifice. Control is also Standard practice.	Yes **C 1.3**
Mitigation: Oil spill response	Refer to **Appendix D**.			
Professional Judgement – Eliminate				
Eliminate use of vessels.	F: No. The use of vessels is required to conduct the Petroleum Activities Program. CS: Not considered, control not feasible.	Not considered, control not feasible.	Not considered, control not feasible.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
Risk Based Analysis				
A quantitative spill risk assessment was undertaken (see detail above).				
ALARP Statement				
On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the risks and consequences of an unplanned loss of hydrocarbon as a result of vessel collision. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that an unplanned loss of hydrocarbon as a result of a vessel collision represents a moderate current risk rating that is unlikely to result in potential consequence greater than localised, minor and temporary disruption to a small proportion of the population and no impact on critical habitat or activity. Relevant recovery plans and conservation advice have been considered during the impact assessment, and the

Petroleum Activities Program is not considered to be inconsistent with the overall recovery objectives and actions of these recovery plans and conservation advice.

Further opportunities to reduce the risks and consequences have been investigated above. The adopted controls are considered good oil and gas industry practice. The potential risks and consequences are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the risks and consequences of the described emissions to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 14 No release of hydrocarbons to the marine environment due to a vessel collision during the Petroleum Activities Program.	**C 14.1** Marine Order 30 (Prevention of collisions) 2016, including: adherence to steering and sailing rules including maintaining lookouts (e.g. visual, hearing, radar, etc.), proceeding at safe speeds, assessing risk of collision and taking action to avoid collision (monitoring radar) adherence to navigation light display requirements, including visibility, light position/ shape appropriate to activity adherence to navigation noise signals as required.	**PS 14.1** Support vessels, installation vessels and MODU compliant with Marine Order 30 (Prevention of collisions) 2016 (which requires vessels to be visible at all times) to prevent unplanned interaction with marine users.	**MC 14.1.1** Marine Assurance inspection records demonstrate compliance with standard maritime safety procedures (Marine Orders 21, 27 and 30).
	C 14.2 Marine Order 21 (Safety and emergency procedures) 2016, including: • adherence to minimum safe manning levels	**PS 14.2** Support vessels, installation vessels and MODU compliant with Marine Order 21 (Safety and emergency procedures) 2016 to prevent unplanned interaction with marine users.	**MC 14.2.1** Marine Assurance inspection records demonstrate compliance with standard maritime safety procedures (Marine Orders 21, 27 and 30).
	C 14.3 Marine Order 27 (safety of navigation and radio equipment) 2016: • maintenance of navigation equipment in efficient working order (compass/radar) • navigational systems and equipment required are those specified in Regulation 19 of Chapter V of *Safety of Life at Sea* • Automatic Identification System that provides other users with information about the vessel's identity, type,	**PS 14.3** Support vessels, installation vessels and MODU compliant with Marine Order 27 (safety of navigation and radio equipment) 2016 to prevent unplanned interaction with marine users.	**MC 14.3.1** Marine Assurance inspection records demonstrate compliance with standard maritime safety procedures (Marine Orders 21, 27 and 30).

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	position, course, speed, navigational status and other safety-related data.		
	C 14.4 Establishment of a 500 m petroleum safety zone around MODU and installation vessels and communicated to marine users.	**PS 14.4** No entry of unauthorised vessels within the 500 m petroleum safety zone.	**MC 14.4.1** Records demonstrate breaches by unauthorised vessels within the petroleum safety zone are recorded. **MC 14.4.2** Consultation records demonstrate that AHS has been notified prior to commencement of the activity to allow generation of navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including AUSCOAST warnings where relevant)), which communicate safety exclusion zones to marine users.
	C 14.5 Use of a transmitting RACON unit on MODU, when drilling in a shipping lane, as an additional navigation aid for commercial shipping traffic utilising shipping fairways.	**PS 14.5** Transmitting RACON unit active when drilling within the shipping lane.	**MC14.5.1** Records demonstrate the RACON unit is activated during drilling activities within the shipping lane.
	C 14.6 Support vessel on standby as required during drilling activities.	**PS 14.6** Support vessel on standby as required to communicate with third-party vessels, prevent unplanned interaction (including warning to vessels approaching the 500 m petroleum safety zone) and to assist in emergencies, as required.	**MC 14.6.1** Records demonstrate an activity support vessel was on standby as required as per definition or reference in Woodside's One Marine Charterers Instructions.
	C 14.7 When a support vessel is designated for standby it will undertake actions to prevent unplanned interactions, such as: • maintain a 24-hour radio watch on designated radio channel(s)	**PS 14.7** Define role of support vessels in maintaining petroleum safety zone, preventing unplanned third-party vessel interactions, monitoring the effectiveness of navigation controls (e.g. signals), and warning third-party vessels of navigation hazards.	**MC 14.7.1** Records of non-conformance against controls maintained.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	• perform continuous surveillance and warn the MODU/project vessels of any approaching vessels reaching 500 m petroleum safety zone. Surveillance shall be conducted by a combination of: • visual lookout • radar watch • other electronic systems available including Automatic Identification System • monitoring any additional/agreed radio communications channels • all other means available • while complying with the International Regulations for Preventing Collisions at Sea (COLREGS), approach any vessel attempting to transit through the 500 m zone and contact vessel by all available means. Monitor and advise the MODU if: • MODU navigation signals are defective • visibility becomes restricted • any buoys in the area are not holding position or are not working as expected.		
	C 1.1 Notify AHO of activities and movements no less than four working weeks prior to the scheduled activity commencement date.	**PS 1.1** Notification to AHO of activities and movements to allow generation of navigation warnings (Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) (including AUSCOAST warnings where relevant)).	**MC 1.2.1** Consultation records demonstrate that AHO has been notified prior to commencement of an activity to allow generation of navigation warnings (MSIN and NTM (including AUSCOAST warnings where relevant)).
	C 1.3	**PS 1.3**	**MC 1.3.1**

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	Notify AMSA JRCC of activities and movements 24 - 48 hours before operations commence.	Notification to AMSA JRCC to prevent activities interfering with other marine users. AMSA's JRCC will require the MODU's details (including name, callsign and MMSI), satellite communications details (including INMARSAT-C and satellite telephone), area of operation, requested clearance from other vessels and need to be advised when operations start and end.	Consultation records demonstrate that AMSA JRCC has been notified before commencing the activity within required timeframes.
Detailed preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are presented in **Appendix D**.			

6.7.4 Accidental Hydrocarbon Release: Bunkering

Context		
Project Vessels – **Section 3.5**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**	Stakeholder Consultation – **Section 5**

Risk Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and groundwater	*Marine sediment*	*Water quality*	*Air quality (incl odour)*	*Ecosystems/habitat*	*Species*	*Socioeconomic*	*Decision type*	*Consequence/impact*	*Likelihood*	*Risk rating*	*ALARP tools*	*Acceptability*	*Outcome*
Loss of hydrocarbons (diesel/jet fuel) to marine environment from bunkering/refuelling			X			X		A	E	2	M	LCS GP PJ	Broadly acceptable	EPO 15

Description of Source of Risk

Bunkering of marine diesel between support vessels and the MODU (see **Section 3.7.4**), as well as the possible refuelling of cranes, helicopters and other equipment which may take place on the MODU, may result in a loss of containment. Three credible scenarios for a loss of containment of marine diesel during bunkering operations identified for this activity are:

- Partial or total failure of a bulk transfer hose or fittings during bunkering, due to operational stress or other integrity issues, could spill marine diesel to the deck and/or into the marine environment. This volume would be in the order of less than 200 L, based on the likely volume of a bulk transfer hose and assuming a failure of the dry break coupling and complete loss of hose volume.
- Partial or total failure of a bulk transfer hose or fittings during bunkering, combined with a failure in procedure to shut off fuel pumps for a period of up to five minutes, resulting in about 8 m^3 of marine diesel loss to the deck and/or into the marine environment.
- Partial or total failure of a bulk transfer hose or fittings during helicopter refuelling could result in a spill of aviation jet fuel to the helicopter deck and/or into the marine environment. All helicopter refuelling activities are closely supervised and leaks on the helideck are considered to be easily detectable. In the event of a leak, transfer would cease immediately. The credible volume of such a release during helicopter refuelling would be in the order of <100 L. Given the limited volume of the potential release, the existing modelling undertaken is considered an appropriate (albeit conservative) surrogate.

Impact Assessment

Potential Consequence Overview

Previous modelling studies for 8 m^3 marine diesel releases, spilled at the surface as a result of bunkering activities, indicated that the potential for exposure to surface hydrocarbons exceeding 10 g/m^2 was confined to within the immediate vicinity (about 1 km) of the release sites. Based on the previous modelling studies and the modelling presented in **Section 6.7.3**, it is considered that there is limited potential for contact with sensitive receptor locations above surface (1 g/m^2 and 10 g/m^2), entrained (100 ppb) or dissolved (100 ppb) threshold concentrations from an 8 m^3 spill of marine diesel within the Operational Area. The modelling presented in **Section 6.7.3** for a much larger volume diesel spill (1000 m^3) predicted the diesel spill to be mainly restricted to open offshore waters, with a low probability of contacting any protected areas (the highest was a probability of 14% for entrained hydrocarbons to contact the Montebello AMP at or above the threshold of 100 ppb).

Summary of Potential Impacts to Protected Species
The potential biological and ecological impacts associated with much larger hydrocarbon spills are presented in **Section 6.7.2** and **Section 6.7.3**; further detail on impacts specific to a spill of marine diesel from a bunkering loss are provided below. The biological consequences of such a small volume spill on identified open water sensitive receptors relate to the potential for minor impacts to megafauna, plankton and fish populations (surface and water column biota) that are within the spill-affected area. No impacts to commercial fisheries are expected. Refer to **Section 6.7.3** (potential impacts of unplanned hydrocarbon release to the marine environment from vessel collision) for the detailed potential impacts. However, the extent of the EMBA associated with a marine diesel spill from loss during bunkering will be much reduced in terms of spatial and temporal scales, and hence, potential impacts from bunkering are considered slight.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[30]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Marine Order 91 (Marine pollution prevention – oil) 2014, requires Ship Oil Pollution Emergency Plan (SOPEP)/Spill Monitoring Programme Execution Plan (SMPEP) (as appropriate to vessel class).	F: Yes. CS: Minimal cost. Standard practice.	By ensuring a SOPEP/SMPEP is in place for the vessel, the likelihood of a spill entering the marine environment is reduced. Although no significant reduction in consequence could result, the overall risk is reduced.	Controls based on legislative requirements – must be adopted.	Yes **C 15.1**
Good Practice				
Bunkering equipment controls: • All hoses that have a potential environmental risk following damage or failure shall be linked to the MODU's preventative maintenance system. • All bulk transfer hoses shall be tested for integrity before use (tested in accordance with Original Equipment Manufacturer recommendations) and re-certified annually as a minimum. • There shall be dry-break couplings and flotation on fuel hoses. • There shall be an adequate number of appropriately stocked, located and maintained spill kits.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a spill occurring. Although no significant reduction in consequence could result, the overall risk is reduced.	Benefits outweigh cost/sacrifice.	Yes **C 15.2**

[30] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[30]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Contractor procedures include requirements to be implemented during bunkering/refuelling operations, including: • A completed PTW and/or Job Safety Assessment (JSA) shall be implemented for the hydrocarbon bunkering/refuelling operation. • Visual monitoring of gauges, hoses, fittings and the sea surface during the operation. • Hose checks prior to commencement. • Bunkering/refuelling will commence in daylight hours. If the transfer is to continue into darkness, the JSA risk assessment must consider lighting and the ability to determine if a spill has occurred. • Hydrocarbons shall not be transferred in marginal weather conditions.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a spill occurring. Although no significant reduction in consequence could result, the overall risk is reduced.	Benefits outweigh cost/sacrifice.	Yes **C 15.3**
Mitigation: Oil spill response Refer to **Appendix D**.				
Professional Judgement – Eliminate				
No refuelling of helicopter on MODU.	F: No. Given the distance of the Permit Area from the airports suitable for helicopter operations, and the endurance of available helicopters, eliminating helicopter refuelling is not feasible. Helicopter flights cannot be eliminated, and may be required in emergency situations. CS: Not assessed, control cannot feasibly be implemented.	Not considered, control not feasible.	Not considered, control not feasible.	No

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[30]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
The MODU/installation vessel brought into port to refuel.	F: No. Does not eliminate the fuel transfer risk. It is not operationally practical to transit MODU back to port for refuelling based on the frequency of the refuelling requirements and distance from the nearest port (Barrow Island 121 km). CS: Significant due to schedule delay and vessel transit costs and day rates.	Eliminates the risk in the Permit Area, However, moves risk to another location. Therefore, no overall benefit.	Disproportionate. The cost/ sacrifice outweighs the benefit gained.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the risks and consequences of a bunkering spill. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement Loss of hydrocarbons to marine environment during bunkering has been evaluated as having a Moderate current risk rating that is unlikely to result in potential impact greater than minor impacts to megafauna, plankton and fish populations (surface and water column biota) that are within the spill-affected area, and no impacts to commercial fisheries. Further opportunities to reduce the risks and consequences have been investigated above. The adopted controls are considered good oil and gas industry practice. The potential risks and consequences are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the risks and consequences of the described emissions to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 15 No unplanned loss of hydrocarbons to the marine environment from bunkering greater than a	**C 15.1** Marine Order 91 (marine pollution prevention – oil) 2014, requires SOPEP/ SMPEP (as appropriate to vessel class).	**PS 15.1** Appropriate initial responses prearranged and exercised for response to a hydrocarbon spill, as appropriate to vessel class in compliance with Marine Order 91 (marine pollution prevention – oil) 2014, requires SOPEP/SMPEP (as appropriate to vessel class).	**MC 15.1.1** Marine Assurance inspection records demonstrate compliance with Marine Order 91.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
consequence level of E[31] during the Petroleum Activities Program.	**C 15.2** Bunkering equipment controls: • All hoses that have a potential environmental risk following damage or failure shall be placed on the MODU's preventative maintenance system. • All bulk transfer hoses shall be tested for integrity before use (tested in accordance with Original Equipment Manufacturer recommendations and re certified annually as a minimum). • There shall be dry-break couplings and flotation on fuel hoses. • There shall be an adequate number of appropriately stocked, located and maintained spill kits.	**PS 15.2.1** Bunkering equipment will be put on the MODU preventative maintenance system to ensure damaged equipment is replaced prior to failure.	**MC 15.2.1** Records confirm the MODU bunkering equipment is subject to systematic integrity checks.
		PS 15.2.2 Inventory loss from hydrocarbon containing equipment minimised in the event of a failure.	**MC 15.2.2** Records confirm presence of dry break of couplings and flotation on fuel hoses.
		PS 15.2.3 Adequate resources are available to allow implementation of SOPEP.	**MC 15.2.3** Records confirm presence of spill kits.

[31] Defined as 'Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function), physical or biological attributes'.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	C 15.3 Contractor procedures include requirements to be implemented during bunkering/refuelling operations, including: • Implement a completed PTW and/or JSA for the hydrocarbon bunkering/refuelling operation. • Visually monitor gauges, hoses, fittings and the sea surface during the operation. • Check hoses prior to commencement. • Commence bunkering/refuelling in daylight hours. If the transfer is to continue into darkness, the JSA risk assessment must consider lighting and the ability to determine if a spill has occurred. • Do not transfer hydrocarbons in marginal weather conditions.	**PS 15.3** Comply with Contractor procedures for managing bunkering/helicopter operations.	**MC 15.3.1** Records demonstrate bunkering/refuelling performed in accordance with contractor bunkering procedures.
Detailed oil spill preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are presented in **Appendix D**.			

6.7.5 Unplanned Discharges: Drilling Fluids

Context	
Drilling Activities – **Section 3.8** Drilling Fluid System - **Section 3.8.10**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**

Risk Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and groundwater	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence/impact***	***Likelihood***	***Risk rating***	***ALARP tools***	***Acceptability***	***Outcome***
Accidental discharge of drilling fluids (WBM/NWBM/ base oil) to marine environment due to failure of slip joint packers, bulk transfer hose/fitting, emergency disconnect system or from routine MODU operations		X	X		X	X		A	E	1	L	LCS GP PJ	Broadly acceptable	EPO 16

Description of Source of Risk

Transfers

A support vessel will undertake bulk transfer of mud or base oil to the MODU, if and when required. Failure of a transfer hose or fittings during a transfer or backload, as a result of an integrity or fatigue issue, could result in a spill of mud or base oil to either the bunded deck of the MODU or to the marine environment.

Similar to a spill event during bunkering/refuelling (**Section 6.7.4**), the most likely spill volume of mud is likely to be less than 0.2 m^3, based on the volume of the transfer hose and the immediate shutoff of the pumps by personnel involved in the bulk transfer process. However, the worst-case credible spill scenario could result in up to 8 m^3 of mud being discharged. This scenario represents a complete failure of the bulk transfer hose combined with a failure to follow procedures requiring transfer activities to be monitored, coupled with a failure to immediately shut off pumps (e.g. mud pumped through a failed transfer hose for a period of about five minutes).

Slip Joint Packer Failure

The riser slip joint allows for dynamic movement of the MODU (heave) in relation to the static location of the BOP. A partial or total failure of the slip joint packer could result in a loss of mud to the marine environment. The likely causes of this failure include a loss of pressure in the pneumatic (primary) system combined with loss of pressure in the back up (hydraulic) system.

Catastrophic sequential failure of both slip joint packers (pneumatic and hydraulic) would trigger the alarm and result in a loss of the volume of fluid above the slip joint (conservatively 1.5 m^3) plus the volume of fluid lost in the one minute (maximum) taken to shut down the pumps, at a flow rate of 1000 gallons (3.8 m^3) per minute. It is expected that this catastrophic failure would result in a total loss of 5.3 m^3.

Failure of either of the slip joint packers at a rate not large enough to trigger the alarms could result in an undetected loss of 20 bbl (3 m^3) maximum, assuming a loss rate of 10 bbl/hr and that MODU personnel would likely walk past the moon pool at least every two hours.

Activation of the Emergency Disconnect Sequence

The EDS (**Section 3.11.11**) is an emergency system that provides a rapid means of shutting in the well (i.e. BOP closed) and disconnecting the MODU from the BOP. There are two main scenarios where the EDS could be activated:

1. automatic activation of the EDS due to a loss of MODU station keeping resulting from loss of multiple moorings
2. manual activation of the EDS due to an identified threat to the safety of the MODU including potential collision by a third-party vessel or a loss of well control.

When drilling, this could result in a subsurface release of a combination of mud (including NWBM) and cuttings at the seabed and a release of base fluid. The volume of material released depends on the water depth and hence the length of the riser (i.e. the entire riser volume would be lost). The volume for the full length of the riser, is estimated to be 30 m^3. Of this total volume base oil accounts for around 70%. The base oil of the NWBM would remain in an emulsion with the other components of the mud system and drill cuttings.

NWBM Drilling Fluid System

The selection of an NWBM drilling fluid system will be based on Woodside processes (as outlined in **Section 3.8.11**); however, for the purposes of this risk assessment an example base oil (Saraline 185V) has been used. Saraline 185V is a mixture of volatile to low volatility hydrocarbons. Predicted weathering of base oil, based on typical conditions in the region, indicates that about 50% by mass is predicted to evaporate over the first day or two (refer to **Table 6-17**). At this time the majority of the remainder could be entrained into the water column, in calm conditions entrained hydrocarbons are likely to resurface with up to 100% able to evaporate over time.

Table 6-17: Characteristics of the non-water-based mud base oil

Oil type	Initial density (kg/m^3)	Viscosity (cP @ 20˚C)	Volatiles (%) <180	Semi volatiles (%) 180–265	Low volatility (%) 265–380	Residual (%) >380	Aromatic (%) of whole oil <380°C boiling point
			Non-Persistent		Persistent		
Base oil (Saraline 185V)	0.7760	2.0 at 40°C	8.5	41.1	50.4	0.0	0.0

Impact Assessment

Potential Impacts to Water Quality, Other Habitats and Communities and Protected Species

NWBM

NWBM is made up of a number of components detailed in **Section 3.8.10.2** including base oil, which generally has a high volatile to semi-volatile fraction. If released to the marine environment at surface, this generally evaporates within the first 48 hours, with the remaining fraction being on the sea surface and weathering at a slower rate. As a result of this volatility, combined with the worst-case credible spill scenario volumes (30 m^3), and based on Woodside's experience of modelling base oil, it is considered there would be an extremely small footprint area associated with any release. Therefore, any surface oil would be confined to open waters with a minor surface slick that would not reach any sensitive receptors. Therefore, impacts on water quality would be minor and temporary in nature. The material safety datasheet for Saraline 185V indicates that it is readily biodegradable, non-toxic in the water column and has low sediment toxicity (Shell, 2014). Marine fauna may be affected if they come in direct contact with a release (i.e. by traversing the immediate spill area), but due to the small footprint of such a spill, it is anticipated that any impacts would be negligible and temporary in nature.

WBM

WBM is made up of a number of components detailed in **Section 3.8.10.1** including a variety of chemicals, incorporated into the selected drilling fluid system to meet specific technical requirements. If released to the marine environment at surface, there would be an extremely small impact footprint area associated with a release. Any release would be confined to the open waters of the Operational Area that would not reach any sensitive receptors. Components of the WBM would settle out in the water column and be subject to dilution. Given the low toxicity of WBM and its planned discharge during drilling, any impacts on water quality would be minor and temporary in nature.

The EMBA associated with the release of NWBM from the activation of the EDS would be small and limited to deeper water seabed surrounding the well site (the release point). The environmental consequence of such a release would include a highly localised area at the discharge location. It is expected the weight of NWBM would result in the majority of the release settling to the seabed and/or remaining at depth within the water column.

As described in **Section 6.6.5** base fluids for NWBM are designed to be biodegradable in offshore marine sediments. Biodegradation can result in a low oxygen (anoxic) environment resulting in changes in benthic community structure. NWBMs are designed to be low in toxicity and are not readily bioavailable, based on their physical/chemical properties, for bioaccumulation to infauna and epifauna. Lethal impacts to the underlying infauna may occur but are considered unlikely, and recolonisation would occur over time. Elevated hydrocarbon and metal concentrations in the

localised area of deposition would also occur, with reduction over time. It is likely that any impacts to water and sediment quality and low-sensitivity deeper water benthos would be short term, localised and a full recovery expected.
Summary of Potential Impacts to Environmental Value(s)
Given the adopted controls, it is considered that accidental discharge of NWBM/base oil or WBM will not result in a potential impact to protected species and water quality greater than 'E', with no significant impact on environmental receptors predicted. It is considered that the release of NWBM cuttings from an unplanned discharge will not result in a potential impact greater than negligible and/or temporary contamination above background levels, water quality standards, or known effect concentrations.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[32]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage must be collected via a closed drainage system. e.g. drill floor.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of contaminated deck drainage water being discharged to the marine environment. No change in consequence would occur.	Benefits outweigh cost/sacrifice.	Yes **C 5.3**
Marine riser's telescopic joint to: • comprise a minimum of two packers (one hydraulic and one pneumatic) • be pressure-tested in accordance with manufacturer's recommendations.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of equipment failure leading to an unplanned release of drilling fluids. Although the consequence of an unplanned release would be reduced, the reduction in likelihood reduces the overall risk providing an overall environmental benefit.	Benefits outweigh cost/sacrifice.	Yes **C 16.1**
Good Practice				
Drilling, completions, cementing, flowline pre-commissioning and subsea control fluids and additives will have an environmental assessment completed prior to use.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the consequence of impacts resulting from discharges to the marine environment by ensuring chemicals have been assessed for environmental acceptability. Planned discharges are required for safely executing activities; therefore, no reduction in likelihood can occur.	Benefits outweigh cost/sacrifice.	Yes **C 6.1**
No overboard disposal of bulk NWBM.	F: Yes.	Reduces the consequence of the	Benefits outweigh cost/sacrifice.	Yes **C 6.4**

[32] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[32]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	CS: Minimal cost. Standard practice.	release on the environment. Although no change in likelihood is provided, the decrease in consequence results in an environmental benefit.		
Contractor procedure for the management of drilling fluids transfers onto, around and off the MODU, which requires: • emergency shutdown systems for stopping losses of containment (e.g. burst hoses) • break-away dry-break couplings for oil-based mud hoses • transfer hoses to have flotation devised to allow detection of a leak • the valve line-up will be checked prior to commencing mud transfers • constant monitoring of the transfer process • direct radio communications • completed PTW and JSA showing contractor procedures are implemented • recording and verification of volumes moved to identify any losses • mud pit dump valves will be locked closed when not in use for mud transfers and operated under a PTW.	F: Yes. CS: Minimal cost. Standard practice for Woodside to review contractor systems prior to undertaking activity.	Reduces the likelihood of an unplanned release occurring. Although no change in consequence would occur, the reduction in likelihood decreases the overall risk, providing environmental benefit.	Benefits outweigh cost/sacrifice.	Yes **C 16.2**
Check the functionality of: • additional SCE (augers and cuttings dryers) • mud tanks • mud tank room • transfer hoses • NWBM base fluid transfer lines	F: Yes. CS: Minimal cost. Standard practice	Reduces the likelihood of an event occurring and reduces the potential consequences (by limiting volume released).	Benefits outweigh cost/sacrifice.	Yes **C 16.3**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[32]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
• NWBM base fluid transfer station • base fluid storage.				
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
Only use WBM.	F: Not feasible. A NWBM drilling fluid system is required for safety and technical reasons; therefore option to use must be maintained. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Engineered Solution				
Use a MODU which may have a larger tank storage capacity for NWBM. As such, there would be fewer bulk transfer movements.	F: Not feasible. The use of a MODU with greater storage capacity cannot be confirmed. CS: Significant cost and schedule delay would occur if the MODU was limited to greater storage capacity.	Not considered – control not feasible.	Not considered – control not feasible.	No
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the risks and consequences of the accidental discharge of drilling fluids, described above. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, unplanned discharges of drilling fluids represent a low risk rating that is unlikely to result in a potential impact greater than minor and/or temporary contamination above background levels and/or national/international quality standards and/or known biological effect concentrations on a localised scale. Further opportunities to reduce the risks and consequences have been investigated above. The adopted controls are considered good oil and gas industry practice. The potential risks and consequences are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the risks and consequences of an unplanned discharge of NWBM/base oil or WBM to a broadly acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 16 No unplanned loss of WBM/ NWBM/base oil greater than a consequence level of E[33] during the Petroleum Activities Program.	**C 5.3** Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage must be collected via a closed drainage system. E.g. drill floor.	**PS 5.3** Contaminated drainage contained, treated and/or separated prior to discharge.	**MC 5.3.1** Records demonstrate MODU has a functioning bilge/oily water management system.
	C 6.1 Drilling, completions, cementing, flowline pre-commissioning and subsea control fluids and additives will have an environmental assessment completed prior to use.	**PS 6.1** Reduces to ALARP the impact potential of all chemicals intended or likely to be discharged into the marine environment.	**MC 6.1.1** Records demonstrate chemical selection, assessment and approval process for selected chemicals is followed.
	C 6.4 Backload of NWBM	**PS 6.4** No overboard disposal of bulk NWBM	**MC 6.4.1** Incident reports of any unplanned discharges of NWBM.
	C 16.1 Marine riser's telescopic joint to: • comprise a minimum of two packers (one hydraulic and one pneumatic) • be pressure-tested in accordance with manufacturers recommendations.	**PS 16.1** MODU's joint packer deigned and maintained to reduce hydrocarbons discharged to the environment.	**MC 16.1.1** Records demonstrate that MODU's joint packer is compliant.
	C 16.2 Contractor procedure for the management of drilling fluids transfers onto, around and off the MODU, which requires: • emergency shutdown systems for stopping losses of containment (e.g. burst hoses) • break-away dry-break couplings for oil-based mud hoses • transfer hoses to have flotation devised to allow detection of a leak • the valve line-up is checked prior to commencing mud transfers	**PS 16.2** Compliance with contractor procedures to limit accidental loss to the marine environment.	**MC 16.2.1** Records demonstrate drilling fluid transfers are performed in accordance with the applicable contractor procedures.

[33] Defined as 'Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function), physical or biological attributes'.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	• constant monitoring of the transfer process • direct radio communications • completed PTW and JSA showing contractor procedures are implemented • recording and verification of volumes moved to identify any losses • mud pit dump valves are locked closed when not in use for mud transfers and operated under a PTW.		
	C 16.3 Check the functionality of: • SCE (augers and cuttings dryer) • mud tanks • mud tank room • transfer hoses • NWBM base fluid transfer lines • NWBM base fluid transfer station • base fluid storage.	**PS 16.3** Functionality checks on mud handling equipment prevent unacceptable use or discharge of NWBM/base oil.	**MC 16.3.1** Records demonstrate functionality of the specified equipment.

6.7.6 Unplanned Discharges: Deck and Subsea Spills

Context	
Project Fluids – **Section 3.8.10** and **Section 3.8.11**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**

Risk Evaluation Summary														
Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and groundwater	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence/impact***	***Likelihood***	***Risk rating***	***ALARP tools***	***Acceptability***	***Outcome***
Accidental discharge to the ocean of other hydrocarbons/ chemicals from MODU or support vessel deck activities and equipment (e.g. cranes) including subsea ROV hydraulic leaks			X		X	X		A	E	1	L	LCS GP PJ	Broadly acceptable	EPO 17

Description of Source of Risk

Deck spills include spills from stored hydrocarbons/chemicals or equipment. Support vessels, installation vessel and the MODU typically store hydrocarbon/chemicals in various volumes (20 L, 205 L; up to about 4000–6000 L). Storage areas are typically set up with effective primary and secondary bunding to contain any deck spills. Releases from equipment are predominantly from the failure of hydraulic hoses, which can either be located within bunded areas or outside of bunded or deck areas (e.g. over water on cranes).

Subsea spills can result from a loss of containment of fluids from subsea equipment including the BOP or ROVs. The ROV hydraulic fluid is supplied through hoses containing about 20 L of fluid. Hydraulic lines to the ROV arms and other tooling may become caught, resulting in minor leaks to the marine environment. Small volume hydraulic leaks may occur from equipment operating via hydraulic controls subsea (subsea control fluid). These include the diamond wire cutter, bolt tensioning equipment, ROV tooling, etc.

Minor leaks during wireline activities (a contingent activity, see **Section 3.11.5**) with a live well are described to include leaks such as:

- leaks from the lubricator, stuffing box and hose or fitting failure, which are expected to be less than 10 L (0.01 m^3)
- loss of containment – fluids – surface holding tanks
- stuffing box leak/under pressure
- draining of lubricator contents
- lubricant used to lubricate hole
- back-loading of raw slop fluids in an intermediate bulk container(s)
- excess grease/lubricant leaking from the grease injection head. Wind-blown lubricant dripping from cable/on deck.

Woodside’s operational experience demonstrates that spills are most likely to originate from hydraulic hoses and have been less than 100 L, with an average volume <10 L.

Impact Assessment
Potential Impacts to Water Quality, Other Habitats and Communities and Protected Species
Accidental spills of hydrocarbons or chemicals from the MODU and project vessels will decrease the water quality in the immediate area of the spill; however, the impacts are expected to be temporary and very localised due to dispersion and dilution in the open ocean environment. Given the offshore/open water location, receptors such as marine fauna may be affected if they come in direct contact with a release (i.e. by traversing the immediate spill area). In the event that marine fauna come into contact with a release, they could suffer fouling, ingestion, inhalation of toxic vapours, irritation of sensitive membranes in the eyes, mouth, digestive and respiratory tracts, and organ or neurological damage. Cetaceans may exhibit avoidance behaviour patterns and, as they are smooth skinned, hydrocarbons and other chemicals are not expected to adhere to them. Given the small area of the potential spill and the dilution and weathering of any spill, the likelihood of ecological impacts to marine fauna (including protected species), other communities and habitats is likely to be negligible to very minor and restricted to individual animals. No impacts on socioeconomic receptors are expected due to the low levels of fishing activity in the Operational Area, the volumes of hydrocarbons/chemicals that could be accidentally spilled, and the localised and temporary nature of the impacts.
Summary of Potential Impacts to Environmental Value(s)
Given the adopted controls, it is considered that other hydrocarbon/chemical spills to the marine environment will not result in a potential consequence greater than slight, short-term local impacts on species, habitat (but not affecting ecosystems function), physical and biological attributes (i.e. Environment consequence – E).

Demonstration of ALARP

Control Considered	*Control Feasibility (F) and Cost/Sacrifice (CS)*[34]	*Benefit in Impact/Risk Reduction*	*Proportionality*	*Control Adopted*
Legislation, Codes and Standards				
Marine Order 91 (marine pollution prevention – oil) 2014, requires SOPEP/SMPEP (as appropriate to vessel class).	F: Yes. CS: Minimal cost. Standard practice.	Legislative requirements to be followed reduce the likelihood of an unplanned release. The consequence is unchanged.	Controls based on legislative requirements – must be adopted.	Yes **C 15.1**
Liquid chemical and fuel storage areas are bunded or secondarily contained when they are not being handled/moved temporarily.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of contaminated deck drainage water being discharged to the marine environment.	Controls based on legislative requirements – must be adopted.	Yes **C 17.1**
Good Practice				
Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage must be collected via a closed drainage system. E.g. drill floor.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of contaminated deck drainage water being discharged to the marine environment.	Benefits outweigh cost/sacrifice.	Yes **C 5.3**
Spill kits positioned in high risk locations around the rig (near potential spill	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a deck spill from entering the marine	Benefits outweigh cost/sacrifice.	Yes **C 17.2**

[34] Qualitative measure

Demonstration of ALARP				
Control Considered	*Control Feasibility (F) and Cost/Sacrifice (CS)[34]*	*Benefit in Impact/Risk Reduction*	*Proportionality*	*Control Adopted*
points such as transfer stations).		environment. The consequence is unchanged.		
Installation vessels have self-containing hydraulic oil drip tray management system.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of a deck spill from entering the marine environment. The consequence is unchanged.	Benefits outweigh cost/sacrifice.	Yes **C 17.3**
Detailed oil spill preparedness and response performance outcomes, standards and measurement criteria for the Petroleum Activities Program are presented in **Appendix D.**				
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
Below-deck storage of all hydrocarbons and chemicals.	F: Not feasible. During operations there is a need to keep small volumes near activities and within equipment requiring use of hydrocarbons and chemicals and can result in increased risk of leaks from transfers via hose or smaller containers. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
A reduction in the volumes of chemicals and hydrocarbons stored onboard MODU/vessels.	F: Yes. Increases the risks associated with transportation and lifting operations. CS: Project delays if required chemicals not on board. Increases the risks associated with transportation and lifting operations.	No reduction in likelihood or consequence since chemicals will still be required to enable drilling activities to occur.	Disproportionate. The cost/ sacrifice outweighs the benefit gained.	No
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (Decision Type A), Woodside considers the adopted controls appropriate to manage the risks and consequences of the potential unplanned accidental spills described above. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that an unplanned minor discharge of hydrocarbons as a result of minor deck and subsea spills represents a low current risk rating that is unlikely to result in potential impact greater than localised, minor and temporary disruption to a small proportion of the population and no impact on critical habitat or activity. Further opportunities to reduce the risks and consequences have been investigated above. The adopted controls are consistent with the most relevant regulatory guidelines and good oil and gas industry practice. The potential risks and consequences are considered acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the risks and consequences of minor unplanned deck and subsea spills to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 17 No unplanned spills to the marine environment from deck activities greater than a consequence level of F[35] during the Petroleum Activities Program.	**C 15.1** Marine Order 91 (marine pollution prevention – oil) 2014, requires SOPEP/SMPEP (as appropriate to vessel class).	**PS 15.1** Appropriate initial responses prearranged and exercised for response to a hydrocarbon spill, as appropriate to vessel class in compliance with Marine Order 91 (marine pollution prevention – oil) 2014, requires SOPEP/ SMPEP (as appropriate to vessel class).	**MC 15.1.1** Marine assurance inspection records demonstrate compliance with Marine Order 91.
	C 17.1 Liquid chemical and fuel storage areas are bunded or secondarily contained when they are not being handled/ moved temporarily.	**PS 17.1** Failure of primary containment in storage areas does not result in loss to the marine environment.	**MC 17.1.1** Records confirms all liquid chemicals and fuel are stored in bunded/ secondarily contained areas when not being handled/ moved temporarily.
	C 5.3 Where there is potential for loss of primary containment of oil and chemicals on the MODU, deck drainage must be collected via a closed drainage system. E.g. drill floor.	**PS 5.3** Contaminated drainage contained, treated and/or separated prior to discharge.	**MC 5.3.1** Records demonstrate MODU has a functioning deck drainage management system.
	C 17.2 Spill kits positioned in high risk locations around the rig (near potential spill points such as transfer stations).	**PS 17.2** Spill kits to be available for use to clean up deck spills.	**MC 17.2.1** Records confirms spill kits are present, maintained and suitably stocked.
	C 17.3 Installation vessels have self-containing hydraulic oil drip tray management system.	**PS 17.3** Contain any on-deck spills of hydraulic oil.	**MC 17.3.1** Records demonstrate project installation vessels are equipped with self-containing hydraulic oil drip tray management system.

[35] Defined as 'Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function), physical or biological attributes'.

6.7.7 Unplanned Discharges: Loss of Solid Hazardous and Non-hazardous Wastes/Equipment

Context	
Project Vessels – **Section 3.5**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**

Risk Evaluation Summary

	Environmental Value Potentially Impacted							*Evaluation*						
Source of Risk	***Soil and groundwater***	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence/impact***	***Likelihood***	***Risk rating***	***ALARP tools***	***Acceptability***	***Outcome***
Accidental loss of hazardous or non-hazardous wastes/ equipment to the marine environment (excludes sewage, grey water, putrescible waste and bilge water)			X		X	X		A	F	2	L	GP	Broadly acceptable	EPO 18

Description of Source of Risk
The MODU and project vessels generate a variety of solid wastes including packaging and domestic wastes such as aluminium cans, bottles, paper and cardboard. Hence, there is the potential for solid wastes to be lost overboard to the marine environment. These have previously occurred during back-loading activities, periods of adverse weather and incorrect waste storage.

Impact Assessment
Potential Impacts to Water Quality, Other Habitats and Communities, and Protected Species
The potential impacts of solid wastes accidentally discharged to the marine environment include direct pollution and contamination of the environment and secondary impacts relating to potential contact of marine fauna with wastes, resulting in entanglement or ingestion and potentially leading to injury and death of individual animals. The temporary or permanent loss of waste materials into the marine environment is not likely to have a significant environmental impact, based on the location of the Operational Area, the types, size and frequency of wastes that could occur, and species present.
Summary of Potential Impacts to Environmental Value(s)
Given the adopted controls, it is considered that the accidental discharge of solid waste described will result in localised impacts not significant to environmental receptors (i.e. Environment consequence – F).

Demonstration of ALARP

Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[36]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
None identified				
Good Practice				

[36] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[36]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Drilling and Completions Waste Management Plan, which requires: • dedicated space for waste segregation bins and skips shall be provided on the MODU • records of all waste to be disposed, treated or recycled • waste streams shall be handled and managed according to their hazard and recyclability class • all non-putrescible waste (excludes all food, greywater or sewage waste) shall be transported from the MODU and disposed of onshore.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of an unplanned release. The consequence is unchanged.	Benefit outweighs cost/ sacrifice.	Yes **C 18.1**
Installation vessel waste arrangements, which require: • dedicated waste segregation bins • records of all waste to be disposed, treated or recycled • waste streams to be handled and managed according to their hazard and recyclability class.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of an unplanned release. The consequence is unchanged.	Benefit outweighs cost sacrifice.	Yes **C 18.2**
Dropped objects/waste will be recovered, using the MODU/project vessel ROV, crane or support vessel, where safe and practicable. Where safe and practicable for this activity, will consider: • risk to personnel to retrieve object • whether the location of the object is in recoverable water depths • object's proximity to subsea infrastructure • ability to recover the object (i.e. nature of object, lifting equipment, or, ROV availability and suitable weather). Any material dropped objects / waste that remain in the title will undergo an	F: Yes. CS: Minimal cost. Standard practice.	Occurs after an unplanned release of solid waste and therefore no change to the likelihood. Since the waste objects may be recovered, a reduction in consequence is possible.	Benefit outweighs cost/ sacrifice.	Yes **C 18.3**

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[36]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
impact assessment and be added to the inventory.				
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the risks and consequences of accidental discharges of waste. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, accidental discharge of solid waste represents a low current risk rating that is unlikely to result in a potential consequence of slight, short term impacts on species, habitat (but not affecting ecosystems function), physical and biological attributes. Further opportunities to reduce the risks and consequences have been investigated above. The adopted controls are considered good oil and gas industry practice and meet legislative requirements (Marine Orders 95 and 94). The potential risks and consequences are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the risks and consequences of these discharges to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 18 No unplanned releases of solid hazardous or non hazardous waste to the marine environment greater than a consequence level of F[37] during the Petroleum Activities Program.	**C 18.1** Drilling and Completions Waste Management Plan, which requires: • dedicated space for waste segregation bins and skips shall be provided on the MODU • records of all waste to be disposed, treated or recycled • waste streams shall be handled and managed according to their hazard and recyclability class • all non-putrescible waste (excludes all food, greywater or sewage waste) shall be	**PS 18.1** Hazardous and non-hazardous waste will be managed in accordance with the Drilling and Completions Waste Management Plan.	**MC 18.1.1** Records demonstrate compliance against Drilling and Completions Waste Management Plan.

[37] Defined as 'Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function), physical or biological attributes'.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	transported from the MODU and disposed of onshore.		
	C 18.2 Installation Vessel Waste Management Plan, which requires: • dedicated waste segregation bins • records of all waste to be disposed, treated or recycled • waste streams shall be handled and managed according to their hazard and recyclability class.	**PS 18.2** Hazardous and non-hazardous waste will be managed in accordance with the Installation Vessel Waste Management Plan.	**MC 18.2.1** Records demonstrate compliance against Installation Vessel Waste Management Plan.
	C 18.3 Dropped objects/waste will be recovered, using the MODU/project vessel ROV, crane or support vessel, where safe and practicable. Where safe and practicable for this activity, will consider: • risk to personnel to retrieve object • whether the location of the object is in recoverable water depths • object's proximity to subsea infrastructure • ability to recover the object (i.e. nature of object, lifting equipment, or, ROV availability and suitable weather). Any material dropped objects / waste that remain in the title will undergo an impact assessment and be added to the inventory.	**PS 18.3a** Any objects dropped to the marine environment will be recovered where safe and practicable to do so.	**MC 18.3.1** Records detail the recovery of any objects/waste lost to the marine environment.
		PS 18.3b Where retrieval is not practicable and / or safe, material items (property) that are lost to the marine environment will undergo an impact assessment and will be added to the inventory for the title.	**MC 18.3.2** First Priority records demonstrate outcomes of the safe and practicable evaluation, including an impact assessment for the objects remaining.
			MC 18.3.3 Records demonstrate that material items left in title are added to the inventory.

6.7.8 Physical Presence: Vessel Collision with Marine Fauna

Context

Project Vessels – **Section 3.5**	Biological Environment – **Section 4.5**

Risk Evaluation Summary

Source of Risk	***Environmental Value Potentially Impacted***							***Evaluation***						
	Soil and groundwater	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence/impact***	***Likelihood***	***Risk rating***	***ALARP tools***	***Acceptability***	***Outcome***
Accidental collision between project vessels and protected marine fauna						X		A	E	1	L	LCS GP PJ	Broadly acceptable	EPO 19

Description of Source of Risk

The MODU and project vessels operating in and around the Operational Area may present a potential hazard to cetaceans (e.g. humpback whales, EIO pygmy blue whales) and other protected marine fauna such as marine turtles. Vessel movements can result in collisions between the vessel (hull and propellers) and marine fauna, potentially resulting in superficial injury, serious injury that may affect life functions (e.g. movement and reproduction) and mortality. The factors that contribute to the frequency and severity of impacts due to collisions vary greatly due to vessel type, vessel operation (specific activity, speed), physical environment (e.g. water depth) and the type of animal potentially present and their behaviours.

To achieve efficiencies the project will optimise vessel transits and limit support vessel time in the field. Support vessels are typically stationary or moving at low speeds when supporting drilling operations; support vessels typically transit to and from the Operational Area between two and four trips per week (e.g. to port) when the MODU is present in the Operational Area.

Impact Assessment

Potential Impacts to Protected Species

The likelihood of vessel–whale collision being lethal is influenced by vessel speed; the greater the speed at impact, the greater the risk of mortality (Jensen and Silber, 2004; Laist et al., 2001). Vanderlaan and Taggart (2007) found that the chance of lethal injury to a large whale as a result of a vessel strike increases from about 20% at 8.6 knots to 80% at 15 knots.

Support vessels within the Operational Area are likely to be travelling less than eight knots; therefore, the chance of a vesssel collision with EPBC Act listed marine species including threatened species resulting in a lethal outcome markedly reduced. The only overlap of biologically important areas and the Operational Area relevant to the risk of vessel strikes is the whale shark foraging area, as defined below. No known key aggregation areas (resting, breeding or feeding) for ther EPBC Act listed marine species are located within or immediately adjacent to the Operational Area. However, the following BIAs overlap with the Operational Area (refer to **Section** 4.5 for more detail of seasonal timings):

- whale shark foraging area extending from the Ningaloo Coast along the northern Western Australian 200 m isobath. This is an important migration route, with migration occurring mainly between July to November.
- internesting BIA for flatback turtles around the Montebello Islands (Hermite Island, Northwest Island and Trimouille Island) (nesting between December to March) however scientific evidence on the movement of internesting flatback turtles (and therefore the Operational Area) does not support their presence in offshore waters.

According to the data of Vanderlaan and Taggart (2007), it is estimated that the risk is less than 10% at a speed of four knots. Vessel–whale collisions at this speed are uncommon and, based on reported data contained in the US NOAA database (Jensen and Silber, 2004), there are only two known instances of collisions when the vessel was travelling at less than 6 knots. Both were from whale watching vessels that were deliberately placed among whales.

The Operational Area overlaps with the whale shark foraging BIA, also defined as the migration route for whale sharks post-aggregation off Ningaloo (March to July), with migration occurring mainly between July and November (Threatened Species Scientific Committee 2015d). The Operational Area overlap with the foraging BIA represents 0.07% of the total area of the foraging BIA. The movement of vessels directly associated with the activities or in support roles are not considered to be a significant risk to whale sharks present within this biologically important area due to: (i) the small spatial extent of the Operational Area in relation to the total area of the defined BIA, (ii) the low numbers of whales sharks potentially present within the Operational Area given there are no aggregation BIAs within the vicinity of the Operational Area, and whale shark presence would be transitory and of a short duration, and (iii) the vessel speed not exceeding eight knots within the Operational Area. Regard to the Conservation Advice for the whale shark was made with respect to the conservation action addressing minimising offshore development and vessel strikes and the predicted potential risk of vessel strikes is considered low.

Marine mammals and fish are at risk of mortality through being caught in thrusters during station keeping operations (dynamic positioning). The risk of marine life getting caught in operating thrusters is unlikely, given the low presence of individuals, combined with the avoidance behaviour commonly displayed during dynamic positioning operations.

Considering the absence of potential nesting or foraging habitat (i.e. no emergent islands, reef habitat or shallow shoals) and the water depth, it is unlikely that the Operational Area represents important habitat for marine turtles but, marine turtles may transit the area. It is acknowledged that there are significant nesting sites along the mainland coast and islands of the region (e.g. Montebello Islands located 74 km and 139 km, south-west and south-east of the GWF-3 and LD Operational Areas, respectively).

It is unlikely that vessel movement associated with the Petroleum Activities Program will have a significant impact on marine fauna populations given: (1) the low presence of transiting individuals; (2) avoidance behaviour commonly displayed by whales and turtles; and (3) low operating speed of the support vessels (generally less than eight knots or stationary, unless operating in an emergency).

Summary of Protected Impacts to Environmental Value(s)

Given the adopted controls, it is considered that a collision, were it to occur, will not result in a potential impact greater than slight, short term impact on species (i.e. Environment consequence – E).

Demonstration of ALARP

Control Considered	*Control Feasibility (F) and Cost/Sacrifice (CS)*[38]	*Benefit in Impact/Risk Reduction*	*Proportionality*	*Control Adopted*
Legislation, Codes and Standards				
EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, including the following measures[39]: • Project vessels will not travel faster than six knots within 300 m of a cetacean or turtle (caution zone) and not approach closer than 100 m from a whale. • Project vessels will not approach closer than 50 m for a dolphin or turtle and/or 100 m for a whale (with the exception of animals bow-riding). • If the cetacean or turtle shows signs of being disturbed, project vessels	F: Yes. CS: Minimal cost. Standard practice.	Implementation of these controls will reduce the likelihood of a collision between a cetacean, whale shark or turtle occurring. The consequence of a collision is unchanged.	Controls based on legislative requirements – must be adopted.	Yes **C 19.1**

[38] Qualitative measure

[39] For safety reasons, the distance requirements below are not applied for a vessel holding station or with limited manoeuvrability; e.g. anchor handling, loading, back-loading, bunkering, close standby cover for overside working and emergency situations.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[38]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
will immediately withdraw from the caution zone at a constant speed of less than six knots. • Vessels will not travel faster than eight knots within 250 m of a whale shark and not allow the vessel to approach closer than 30 m of a whale shark.				
Good Practice				
Variation of the timing of the Petroleum Activities Program to avoid whale migration periods.	F: Not feasible. Timing of activities is linked to MODU schedule. Timing of all activities is currently not determined, and due to MODU availability and operational requirements, conducting activities during migration/ nesting seasons may not be able to be avoided. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
The use of dedicated MFOs on support vessels for the duration of each activity to watch for whales and provide direction on and monitor compliance with Part 8 of the EPBC Regulations.	F: Yes, however vessel bridge crews already maintain a constant watch during operations, and crew complete specific cetacean observation training. CS: Additional cost of MFOs considered unnecessary.	Given support vessel bridge crews already maintain a constant watch during operations, additional MFOs would not significantly further reduce the risk.	Disproportionate. The cost/sacrifice outweighs the benefit gained.	No
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts and risks of potential vessel collision with protected marine fauna. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, vessel collision with marine fauna represents a low current risk rating that is unlikely to result in a potential impact greater than minor and temporary disruption to a small proportion of fauna species populations. Regard to the Conservation Advice for the whale shark was made and the potential risk of vessel strikes considered to be low. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil and gas industry practice and meet the requirements of Part 8 (Division 8.1) of the EPBC Regulations 2000. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of vessel collision with marine fauna to a level that is broadly acceptable.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 19 No vessel strikes with protected marine fauna (whales, whale sharks, turtles) during the Petroleum Activities Program.	**C 19.1** EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, including the following measures[40], including: • Project vessels will not travel greater than 6 knots within 300 m of a cetacean or turtle (caution zone) and not approach closer than 100 m from a whale. • Project vessels will not approach closer than 50 m for a dolphin or turtle and/or 100 m for a whale (with the exception of animals bow riding). • If the cetacean or turtle shows signs of being disturbed, project vessels will immediately withdraw from the caution zone at a constant speed of less than 6 knots. • Vessels will not travel greater than 8 knots within 250 m of a whale shark and not allow the vessel to approach closer than 30 m of a whale shark.	**PS 19.1** Compliance with EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05 and 8.06) Interacting with cetaceans to minimise potential for vessel strike.	**MC 19.1.1** Records demonstrate no breaches with EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans.
		PS 19.2 All vessel strike incidents with cetaceans will be reported in the National Ship Strike Database (as outlined in the Conservation Management Plan for the Blue Whale – A Recovery Plan under the EPBC Act 1999, Commonwealth of Australia, 2015).	**MC 19.2.1** Records demonstrate reporting cetacean ship strike incidents to the National Ship Strike Database.

[40]For safety reasons, the distance requirements below are not applied for a vessel holding station or with limited manoeuvrability e.g. anchor handling, loading, back-loading, bunkering, close standby cover for overside working and emergency situations.

6.7.9 Physical Presence: Disturbance to Seabed from Loss of Station Keeping

Context	
Project Vessels – **Section 3.5** Project Vessels-based Activities – **Section 3.7**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5** Socioeconomic Environment – **Section 4.6** Values and Sensitivities – **Section 4.7**

Risk Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and groundwater	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence/impact***	***Likelihood***	***Risk rating***	***ALARP tools***	***Acceptability***	***Outcome***
Loss of station keeping of MODU leading to seabed disturbance			X		X			A	E	1	L	GP PJ RBA	Broadly acceptable	EPO 20

Description of Source of Risk

A moored MODU is planned to be used for drilling the wells. The rig will be secured on station by a number of mooring lines, as dictated by the mooring analysis, which are held in place by anchors deployed to the seabed (**Section 3.7.1**). High energy weather events such as cyclones, while the MODU is on station, can lead to excessive loads on the mooring lines resulting in failure (either anchor(s) dragging or mooring lines parting). A failure of mooring integrity may lead to the mooring lines and anchors attached to the MODU being trailed across the seabed. If mooring failure is sufficient, the MODU may move off station, increasing the likelihood of anchor drag across the seafloor.

For a moored MODU, personnel on-board the MODU are typically evacuated during cyclones. Woodside implements a risk-based assessment process to aid in decision making for cyclone evacuations, with the well suspended prior to MODU evacuation. Support vessels also demobilise from the Operational Area during the passage of a cyclone. While the MODU is temporarily abandoned, the position of the MODU is monitored remotely for any deviation. Support vessels and MODU personnel return to the Operational Area as soon as safe to do so following a cyclone evacuation. Operational experience indicates cyclone evacuations typically last for seven days.

Industry statistics from the North Sea show that a single mooring line failure for MODUs is the most common failure mechanism (33 × 10-4 per line per year), followed by a double mooring line failure (11 × 10-4 per line per year) (Petroleumstilsynet, 2014). Note that single and double mooring line failures do not typically result in the loss of station keeping. In the event of partial or complete mooring failures that are sufficient to result in a loss of station keeping, industry experience indicates that MODUs may drift considerable distances from their initial position (Offshore: Risk & Technology Consulting Inc., 2002). Partial mooring failures leading to a loss of station keeping resulted in smaller MODU displacements due to the remaining anchors dragging along the seabed when compared to complete mooring failures; complete mooring failures resulted in a freely drifting MODU (Offshore: Risk & Technology Consulting Inc., 2002).

NOPSEMA has recorded four cases of anchor drag due to loss of MODU holding station during cyclone activity between 2004 and 2015 (NOPSEMA, 2015).

Impact Assessment

Potential Impacts to Benthic Communities

Benthic habitats in the Operational Area are expected to largely consist of fine grained muddy sands and silts with an absence of hard substrate. In the unlikely event of a cyclone resulting in the MODU breaking its moorings, the anchors could cause physical damage to soft sediment and potentially limited hard bottom habitats (including in the Ancient Coastline at 125 m Depth Contour KEF, which overlaps part of the Operational Area) and associated benthic communities (e.g. epifauna and infauna). This would result in localised short-term impacts to habitat and biological

attributes. Given the low abundance, diversity and broad-scale distribution of the benthic habitat types within and adjacent to the Operational Area, the scale of impact will not be significant.
Summary of Potential Impacts to Environmental Value(s)
Given the adopted controls, seabed disturbance from a loss of station keeping would result in only slight, short-term local impacts to soft sediment benthic communities (i.e. Environment Impact – E).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[41]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No controls identified.				
Good Practice				
Specifications and requirements for station keeping equipment (mooring systems) require that: • systems are tested and inspected in accordance with API RP 21 • systems have sufficient capability such that a failure of any single component will not cause progressive failure of the remaining anchoring arrangement.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of mooring failure leading to loss of station keeping. Should mooring failure occur, no significant reduction in consequence could occur.	Benefit outweighs cost sacrifice.	Yes **C 20.1**
Professional Judgement – Eliminate				
Only use a DP MODU (no anchoring required) for all wells.	F: No. It is not feasible to use a DP MODU for the wells due to shallow depths. CS: Restricting MODU selection to only DP-capable rigs would introduce unacceptable additional costs and operational delays. Woodside has a demonstrated capacity to manage the environmental risks and impacts from mooring to a level that is ALARP and acceptable.	Application of control would eliminate the risk.	Disproportionate. The cost/ sacrifice associated with only using a DP capable MODU outweighs the benefit gained.	No
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
MODU tracking equipment operational when the MODU unmanned.	F: Yes. CS: Minimal cost. Standard practice.	Notification when loss of station keeping has occurred. Although	Benefit outweighs cost/ sacrifice.	Yes **C 20.2**

[41] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[41]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
		no reduction in consequence could occur, the overall risk is reduced		
Risk Based Analysis				
Mooring system is tested to recommended tension as per API RP 2SK.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of anchor drag leading to seabed disturbance.	Benefit outweighs cost/ sacrifice.	Yes **C 20.3**
Project-specific Mooring Design Analysis.	F: Yes. CS: Minimal cost. Standard practice.	Reduces the likelihood of mooring failure occurring. Although no reduction in consequence would occur, the overall risk is reduced.	Benefit outweighs cost/ sacrifice.	Yes **C 3.2**
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the risks and consequences of seabed disturbance from a loss of station keeping. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, seabed disturbance from a loss of station represents a low current risk rating that is unlikely to result in a potential consequence greater than localised and short-term effects to benthic habitat. Further opportunities to reduce risks and consequences have been investigated above. The adopted controls are considered good oil and gas industry practice. The potential consequences and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of seabed disturbance from a loss of station keeping to an acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 20 No mooring failure for the MODU during the Petroleum Activities Program.	**C 20.1** Specification and requirements for station keeping equipment (mooring systems), require that: • systems are tested and inspected in accordance with API RP 21 • systems have sufficient capability such that a failure of any single component will not cause progressive failure of the remaining anchoring arrangement.	**PS 20.1** MODU mooring system tested and in place to ensure no complete mooring failure.	**MC 20.1.1** Records demonstrate mooring system tests and inspection.
	C 20.2 MODU tracking equipment operational when the MODU is unmanned.	**PS 20.2** Tracking of the MODU is possible when the MODU is unmanned.	**MC 20.2.1** Records show the MODU has functional tracking equipment for instances when MODU is unmanned.
	C 20.3 Mooring system is tested to recommended tension as per API RP 2SK.	**PS 20.3** Monitoring compliant with ISO 19901-7:2013.	**MC 20.3.1** Records confirm mooring system is tested to recommended tension as per API RP 2SK.
	C 3.2 Project-specific Mooring Design Analysis.	**PS 3.2.1** Anchors installed as per Mooring Design Analysis to ensure adequate MODU station holding capacity.	**MC 3.2.1** Records demonstrate Mooring Design Analysis completed and implemented during anchor deployment.

6.7.10 Physical Presence: Dropped Object Resulting in Seabed Disturbance

Context	
Project Vessels – **Section 3.5** Project Vessels-based Activities **– Section 3.7** Drilling activities **– Section 3.8** Subsea Installation and Pre-commissioning Activities **– Section 3.9** Contingent activities **– Section 3.10**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**

Risk Evaluation Summary

	Environmental Value Potentially Impacted							***Evaluation***						
Source of Risk	***Soil and groundwater***	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence/impact***	***Likelihood***	***Risk rating***	***ALARP tools***	***Acceptability***	***Outcome***
Dropped objects resulting in the disturbance of benthic habitat		X			X			A	F	2	L	GP	Broadly acceptable	EPO 21

Description of Source of Risk

There is the potential for objects to be dropped overboard from the MODU and project vessels to the marine environment. Objects that have been dropped during previous offshore projects include small numbers of personal protective gear (e.g. glasses, gloves, hard hats), small tools (e.g. spanners) hardware fixtures (e.g. riser hose clamp) and drill equipment (e.g. drill pipe).

Impact Assessment

Potential Impacts to Other Benthic Communities

In the unlikely event of loss of equipment or materials to the marine environment, potential environmental effects would be limited to localised physical impacts on benthic communities. As a result of recovery of any dropped objects, this impact will be temporary in nature. However, if the object cannot be recovered due to health and safety, operational constraints and other factors (locating dropped objects at depth) then the impact may be long term.

The temporary or permanent loss of dropped objects into the marine environment is not likely to have a significant environmental impact, as the benthic communities associated with the Operational Area are of low sensitivity and are broadly represented throughout the NWMR (**Section 4.4.4**). One KEF – the Ancient Coastline at 125 m Depth Contour has been identified as overlapping the Operational Area, as described in **Section 4.7.7.1**. Given only a small proportion of the KEFs is overlapping the Operational Area, and the nature and scale of impacts and risks from dropped objects, seabed sensitivities associated with this KEF are not expected to be significantly impacted. Further, considering the types, size and frequency of dropped objects that could occur, it is unlikely that a dropped object would have a significant impact on any benthic community.

Summary of Potential Impacts to Environmental Value(s)

Given the adopted controls and the predicted small footprint of a dropped object, it is considered that a dropped object will result in only localised impacts to a small area of the seabed and a small proportion of the benthic population; however, no significant impact to environmental receptors, and with no lasting effect (i.e. Environment consequence – F).

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[42]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
No controls identified.				
Good Practice				
The MODU/ installation vessels' work procedures for lifts, bulk transfers and cargo loading, which require: • The security of loads shall be checked prior to commencing lifts. • Loads shall be covered if there is a risk of loss of loose materials. • Lifting operations shall be conducted using the PTW and JSA systems to manage the specific risks of that lift, including consideration of weather and sea state.	F: Yes. CS: Minimal cost. Standard practice.	Occurs after a dropped object event and therefore no change to the likelihood. Since the object may be recovered, a reduction in consequence is possible.	Benefits outweigh cost/sacrifice.	Yes **C 21.1**
MODU/ installation vessel inductions include control measures in dropped object prevention.	F: Yes. CS: Minimal cost. Standard practice.	By ensuring crew are aware of dropped object prevention requirements, the likelihood of a dropped object event is reduced. No change in consequence will occur.	Benefits outweigh cost/sacrifice.	Yes **C 21.2**
Dropped objects/waste will be recovered, using the MODU/project vessel ROV, crane or support vessel, where safe and practicable. Where safe and practicable for this activity, will consider: • risk to personnel to retrieve object • whether the location of the object is in recoverable water depths • object's proximity to subsea infrastructure ability to recover the object (i.e. nature of object, lifting equipment, or ROV availability and suitable weather).	F: Yes. CS: Minimal cost. Standard practice.	Occurs after an object has been dropped and therefore no change to the likelihood. Since the objects may be recovered, a reduction in consequence is possible.	Benefit outweighs cost/sacrifice.	Yes **C 18.3**

[42] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[42]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Any material dropped objects / waste that remain in the title will undergo an impact assessment and be added to the inventory.				
Professional Judgement – Eliminate				
No additional controls identified.				
Professional Judgement – Substitute				
No additional controls identified.				
Professional Judgement – Engineered Solution				
No additional controls identified.				
ALARP Statement On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the impacts and risks of seabed disturbance from dropped objects. As no reasonable additional/alternative controls were identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts and risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement The impact assessment has determined that, given the adopted controls, dropped objects will not result in a potential impact greater than minor and temporary disruption to a small area of the seabed, a small proportion of the benthic population and no impact on critical habitat or activity. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil and gas industry practice. The potential impacts and risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts and risks of seabed disturbance from dropped objects to an acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 21 No incidents of dropped objects to the marine environment greater than a consequence level of F[43] during the Petroleum Activities Program.	**C 21.1** The MODU/installation vessels' work procedures for lifts, bulk transfers and cargo loading, which require: • the security of loads to be checked prior to commencing lifts • loads to be covered if there is a risk of losing loose materials • lifting operations to be conducted using the PTW and JSA systems to manage the specific risks of that lift,	**PS 21.1** All lifts conducted in accordance with applicable MODU/ installation vessel work procedures to limit potential for dropped objects.	**MC 21.1.1** Records show lifts conducted in accordance with the applicable MODU/ installation vessel work procedures.

[43] Defined as 'Slight, short term local impact (<1 year), on species, habitat but not affecting ecosystem function), physical or biological attributes'.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	including consideration of weather and sea state.		
	C 21.2 MODU/ installation vessel inductions include control measures in dropped object prevention.	**PS 21.2** Awareness of requirements for dropped object prevention.	**MC 21.2** Records show dropped object prevention included in the MODU/ installation vessels inductions.
	C 18.3 Dropped objects/waste will be recovered, using the MODU/project vessel ROV, crane or support vessel, where safe and practicable. Where safe and practicable for this activity, will consider: • risk to personnel to retrieve object • whether the location of the object is in recoverable water depths • object's proximity to subsea infrastructure • ability to recover the object (i.e. nature of object, lifting equipment, or, ROV availability and suitable weather). Any material dropped objects / waste that remain in the title will undergo an impact assessment and be added to the inventory.	**PS 18.3a** Any objects dropped to the marine environment will be recovered where safe and practicable to do so.	**MC 18.3.1** Records detail the recovery of any objects/waste lost to the marine environment.
		PS 18.3b Where retrieval is not practicable and / or safe, material items (property) that are lost to the marine environment will undergo an impact assessment and will be added to the inventory for the title.	**MC 18.3.2** First Priority records demonstrate outcomes of the safe and practicable evaluation, including an impact assessment for the objects remaining.
			MC 18.3.3 Records demonstrate that material items left in title are added to the inventory.

6.7.11 Physical Presence: Accidental Introduction and Establishment of Invasive Marine Species

Context		
Project vessels **– Section 3.5**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5** Socioeconomic environment – **Section 4.6**	Stakeholder Consultation – **Section 5**

Risk Evaluation Summary

Source of Risk	*Environmental Value Potentially Impacted*							*Evaluation*						
	Soil and groundwater	***Marine sediment***	***Water quality***	***Air quality (incl odour)***	***Ecosystems/habitat***	***Species***	***Socioeconomic***	***Decision type***	***Consequence/impact***	***Likelihood***	***Risk rating***	***ALARP tools***	***Acceptability***	***Outcome***
Introduction of invasive marine species (IMS)					X	X	X	A	B	0	M	LCS GP	Broadly acceptable	EPO 22

Description of Source of Risk

IMS are a subset of Non-indigenous Marine Species (NIMS) that have been introduced into a region beyond their natural biogeographic range, resulting in impacts to social/cultural, human health, economic and/or environmental values. NIMS are species that have the ability to survive, reproduce and establish founder populations. However, not all NIMS introduced into an area can thrive or cause demonstrable impacts. The majority of NIMS around the world are relatively benign and few have spread widely beyond sheltered ports and harbours.

NIMS can be translocated from a donor to a recipient location by two mechanisms, within a ships ballast water or as biofouling on submerged surfaces or internal systems of a vessel. During the Petroleum Activities Program, MODUs and project vessels will be transiting to and from the Operational Area, potentially including vessels mobilising from beyond Australian waters. These project vessels may include installation vessels, construction vessels, AHVs, HLVs and activity support vessels (**Section 3.5**).

<u>Introduction to Operational Area</u>

Ballast water is carried in ships' ballast tanks to improve stability, balance and trim. It is taken up or discharged when cargo is unloaded or loaded, or when a ship needs extra stability in adverse weather. When a ship takes on ballast water, organisms can also be drawn into ballast tanks. Ballast water exchange involves the substitution of water in ship's ballast tanks using either a sequential, flow-through, dilution or other exchange method, potentially releasing ballast water at a location foreign to where it was taken on. Ballasting and deballasting a vessel is essential in achieving maximum vessel performance through a range of functions such as vessel propulsion, stress reduction on ship hull, stability and manoeuvrability, among others.

Release of unmanaged ballast water could transfer a range of NIMS into a recipient environment, depending on the location that ballast water was taken onboard. Ballast water has been recognised as a major pathway for introducing IMS into new environments, giving rise to adoption of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention), which is given effect through the Commonwealth Biosecurity Act 2015. The Ballast Water Convention aims to prevent the spread of IMS from one region to another, by establishing standards and procedures for the ballast water management, including phasing out the use of ballast water exchange. In Australian waters, vessels are required to demonstrate compliance to Australian Ballast Water Management Requirements (Commonwealth of Australia, 2017d) which outlines approved methods of ballast water management in line with the Ballast Water Convention.

Previously, ballast water discharges from commercial vessels were thought to be the most significant mechanism for the translocation of NIMS, however research suggests that more NIMS translocations are attributable to vessel biofouling more than any other mechanism (Hewitt et al., 1999, 2004; Mineur et al., 2007). Biofouling can be defined as the accumulation of living organisms on artificial surfaces by adhesion, growth and reproduction (Cao et al., 2011). All vessels are subject to some level of marine fouling. Surfaces commonly affected by biofouling on vessels include internal niches and areas subjected to low turbulence, such as seawater intakes and sea chests. Establishment of IMS NIMS pose a biosecurity risk if organisms are translocated from a donor location and establish a self-sustaining abundant population in a recipient location. For this is occur organisms must be successful in passing through a series of stages as follows. 1. colonise a vessel (or other infrastructure) / present in ballast water from a donor location 2. survive translocation from the donor to the recipient location 3. adults, offspring and/or fragments transfer from the vessel to the surrounding recipient environment 4. survive and colonise available substrata or habitat[44] in the recipient location 5. undergo ongoing reproduction in the recipient location to establish a viable population. There is potential for significant natural attrition along the invasion pathway due to selective filters, resulting in a reduction in the total number of organisms that can survive and successfully transition to the next stage. These include, but not limited to, the presence/absence and efficacy of antifouling coatings and marine growth prevention systems, residency periods in donor and recipient locations, voyage characteristics (e.g. speed, route and duration), environmental compatibility (e.g. water temperature, salinity etc.), ballast water tank conditions (e.g. lack of light and physical water quality properties), extent of biofouling and associated number of IMS individuals (e.g. propagule pressure), organism fecundity and life history, water depth, current and wind conditions, distance to and availability of suitable habitat and predation pressures (Lewis and Coutts, 2010). Notably, the majority of species introduced to an area outside of their natural range will not survive to establish or subsequently become invasive or a pest (Wells et al., 2009; Bax et al., 2003). Therefore, although there is a potential for IMS to establish themselves in a foreign environment via ballast water and biofouling, not all IMS that enter Australian waters and are released into the marine environment are successful in establishing a population. For successful establishment to occur, a NIMS must first enter the ballast during water uptake and/or establish on a vector (e.g. hull), survive translocation from donor to recipient region, and then successfully be transferred, colonise and spread in the recipient environment to establish a new viable population. The likelihood of this series of stages occurring are considered remote given Woodside and legislative requirements.
Impact Assessment
Potential Impacts to Ecosystems/Habitats, Species and Socioeconomic Values
Potential IMS have historically been introduced and translocated around Australia by a variety of natural and human means including biofouling and ballast water. Potential IMS vary from one region to another depending on various environmental factors such as water temperature, salinity, nutrient levels and habitat type, which dictate their survival and invasive capabilities. IMS typically require hard substrate in the photic zone; therefore, requiring shallow waters to become established. Highly-disturbed, shallow-water environments such as shallow coastal waters, ports and marinas are more susceptible to IMS colonisation, whereas IMS are generally unable to successfully establish in deep water ecosystems and open-water environments where the rate of dilution and the degree of dispersal are high (Williamson and Fitter, 1996; Paulay et al., 2002; Geiling, 2014). The undisturbed, deep water, offshore location of the Operational Area is therefore unlikely to represent suitable habitat for the establishment of IMS. However, depending on prevailing currents, the larval life history of the IMS, and the recruitment potential based on a variety of factors, including propagule pressure, there is a remote likelihood that an IMS may be carried to and establish within the shallow waters at Glomar Shoals (<50 m depth), 8 km away from the Operational Area, where available substrate and light could facilitate establishment and growth. Once introduced, IMS may prey on local species (which had previously not been subject to this kind of predation and therefore not have evolved protective measures against the attack), they may outcompete indigenous species for food, space or light and can also interbreed with local species, creating hybrids such that the endemic species is lost. These changes to the local marine environment result in changes to the natural ecosystem. IMS have also proven economically damaging to areas where they have been introduced and established. Such impacts include direct damage to assets (fouling of vessel hulls and infrastructure) and depletion of commercially harvested marine life (e.g. shellfish stocks). IMS have proven particularly difficult to eradicate from areas once established. If the

[44] Suitable habitats, which are more susceptible to IMS establishment, have been defined as nearshore waters that are within 12 nm of any coast or areas that are less than 50 m deep.

introduction is detected early, eradication may be effective but is likely to be expensive, disruptive and, depending on the method of eradication, harmful to other local marine life.

Summary of Potential Impacts to Environmental Value(s)

In support of Woodside's assessment of the impacts and risks of IMS introduction associated with the Petroleum Activities Program, Woodside conducted a risk and impact evaluation of the different aspects of a marine pest translocation. The results of this assessment are presented in **Table 6-18**.

As a result of this assessment, Woodside has presented the highest potential consequence of B 'a major, long term impact on highly valued ecosystem' and likelihood as Remote (0), resulting in an overall moderate risk following the implementation of identified controls.

Table 6-18: Evaluation of risks and impacts from marine pest translocation

IMS Introduction Location	Credibility of Introduction	Consequence of Introduction	Likelihood
Introduced to Operational Area and establishment on the seafloor or subsea structures.	**Not Credible** The deep offshore open waters of the Operational Area are located away from shorelines (more than 74 km from a shore) and in waters 80-130 m deep; they are therefore not conducive to the settlement and establishment of IMS.		
Introduced to Operational Area, and then transferred, settles and establishes at Glomar Shoal shallow water habitats (<50 m).	**Credible** There is potential for the introduction of IMS into the Operational Area could result in the translocation of IMS to Glomar Shoals.	The transfer of IMS from a colonised MODU or project vessel to shallower environments (Glomar Shoal) via natural dispersion is considered credible if unmanaged. The Glomar Shoal KEF is 1 km from the Operational Area and the shallow waters associated with the KEF (<50 m) are approximately 8 km from the Operational Area. As described above the establishment of IMS in the shallow waters at Glomar Shoal would potentially have major consequences on a highly valued ecosystem.	**Remote (0)** Given the existing Woodside and legislative controls in place that minimise the introduction of IMS it is considered that the likelihood that IMS become established is remote.
Transfer between project vessels and by extension from project vessels to other marine environments beyond the Operational Area (i.e. transfer of IMS from offshore MODU, primary installation vessel to an activity support vessel and then to another environment).	**Not Credible** This risk is considered so remote that it is not credible for the purposes of the activity. The transfer of a marine pest between project vessels was already considered remote, given the offshore open ocean environment (i.e. transfer pathway discussed above). For a marine pest to then establish into a mature spawning population on the new project vessel (which would have been through Woodside's risk assessment process) and then transfer to another environment is not considered credible (i.e. beyond the Woodside risk matrix). Project vessels are located in an offshore, open ocean, deep environment, where IMS survival is implausible. Furthermore this marine pest once transferred would need to survive on a new vessel with good vessel hygiene (i.e. has been through Woodside's risk assessment process), and survive the transport back from the Operational Area to shore. In the event it was to survive this trip, it would then need to establish a viable population in nearshore waters.		

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[45]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Project vessels will manage their ballast water using one of the approved ballast water management options, as specified in the Australian Ballast Water Management Requirements.	F: Yes. CS: Minimal cost. Standard practice.	The use of an approved ballast water treatment system will reduce the likelihood of transfer of marine pests between project vessels within the Operational Area. No change in consequence would occur.	Controls based on legislative requirements under the *Biosecurity Act 2015* – must be adopted.	Yes **C 22.1**
Good Practice				
Woodside's IMS risk assessment process will be applied to the MODU, project vessels and immersible equipment. Assessment will consider the following risk factors: For vessels: • vessel type • recent IMS inspection and cleaning history, including for internal niches • out-of-water period prior to mobilisation • age and suitability of antifouling coating at mobilisation date • internal treatment systems and history • origin and proposed area of operation • number of stationary/slow speed periods greater than seven days • region of stationary or slow periods • type of activity – contact with seafloor. For immersible equipment • region of deployment since last thorough clean, particularly coastal locations • duration of deployments	F: Yes. CS: Minimal cost. Good practice implemented across all Woodside Operations.	Identifies potential risks and additional controls implemented accordingly. In doing so, the likelihood of transferring marine pests between MODU and project vessels within the Operational Area is reduced. No change in consequence would occur.	Benefits outweigh cost/sacrifice.	Yes **C 22.2**

[45] Qualitative measure

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[45]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
• duration of time out-of-water since last deployment • transport conditions during mobilisation • post-retrieval maintenance regime. Based on the outcomes of each IMS risk assessment, management measures commensurate with the risk (such as the treatment of internal systems, IMS inspections or cleaning) will be implemented to minimise the likelihood of IMS being introduced.				
Professional Judgement – Eliminate				
No discharge of ballast water during the Petroleum Activities Program.	F: No. Ballast water discharges are critical for maintaining vessel stability. Given the nature of the Petroleum Activities Program, the use of ballast (including the potential discharge of ballast water) is considered to be a safety-critical requirement. CS: Not assessed, control not feasible.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Eliminate use of MODU/vessels.	F: No. Given that vessels must be used to implement project, there is no feasible means to eliminate the source of risk. CS: Loss of the project.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Professional Judgement – Substitute				
Source project vessels based in Australia only.	F: Potentially. Limiting activities to only use local project vessels could potentially pose a significant risk in terms of time and duration of sourcing a vessel,	Sourcing vessels from within Australia will reduce the likelihood of IMS from outside Australian waters; however, it does not reduce the likelihood of introduction of	Disproportionate. Sourcing vessels from Australian waters may result in a reduction in the likelihood of IMS introduction to the Operational Area; however, the potential	No

Demonstration of ALARP				
Control Considered	*Control Feasibility (F) and Cost/Sacrifice (CS)*[45]	*Benefit in Impact/Risk Reduction*	*Proportionality*	*Control Adopted*
	as well as the ability of the local vessels to perform the required tasks. For example, there are limited installation vessels based in Australian waters. While the project will attempt to source support vessels locally, it is not always possible. Availability cannot always be guaranteed when considering competing oil and gas activities in the region. In addition, sourcing Australian based vessels only will cause increases in cost due to pressures of vessel availability. CS: Significant cost and schedule impacts due to restrictions of vessel hire opportunities.	species native to Australia but alien to the Operational Area and NWMR, or of IMS that have established elsewhere in Australia. The consequence is unchanged.	cost of implementing this control is grossly disproportionate to the minor environmental gain (or reducing an already remote likelihood of IMS introduction) potentially achieved by using only Australian based vessels, consequently this risk is considered not reasonably practicable.	
IMS Inspection of all vessels.	F: Yes. Approach to inspect vessels could be a feasible option. CS: Significant cost and schedule impacts. In addition, Woodside's IMS risk assessment process (**C 19.2**) is seen to be more cost-effective as this control allows Woodside to manage the introduction of marine pests through biofouling, while targeting its efforts and resources to areas of greatest concern.	Inspection of all vessels for IMS would reduce the likelihood of IMS being introduced to the Operational Area. However, this reduction is unlikely to be significant given the other control measures implemented. No change in consequence would occur.	Disproportionate. The cost/sacrifice outweighs the benefit gained, as other controls to be implemented achieve an ALARP position.	No
Professional Judgement – Engineered Solution				
No additional controls identified.				

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[45]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type (i.e. Decision Type A), Woodside considers the adopted controls appropriate to manage the risks and consequences of IMS introduction. As no reasonable additional/alternative controls were identified that would further reduce the risks and consequences without grossly disproportionate sacrifice, the risks and consequences are considered ALARP.

Demonstration of Acceptability

Acceptability Statement

The impact assessment has determined that translocation of IMS may result in a major long term impact however given the adopted controls the likelihood of introducing IMS to the Operational Arean and then translocating to the Glomar Shoal KEF is considered remote[46]. Further opportunities to reduce the risks and consequences have been investigated above. Therefore, there is a high level of confidence that the establishment of IMS within this KEF will not result in an adverse impact to marine ecosystem function or in the KEFs; or any reduction in to the conservation value of the KEFs will occur.

The adopted controls are considered good oil and gas industry practice. The potential risks and consequences are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the risks and consequences of invasive marine species to an acceptable level.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
EPO 22 No introduction and establishment of invasive marine species into the Operational Area as a result of the Petroleum Activities Program.	**C 22.1** Project vessels will manage their ballast water using one of the approved ballast water management options, as specified in the Australian Ballast Water Management Requirements.	**PS 22.1** Project vessels manage ballast water in accordance with Australian Ballast Water Management Requirements.	**MC 22.1.1** Ballast Water Records System maintained by vessels which verifies compliance against Australian Ballast Water Management Requirements.
	Woodside's IMS risk assessment process will be applied to the MODU, project vessels and immersible equipment. Assessment will consider the following risk factors: For vessels: • vessel type	**PS 22.2a** Prior to entering the Operational Area MODUs, project vessels and relevant immersible equipment are determined to be low risk[47] of introducing IMS of concern.	**MC 22.2.1** Records of IMS risk assessments maintained for all project vessels and relevant immersible equipment entering the Operational Area to undertake the Petroleum Activities Program.

[46] All project vessels including the MODU will undergo Woodside's IMS risk assessment process therefore the risk of introducing IMS to the Operational Area and then onto nearshore or coastal areas was considered not credible.

[47] Low risk of introducing IMS of concern is defined as either no additional management measures required or, management measures have been applied to reduce the risk.

Environmental Performance Outcomes, Standards and Measurement Criteria			
Outcomes	***Controls***	***Standards***	***Measurement Criteria***
	• recent IMS inspection and cleaning history, including for internal niches • out-of-water period prior to mobilisation • age and suitability of antifouling coating at mobilisation date • internal treatment systems and history • origin and proposed area of operation • number of stationary/slow speed periods greater than seven days • region of stationary or slow periods • type of activity – contact with seafloor. For immersible equipment • region of deployment since last thorough clean, particularly coastal locations • duration of deployments • duration of time out-of-water since last deployment • transport conditions during mobilisation • post-retrieval maintenance regime. Based on the outcomes of each IMS risk assessment, management measures commensurate with the risk (such as the treatment of internal systems, IMS inspections or cleaning) will be implemented to minimise the likelihood of IMS being introduced.	**PS 22.2b** IMS risk assessments undertaken by an authorised Environment Advisor who has completed relevant Woodside IMS training or by qualified and experienced IMS inspector.	**MC 22.2.2** Records of Environment Adviser training and IMS inspector qualifications (as relevant).

7. IMPLEMENTATION STRATEGY

Regulation 14 of the Environment Regulations requires an EP to contain an implementation strategy for the activity. The implementation strategy for the Petroleum Activities Program confirms fit-for-purpose systems, practices and procedures are in place to direct, review and manage the activities so that environmental risks and impacts are continually being reduced to ALARP and are acceptable, and that EPOs and EPSs outlined in this EP are achieved.

Woodside, as Operator, is responsible for ensuring that the Petroleum Activities Program is managed in accordance with this implementation strategy and the WMS (see **Section 1.9**).

7.1 Systems, Practice and Procedures

All operational activities are planned and carried out in accordance with relevant legislation and standards, management measures identified in this EP and internal environment standards and procedures (**Section 6**).

The systems, practices and procedures that are to be implemented are listed in the EPSs contained in this EP. Document names and reference numbers may be subject to change during the statutory duration of this EP and is managed through a change register and update process (**Section 7.5**).

7.2 Roles and Responsibilities

Key roles and responsibilities for Woodside and Contractor personnel relating to implementing, managing and reviewing this EP are described in **Table 7-1**. Roles and responsibilities for oil spill preparation and response are outlined in **Appendix D** and the Woodside Oil Pollution Emergency Arrangements (Australia).

Table 7-1: Roles and responsibilities

Title (role)	Responsibilities related to EP
Office-based Personnel	
Woodside Project Manager	• Monitor and manage the activity so it is performed as per the relevant standards and commitments in this EP. • Notify the Woodside Environmental Adviser of any scope changes in a timely manner. • Liaise with regulatory authorities as required. • Review this EP as necessary and manage change requests. • Ensure all project and support vessel crew members complete an HSE induction. • Verify that contractors meet environmental related contractual obligations. • Confirm environmental incident reporting meets regulatory requirements (as outlined in this EP) and Woodside’s Health, Safety and Environment Reporting and Investigation Procedure. • Monitor and close out corrective actions identified during environmental monitoring or audits.
Woodside Well Delivery Manager	• Ensure drilling operations are conducted as per this EP and approval conditions. • Provide sufficient resources to implement the drilling-related management measures (i.e. controls, EPOs, PSs and MC) in this EP. • Ensure MODU and support vessel personnel are given an Environmental Induction as per **Section 7.3.1** of this EP at the start of the drilling programs. • Confirm controls and performance standards in this EP are actioned, as required, before drilling commences. • Ensure the MODU start-up meets the requirements of Woodside's drilling and managing rig operations process.
Subsea Delivery Manager	• Provide sufficient resources to implement the subsea installation-related management measures (i.e. controls, EPOs, PSs and MC) in this EP.
Subsea Installation Co-ordinator	• Ensure the subsea installation activities are conducted as per this EP and approval conditions. • Ensure installation vessel personnel are given an Environmental Induction as per **Section 7.3.1** of this EP at the start of the installation activities. • Confirm controls and performance standards in this EP are actioned, as required, before installation activities commence. • Ensure relevant vessels meet the requirements of Woodside's Marine Operations Operating Standard. • Manage change requests for the activity and notify the Woodside Environmental Adviser of any scope changes. • Communicate changes to the subsea and flowline/pipeline installation program to the Woodside Environmental Adviser in a timely manner. • Ensure all chemicals and drilling fluids proposed to be discharged are assessed and approved as per the requirements of the EP.
Woodside Drilling Superintendent	• Ensure the drilling program meets the requirements detailed in this EP. • Ensure changes to the drilling program are communicated to the Woodside Environmental Adviser.

Title (role)	Responsibilities related to EP
	• Ensure Woodside's Well Site Manager is provided with the resources required to ensure the management measures (i.e. controls, EPOs, EPs and MC) in this EP are implemented. • Confirm environmental incident reporting meets regulatory requirements (as outlined in this EP) and Woodside's Health, Safety and Environment Reporting and Investigation Procedure. • Monitor and close out corrective actions identified during environmental monitoring or audits.
Woodside Drilling Engineers	• Ensure changes to the drilling program are communicated to the Woodside Environmental Adviser. • Ensure all drill and completions fluid chemical components and other fluids that may be used downhole have been reviewed by the Drilling and Completions Environmental Adviser.
Woodside Environmental Adviser	• Verify relevant Environmental Approvals for the activities exist prior to commencing activity. • Track compliance with performance outcomes and performance standards as per the requirements of this EP. • Prepare environmental component of relevant Induction Package. • Assist with reviewing, investigating and reporting environmental incidents. • Ensure environmental monitoring and inspections/audits are conducted as per the requirements of this EP. • Liaise with relevant regulatory authorities as required. • Assist in preparing external regulatory reports required, in line with environmental approval requirements and Woodside external regulatory reporting obligations. • Monitor and close out corrective actions (Campaign Action Register) identified during environmental monitoring or audits. • Provide advice to relevant Woodside personnel and contractors to assist them to understand their environment responsibilities. • Liaise with primary installation contractors to ensure communication and understanding of environment requirements as outlined in this EP and in line with Woodside's Compass values and management systems.
Woodside Corporate Affairs Adviser	• Prepare and implement the Stakeholder Consultation Plan for the Petroleum Activities Program. • Report on stakeholder consultation. • Perform ongoing liaison and notification as outlined in the EP.
Woodside Marine Assurance Superintendent	• Conduct relevant audit and inspection to confirm vessels comply with relevant Marine Orders and Woodside Marine Charter Instructions to meet safety, navigation and emergency response requirements.
Woodside Corporate Incident Coordination Centre (CICC) Duty Manager	On receiving notification of an incident, the CICC Duty Manager shall: • Establish and take control of the Incident Management Team (IMT) and establish an appropriate command structure for the incident. • Assess the situation and identify risks and actions to minimise the risk. • Communicate impact, risk and progress to the Crisis Management Team and stakeholders. • Develop the incident action plan, including setting objectives for action.

Title (role)	Responsibilities related to EP
	• Approve, implement and manage the incident action plan. • Communicate within and beyond the incident management structure. • Manage and review safety of responders. • Address the broader public safety considerations. • Conclude and review activities.
MODU-based Personnel	
MODU Offshore Installation Manager	• Ensure the MODU's management system and procedures are implemented. • Ensure the personnel starting work on the MODU receive an environmental induction that meets the requirements specified in this EP. • Ensure personnel are competent to perform the work they have been assigned. • Ensure emergency drills are conducted as per the MODU's schedule. • Ensure the MODU's Emergency Response Team has been given sufficient training to implement the MODU's SOPEP. • Ensure any environmental incidents or breaches of outcomes or standards are reported immediately to the Well Site Manager. • Ensure corrective actions for incidents or breaches are developed, communicated to the Well Site Manager, and tracked to close out in a timely manner. Close out of actions is communicated to the Well Site Manager.
Woodside Well Site Manager	• Ensure the drilling program is conducted as detailed in this EP. • Ensure the management measures (i.e. controls, EPOs, PSs and MC) detailed in this EP (relevant to offshore activities) are implemented on the MODU (other controls are implemented onshore). • Ensure environmental incidents or breaches of outcomes or standards are reported as per the Woodside event notification requirements. Corrective actions for incidents and breaches must be developed, tracked and closed out in a timely manner. • Ensure actions in the Drilling and Completions HSE Improvement Plan are performed. • Ensure periodic environmental inspections/reviews are completed. Corrective actions from inspections must be developed, tracked and closed out in a timely manner.
Woodside Offshore HSE Adviser	• Support the Well Site Manager to ensure the controls detailed in this EP relevant to offshore activities are implemented on the MODU, and assist in collecting and recording evidence of implementation (other controls are implemented and evidence collected onshore). • Support the Well Site Manager to ensure the environmental performance outcomes are met and the performance standards detailed in this EP are implemented on the MODU. • Confirm actions in the Drilling and Completions HSE Improvement Plan are performed. • Support the Well Site Manager to ensure environmental incidents or breaches of outcomes or standards outlined in this EP are reported, and corrective actions for incidents and breaches are developed, tracked and closed out in a timely manner. • Ensure periodic environmental inspections/reviews are completed and corrective actions from inspections are developed, tracked and closed out in a timely manner.

Title (role)	Responsibilities related to EP
	• Review Contractors' procedures, input into Toolbox talks and JSAs. • Provide day to day environmental support for activities in consultation with the Woodside Environmental Adviser.
Drilling Logistics Coordinator	• Ensure waste is managed on the MODU and sent to shore as per relevant Waste Management Plan.
Vessel-based Personnel	
Installation Vessels Master	• Ensure the vessel management system and procedures are implemented. • Ensure personnel commencing work on the vessel receive an environmental induction that meets the relevant requirements specified in this EP. • Ensure personnel are competent to perform the work they have been assigned. • Ensure SOPEP drills are conducted as per the vessel's schedule. • Ensure the vessel Emergency Response Team has been given sufficient training to implement the SOPEP. • Ensure any environmental incidents or breaches of relevant environmental performance outcomes or performance standards detailed in this EP are reported immediately to the Woodside Site Representative. Corrective actions for incidents or breaches must be developed, communicated to the Woodside Site Representative, and tracked to close out in a timely manner. Close out of actions must be communicated to the Woodside Site Representative.
Vessel Logistics Coordinators	• Ensure waste is managed on the relevant support vessels or primary installation vessels and sent to shore as per the relevant Waste Management Plan.
Vessel HSE Advisers	• Refer to Woodside HSE Offshore Adviser responsibilities detailed above under MODU-based personnel.
Contractor Project Manager	• Confirm that activities are conducted in accordance with this EP, as detailed in the Woodside approved Contactor environmental management plan (or equivalent). • Ensure personnel commencing work on the project receive a relevant environmental induction that meets the requirements specified in this EP. • Ensure personnel are competent to perform the work they have been assigned. • Ensure any environmental incidents or breaches of objectives, standards or criteria outlined in this EP are reported immediately to the Woodside Responsible Engineer or Vessel Master.

7.3 Training and Competency

Woodside as part of its contracting process assesses a proposed Contractor's environmental management system to determine the level of consistency with the standard AS/NZ ISO 14001. This assessment is conducted for the Petroleum Activities Program as part of the pre-mobilisation process. The assessment determines whether there is an organisational structure that clearly defines the roles and responsibilities for key positions. The assessment also determines whether there is an up-to-date training matrix that defines any corporate and site/activity-specific environmental training and competency requirements.

As a minimum, environmental awareness training is required for all personnel, detailing awareness and compliance with the Contractor's environmental policy and environmental management system.

7.3.1 Inductions

Inductions are provided to all relevant personnel (e.g. Contractors and Company representatives) before mobilising to or on arrival at the activity location. The induction covers the HSE requirements and environmental information specific to the activity location. Attendance records are maintained.

The Petroleum Activities Program induction may cover information about:

- description of the activity
- ecological and socioeconomic values of the activity location
- Regulations relevant to the activity
- Woodside's Environmental Management System – Health Safety, Environment and Quality Policy
- EP importance/structure/implementation/roles and responsibilities
- main environmental aspects/hazards and potential environmental impacts and related performance outcomes
- oil spill preparedness and response
- monitoring and reporting on performance outcomes and standards using measurement criteria
- incident reporting.

7.3.2 Petroleum Activity Specific Environmental Awareness

Before commencing drilling and subsea installation campaigns associated with the Petroleum Activities Program, a pre-activity meeting will be held on the MODU/primary installation vessels with all relevant personnel. The pre-activity meeting provides an opportunity to reiterate specific environmental sensitivities or commitments associated with the activity. Relevant sections of the pre-activity meeting will also be communicated to the support vessel personnel. Attendance lists are recorded and retained.

During operations, regular HSE meetings are held on the MODU and project vessels. During these meetings, recent environmental incidents are reviewed and awareness material presented regularly.

7.3.3 Management of Training Requirements

All personnel on the MODU and project vessels are required to be competent to perform their assigned positions. This may be in the form of external or 'on the job' training. The vessel Safety Training Coordinator (or equivalent) is responsible for identifying training needs, keeping records of training undertaken, and identifying minimum training requirements.

7.4 Monitoring, Auditing, Management of Non-conformance and Review

7.4.1 Monitoring

Woodside and its Contractors will conduct a program of periodic monitoring during the Petroleum Activities Program – starting at mobilisation of each activity and continuing through the duration of each activity to activity completion. This information will be collected using the tools and systems outlined below, developed based on the environmental performance outcomes, controls, standards and measurement criteria in this EP. The tools and systems will collect, as a minimum, the data (evidence) referred to in the measurement criteria in **Section 6** and **Appendix B**.

The collection of this data (against the measurement criteria) will form part of the permanent record of compliance maintained by Woodside. It will form the basis for demonstrating that the environmental performance outcomes and standards are met, which will be summarised in a series of routine reporting documents.

7.4.1.1 Source-Based Impacts and Risks

The tools and systems to monitor environmental performance, where relevant, will include:

- daily reports, which include leading indicator compliance
- periodic review of waste management and recycling records
- use of Contractor's risk identification program that requires personnel to record and submit safety and environment risk observation cards on a routine basis (frequency varies with contractor)
- collection of evidence of compliance with the controls detailed in the EP relevant to offshore activities by the Woodside/Contractor Offshore HSE Adviser (other compliance evidence is collected onshore)
- environmental discharge reports that record volumes of planned and unplanned discharges downhole (in the well), to ocean and atmosphere
- monitoring of progress against the Drilling and Completions function scorecard for key performance indicators
- internal auditing and assurance program as described in **Section 7.4.2**.

Throughout this activity, Woodside will continuously identify new source-based risks and impacts through the Monitoring and Auditing systems and tools described above and in **Section 7.4.2**.

7.4.1.2 Management of Knowledge

Review of knowledge relevant to the existing environment is undertaken in order to identify changes relating to the understanding of the environment or legislation that supports the risk and impact assessments for EPs (in-force and in-preparation). Relevant knowledge is defined as:

- Environmental science supporting the description of the existing environment
- Socio-economic environment and stakeholder information
- Environmental legislation.

The frequency and documentation of reviews, communication of relevant new knowledge and consideration of management of change are documented in the WMS Environment Plan Guideline.

Under the Oil Spill Scientific Monitoring Program preparedness, an annual review and update to the environmental baseline studies database is completed and documented. Periodic location-focused environmental studies and baseline data gap analyses are completed and documented. Any subsequent studies scoped and executed as a result of such gap analysis are managed by the Environment Science Team and tracked via the Corporate Environment Baseline Database.

7.4.1.3 Management of Newly Identified Impacts and Risks

New sources of receptor based impacts and risks identified through monitoring and auditing systems and tools and the Woodside Environment Knowledge Management System are assessed using the Change Management Process (**Section 7.5**).

7.4.2 Auditing

Environmental performance auditing will be performed to:

- identify potential new or changes to existing environmental impacts and risk, and methods for reducing those to ALARP
- confirm that mitigation measures detailed in this EP are effectively reducing environmental impacts and risk, that mitigation measures proposed are practicable and provide appropriate information to verify compliance
- confirm compliance with the Performance Outcomes, Controls and Standards detailed in this EP.

Internal auditing will be performed to cover each key project activity as summarised below.

7.4.2.1 MODU Activities

Internal auditing is performed on a MODU-specific schedule, rather than a schedule to align with each well. This enables continuous review and improvement of environmental performance over the term of the MODU contract. The following internal audits, inspections and reviews will be performed to review the environmental performance of the activities:

- Survey environment rig equipment for a newly contracted MODU (if not previously contracted to Woodside within the last two years) against Woodside's Engineering Standard – Rig Equipment. This standard covers functional and technical requirements for Woodside contracted- rigs and their associated equipment. An environment rig equipment survey scope typically includes mud and solids control systems, environmental discharge control (including drainage management), and loss of containment management.
- Complete a minimum of monthly environmental inspection (conducted by offshore Woodside personnel or a delegate) which may include verifying:
  - bunkering/transfers between support vessels and MODU/project vessels
  - environment containment including chemical storage, spill response equipment and housekeeping
  - general MODU environment risks including waste management, drilling fluids oil/water separation, and inspection of subsea and moonpool areas.
- Perform at least one environment audit during the Petroleum Activities Program, while the MODU is on location (by a Woodside Environment Adviser or delegate), which may include:
  - operational compliance audits relevant to environmental risk of activities which may include compliance with training commitments, discharge requirements, bunkering activities, verification of use of approved chemicals, and satisfactory close-out of items from previous audits
  - inspection of selected risk areas/activities (which may include shaker house, drill floor and mud management while commencing riser drilling or reservoir interception) during routine MODU visits throughout the MODU campaign, determined by risk, previous incidents or operation specification requirements.

7.4.2.2 Subsea Scope Activities

The following internal auditing are performed for the subsea installation and pre-commissioning scopes:

- Pre-mobilisation inspection/audit report are conducted by a relevant person (before commencing). The scope of the audits are risk-based and specific to the relevant activity, but will generally focus on aspects relating to ensuring appropriate understanding of environmental commitments and the operational readiness of the activity scope, including appropriate environmental controls in place. All primary vessels associated with the above scopes will be audited by Woodside, including the installation vessels.
- At least one operational compliance audit relevant to applicable EP commitments will be conducted by a Woodside Environment Adviser, or delegate, for the subsea campaign. The audit may be conducted offshore or office-based, subject to the duration of the activity and logistics of performing the audit offshore for short duration scopes.
- Contractor-specific HSE audits will also be conducted of the installation vessels and associated support vessels. The audits will consider the implementation of HSE management, risk management, as well as pre-mobilisation and offshore readiness.
- Vessel-based HSE inspections will be conducted fortnightly by vessel HSE personnel. Each inspection will focus on a specific risk area relevant to the project activity and a formal report are issued (for example, bunkering controls, chemical and discharge management, cetacean reporting, etc.).

The internal audits and reviews, combined with the ongoing monitoring described in **Section 7.4.1**, and collection of evidence for measurement criteria are used to assess environmental performance outcomes and standards.

As part of Woodside's EMS and/or assurances processes, activities may also be periodically selected for environmental audits as per Woodside's internal auditing process. Audit, inspection and review findings relevant to continuous improvement of environmental performance are tracked through the Environmental Commitments and Actions Register.

This Environmental Commitments and Actions Register is used to track subsea support vessel and subsea activity compliance with EP commitments, including any findings and corrective actions.

Non-conformances identified will be reported and/or tracked in accordance with **Section 7.4.4**.

7.4.3 Marine Assurance

Woodside's marine assurance is managed by the Marine Assurance Team of the Marine Services Group. The Woodside process is based on industry standards and consideration of guidelines and recommendations from recognised industry organisations such as Oil Companies International Marine Forum and International Maritime Contractors Association.

The process is mandatory for all vessels hired for Woodside operations, including for short term hires (i.e. <3 months in duration). It defines applicable marine offshore assurance activities, ensuring all vessel operators operate seaworthy vessels that meet the requirements for a defined scope of work and are managed with a robust safety management system.

The process is multi-faceted and encompasses the following marine assurance activities:

- Offshore Vessel Safety Management System assessment (OVMSA)
- DP system verification
- Offshore Vessel Inspection Database (OVID)
- project support for tender review, evaluation and pre/post contract award.

OVID inspections are objective in nature and reflect what was observed by the Inspector while conducting the inspection. The inspection provides observations as opposed to non-conformities.

Where an OVID inspection and/or OVMSA Verification Review is not available and all reasonable efforts based on time and resource availability to complete an OVID inspection and/or OVMSA Verification Review are performed (i.e. short term vessel hire), the Marine Assurance Specialist Offshore may approve the use of an alternate means of inspection, known as a risk assessment.

All required audits and inspections will assess compliance with the laws of the international shipping industry, which includes safety and environmental management requirements, and maritime legislation including International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL) and other IMO standards.

7.4.3.1 Risk Assessment

Woodside conducts a risk assessment of vessels where either an OVMSA Verification Review and/or an OVID inspection cannot be completed. This is not a regular occurrence and is typically used when the requirements of the assurance process are unable to be met or the processes detailed are not applicable to a proposed vessel(s).

The risk assessment is a semi-quantitative method of determining what further assurance process activity, if any, is required to assure a vessel for a particular task or role. The process compares the level of management control a vessel is subject to against the risk factors associated with the activity or role.

Several factors are assessed as part of a vessel risk assessment, including:

- management control factors:
  - Company audit score (i.e. management system)
  - vessel HSE incidents
  - vessel Port State Control deficiencies
  - instances of Port State Control vessel detainment
  - years since previous satisfactory vessel inspection
  - age of vessel
  - contractors’ prior experience operating for Woodside.
- activity risk factors:
  - people health and safety risks (a function of the nature of the work and the area of operation)
  - environmental risks (a function of environmental sensitivity, activity type and magnitude of potential environment damage (e.g. largest credible oil spill scenario))
  - value risk (likely time and cost consequence to Woodside if the vessel becomes unusable)
  - reputation risk
  - exposure (i.e. exposure to risk based on duration of project)
  - industrial relations risk.

The acceptability of the vessel or requirement for further vessel inspections or audits is based on the ratio of vessel score to activity risk. If the vessel management control is not deemed to appropriately manage activity risk, a satisfactory company audit and/or vessel inspection may be required before awarding work.

The risk assessment is valid for the period a vessel is on hire and for the defined scope of work.

7.4.4 Management of Non-Conformance

Woodside classifies non-conformances with environmental performance outcomes and standards in this EP as environmental incidents. Woodside employees and contractors are required to report all environmental incidents, and these are managed as per Woodside's internal event recording, investigation and learning requirements.

An internal computerised database called First Priority is used to record and report these incidents. Details of the event, immediate action taken to control the situation, investigation outcomes and corrective actions to prevent reoccurrence are all recorded. Corrective actions are monitored using First Priority and closed out in a timely manner.

Woodside uses a consequence matrix for classification of environmental incidents, with the significant categories being A, B and C (as detailed in **Section 2.6**). Detailed investigations are completed for all categories A, B, C and high potential environmental incidents.

7.4.5 Review

7.4.5.1 Management Review

Within the Environment Function, senior management regularly monitor and review environmental performance and the effectiveness of managing environmental risks and performance. Within each Function and Business Unit Leadership Team (e.g. Drilling and Completions, Subsea and Developments/Projects), managers review environmental performance regularly, including through quarterly HSE review meetings.

Woodside's Drilling and Completions Environment Team will perform six-monthly reviews of the effectiveness of the implementation strategy and associated tools. This will involve reviewing the:

- Drilling and Completions environment key performance indicators (leading and lagging)
- tools and systems to monitor environmental performance (detailed in **Section 7.4.1**)
- lessons learned about implementation tools and throughout each campaign.

Reviews of oil spill arrangements and testing are performed in accordance with **Section 7.9**.

7.4.5.2 Learning and Knowledge Sharing

Learning and knowledge sharing occurs via a number of different methods including:

- event investigations
- event bulletins
- after action review conducted at the end of each well, including review of environmental incidents as relevant
- ongoing communication with MODU operators
- formal and informal industry benchmarking
- cross asset learnings
- engineering and technical authorities discipline communications and sharing.

7.4.5.3 Review of Impacts, Risks and Controls Across the Life of the EP

In the unlikely case that activities described in this EP do not occur continuously or sequentially, before recommencing activities after a cessation period greater than 12 months, impacts, risks and controls will be reviewed.

The process will identify or review impacts and risks associated with the newly-commencing activity, and will identify or review controls to ensure impacts and risks remain/are reduced to ALARP and acceptable levels. Information learned from previous activities conducted under this EP will be considered. Controls which have previously been excluded on the basis of proportionality will be reconsidered. Any required changes will be managed by the MoC process outlined below (**Section 7.5**).

7.5 Environment Plan Management of Change and Revision

Management of changes relevant to this EP, concerning the scope of the activity description (**Section 3**) including: review of advances in technology at stages where new equipment may be selected such as vessel contracting; changes in understanding of the environment, including all current advice from DAWE on species protected under the EPBC Act and current requirements for Australian Marine Parks (**Section 4**); and potential new advice from external stakeholders (**Section 5**), are managed in accordance with Regulation 17 of the Environment Regulations.

Risk are assessed in accordance with the environmental risk management methodology (**Section 2.5**) to determine the significance of any potential new environmental impacts or risks not provided for in this EP. Risk assessment outcomes are reviewed in compliance with Regulation 17 of the Environment Regulations.

Minor changes where a review of the activity and the environmental risks and impacts of the activity do not trigger a requirement for a formal revision under Regulation 17 of the Environment Regulations, will be considered a 'minor revision'. Minor administrative changes to this EP, where an assessment of the environmental risks and impacts is not required (e.g. document references, phone numbers, etc.), will also be considered a 'minor revision'. Minor revisions as defined above will be made to this EP using Woodside's document control process. Minor revisions will be tracked in an MoC Register to ensure visibility of cumulative risk changes, as well as enable internal EP updates/reissuing as required. This document will be made available to NOPSEMA during regulator environment inspections.

7.6 Record Keeping

Compliance records (outlined in Measurement Criteria in **Section 6**) will be maintained.

Record keeping will be in accordance with Regulation 14(7) that addresses maintaining records of emissions and discharges.

7.7 Reporting

To meet the environmental performance outcomes and standards outlined in this EP, Woodside reports at a number of levels, as outlined in the next sections.

7.7.1 Routine Reporting (Internal)

7.7.1.1 Daily Progress Reports and Meetings

Daily reports for drilling activities are prepared and issued to key support personnel and stakeholders, by relevant managers responsible for the well. The report provides performance information about drilling activities, heath, safety and environment, and current and planned work activities.

Meetings between key personnel are used to transfer information, discuss incidents, agree plans for future activities and develop plans and accountabilities for resolving issues.

7.7.1.2 Regular HSE Meetings

Regular dedicated HSE meetings are held with the offshore and Perth-based management and advisers to address targeted HSE incidents and initiatives. Minutes of these meetings are produced and distributed as appropriate.

7.7.1.3 Performance Reporting

Monthly and quarterly performance reports are developed and reviewed by the Function and Business Unit Leadership Teams (e.g. Drilling and Completions). These reports cover a number of subject matters, including:

- HSE incidents (including high potential incidents and those related to this EP) and recent activities
- corporate Key Performance Indicator targets, which include environmental metrics
- outstanding actions as a result of audits or incident investigations
- technical high and low lights.

7.7.2 Routine Reporting (External)

7.7.2.1 Start and End Notifications of the Petroleum Activities Program

In accordance with Regulation 29, Woodside will notify NOPSEMA and DMIRS of the commencement of the Petroleum Activities Program at least ten days before the activity commences and will notify NOPSEMA and DMIRS within ten days of completing the activity.

7.7.2.2 Environmental Performance Review and Reporting

In accordance with applicable environmental legislation for the activity, Woodside is required to report information about environmental performance to the appropriate regulator. Regulatory reporting requirements are summarised in **Table 7-2**.

Table 7-2: Routine external reporting requirements

Report	Recipient	Frequency	Content
Monthly Recordable Incident Reports (**Appendix E**)	NOPSEMA	Monthly, by the 15th of each month.	Details of recordable incidents that have occurred during the Petroleum Activities Program for previous month (if applicable).
Environmental Performance Report	NOPSEMA	Annually, with the first report submitted within 12 months of the commencement of the Petroleum Activities Program covered by this EP (as per the requirements of Regulation 14(2).	Compliance with environmental performance outcomes, controls and standards outlined in this EP, in accordance with the Environment Regulations.

7.7.2.3 End of the Environment Plan

The EP will end when Woodside notifies NOPSEMA that the Petroleum Activities Program has ended and all of the obligations identified in this EP have been completed, and NOPSEMA has accepted the notification, in accordance with Regulation 25A of the Environment Regulations.

7.7.3 Incident Reporting (Internal)

The process for reporting environmental incidents is described in **Sections 7.7.4** of this EP. It is the responsibility of the Woodside Project Manager to ensure reporting of environmental incidents meets Woodside and regulatory reporting requirements as detailed in the Woodside Health, Safety and Environment Event Reporting and Investigation Procedure and this section of this EP.

7.7.4 Incident Reporting (External) – Reportable and Recordable

7.7.4.1 Reportable Incidents

Definition

A reportable incident is defined under Regulation 4 of the Environment Regulations as:

- '*an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage*'.

A reportable incident for the Petroleum Activities Program is:

- an incident that has caused environmental damage with a Consequence Level of Moderate (C) or above (as defined under Woodside's Risk Table (refer to **Figure 2-4**))
- an incident that has the potential to cause environmental damage with a Consequence Level of Moderate (C) or above (as defined under Woodside's Risk Table (refer to **Figure 2-4**)).

The environmental risk assessment (**Section 6**) for the Petroleum Activities Program identifies those risks with a potential consequence level of C+ for environment. The incidents that have the potential to cause this level of impact include hydrocarbon loss of containment events to the marine environment resulting from a loss of well integrity.

Any such incidents represent potential events which would be reportable incidents. Incident reporting is undertaken with consideration of NOPSEMA (2014) guidance stating, 'if in doubt, notify NOPSEMA', and assessed on a case-by-case basis to determine if they trigger a reportable incident as defined in this EP and by the Regulations.

Notification

NOPSEMA will be notified of all reportable incidents, according to the requirements of Regulations 26, 26A and 26AA of the Environment Regulations. Woodside will:

- report all reportable incidents to the regulator (orally) as soon as practicable, but within two hours of the incident or of its detection by Woodside
- provide a written record of the reported incident to NOPSEMA, the National Offshore Petroleum Titles Administrator and the Department of the responsible State Minister (DMIRS) as soon as practicable after orally reporting the incident
- complete a written report for all reportable incidents using a format consistent with the NOPSEMA Form FM0831 – Reportable Environmental Incident (**Appendix E**) which must be submitted to NOPSEMA as soon as practicable, but within three days of the incident or of its detection by Woodside
- provide a copy of the written report to the National Offshore Petroleum Titles Administrator and DMIRS, within seven days of the written report being provided to NOPSEMA.

AMSA will be notified of oil spill incidents as soon as practicable after their occurrence, and DAWE notified if MNES are to be affected by the oil spill incident.

7.7.4.2 Recordable Incidents

Definition

A recordable incident as defined under Regulation 4 of the Environment Regulations is an incident arising from the activity that '*breaches an environmental performance outcome or environmental performance standard, in the EP that applies to the activity, that is not a reportable incident*'.

Notification

NOPSEMA will be notified of all recordable incidents, according to the requirements of Regulation 26B(4), no later than 15 days after the end of the calendar month using the NOPSEMA Form – Recordable Environmental Incident Monthly Summary Report (**Appendix E**) detailing:

- all recordable incidents that occurred during the calendar month
- all material facts and circumstances concerning the recordable incidents that the operator knows or is able, by reasonable search or enquiry, to find out
- any action taken to avoid or mitigate any adverse environment impacts of the recordable incidents
- the corrective action that has been taken, or is proposed to be taken, to prevent similar recordable incidents
- the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future.

7.7.4.3 Other External Incident Reporting Requirements

In addition to the notification and reporting of environmental incidents defined under the Environment Regulations and Woodside requirements, **Table 7-3** describes the incident reporting requirements that also apply in the Permit Area.

Table 7-3: External Incident Reporting Requirements

Event	Responsibility	Notifiable party	Notification requirements	Contact	Contact detail
Any marine incidents during Petroleum Activities Program	Vessel Master	AMSA	Incident Alert Form 18 as soon as reasonably practicable* Within 72 hours after becoming aware of the incident, submit Incident Report Form 19	AMSA	reports@amsa.gov.au
Oil pollution incidents in Commonwealth waters	Vessel Master	AMSA RCC	As per Article 8 and Protocol I of MARPOL within two hours via the national emergency 24-hour notification contacts and a written report within 24 hours of the request by AMSA	AMSA Rescue Coordination Centre (RCC) Australia	If the ship is at sea, reports are to be made to: Free call: 1800 641 792 Phone: 08 9430 2100 (Fremantle)
Oil pollution incidents in Commonwealth waters	Vessel Master	AMSA	Without delay as per *Protection of the Sea Act*, part II, section 11(1), AMSA RCC notified verbally via the national emergency 24-hour notification contact of the hydrocarbon spill; follow up with a written Pollution Report as soon as practicable after verbal notification	RCC Australia	Phone: 1800 641 792 or +61 2 6230 6811 AFTN: YSARYCYX
Any oil pollution incident which has the potential to enter a National Park or requires oil spill response activities to be conducted within a National Park	Vessel Master	Department of Agriculture, Water and the Environment	Reported verbally, as soon as practicable	Director of National Parks	Phone: 02 6274 2220
Activity causes unintentional death of or injury to fauna species listed as Threatened or Migratory under the EPBC Act	Vessel Master	Department of Agriculture, Water and the Environment	Within seven days of becoming aware	Secretary of the DAWE	Phone: 1800 803 772 Email: protected.species@environment.gov.au

The following pollution activity should also be reported to AMSA via RCC Australia by the Vessel Master:

- any loss of plastic material
- garbage disposed of in the sea within 12 NM of land (garbage includes food, paper, bottles, etc.)
- any loss of hazardous materials.

For oil spill incidents, other agencies and organisations will be notified as appropriate to the nature and scale of the incident as per procedures and contact lists in the Oil Pollution Emergency Arrangements (Australia) and the Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation Drilling and Subsea Installation Oil Pollution First Strike Plan.

External incident reporting requirements required under the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations including under sub regulation 2.42, notices and reports of dangerous occurrences will be reported to NOPSEMA under the approved activity safety cases.

7.8 Emergency Preparedness and Response

Under Regulation 14(8), the implementation strategy must contain an Oil Pollution Emergency Plan and provide for updating the OPEP. Regulation 14(8AA) outlines the requirements for the OPEP which must include adequate arrangements for responding to and monitoring hydrocarbon pollution.

A summary of how this EP and supporting documents address the various requirements of Environment Regulations relating to hydrocarbon pollution response arrangements is shown in **Table 7-4**.

Table 7-4: Oil pollution and preparedness and response overview

Content	Environment Regulations Reference	Document/Section Reference
Details of (oil pollution response) control measures that will be used to reduce the impacts and risks of the activity to ALARP and an acceptable level	Regulation 13(5), (6), 14(3)	Oil Spill Preparedness and Response Mitigation Assessment for the Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation Environment Plan (**Appendix D**)
Describes the OPEP	Regulation 14(8)	Environment Plan: Woodside's oil pollution emergency plan has the following components: • Woodside Oil Pollution Emergency Arrangements (Australia) • Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation Oil Pollution First Strike Plan • Oil Spill Preparedness and Response Mitigation Assessment for the Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation Environment Plan (**Appendix D**)
Details the arrangements for responding to and monitoring oil pollution (to inform response activities), including control measures	Regulation 14(8AA)	Oil Spill Preparedness and Response Mitigation Assessment for the Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation EP (**Appendix D**) Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation Oil Pollution First Strike Plan
Details the arrangements for updating and testing the oil pollution response arrangements	Regulation 14(8), (8A), (8B), (8C)	Environment Plan: **Section 7.9.4** Oil Spill Preparedness and Response Mitigation Assessment for the Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation EP (**Appendix D**)
Details of provisions for monitoring impacts to the environment from oil pollution and response activities	Regulation 14(8D)	Oil Spill Preparedness and Response Mitigation Assessment for the Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation EP (**Appendix D**)
Demonstrates that the oil pollution response arrangements are consistent with the national system for oil pollution preparedness and control	Regulation 14(8E)	Oil Pollution Emergency Arrangements (Australia)

7.8.1 Emergency Response Training

Regulation 14(5) requires that the implementation strategy includes measures to ensure that employees and contractors have the appropriate competencies and training. Woodside has conducted a risk based training needs analysis on positions required for effective oil spill response. Following the mapping of training to Woodside identified competencies, training was then mapped to positions based on their required competencies (Table 7-5).

Table 7-5: Minimum levels of competency for key IMT positions.

IMT Position	Competency
CICC Leader and S&EM Duty Manager	• Undertake Incident Crisis Leadership Development Program (ICLDP) • Participation in L2 oil spill exercise (initial) • Participation in L2 oil spill exercise (refresher) • Undertake ICC Fundaments Course (all CICC positions)

Operations, Planning, Logistics, Safety	• Participation in L2 oil spill exercise (initial) • Participation in L2 oil spill exercise (refresher) • Oil Spill Response Skills Enhancement Course (OSREC – internal course) • Undertake ICC Fundaments Course (all CICC positions)

7.8.2 Emergency Response Preparation

The Corporate Incident Coordination Centre (CICC), based in Woodside's head office in Perth, is the onshore coordination point for an offshore emergency. The CICC is staffed by a roster of appropriately skilled personnel available on call 24 hours a day. The purpose of the team is to coordinate incidents, maintain the safety of personnel, minimise damage to the environment and facilities, and to liaise with external agencies. A description of Woodside's Incident Command Structure and arrangements is further detailed in the Woodside OPEA (Australia).

Woodside will have an Emergency Response Plan (ERP) in place relevant to the Petroleum Activities Program. The ERP provides procedural guidance specific to the rig and location of operations to control, coordinate and respond to an emergency or incident. For a drilling activity, the ERP will be a bridging document to the contracted rig's emergency documentation. This document summarises the emergency command, control and communications processes for the integrated operation and management of an emergency. It is developed in collaboration with the contracted rig and ensures roles and responsibilities between the contracted rig and Woodside personnel are identified and understood. The ERPs will contain instructions for vessel emergency, medical emergency, search and rescue, reportable incidents, incident notification, contact information and activation of the contractor's emergency centre and Woodside Communication Centre (WCC).

7.8.3 Initial Response to an Incident

In the event of an emergency of any type:

- On the MODU the Offshore Installation Manager will assume overall onsite command and act as the Incident Controller (IC). All persons aboard the MODU will be required to act under the IC's directions. The MODU/vessels will maintain communications with the onshore Drilling Superintendent and/or other emergency services in the event of an emergency. Emergency response support can be provided by the contractor's emergency centre or WCC if requested by the IC.
- The Vessel Master (depending on the location of the emergency) will assume overall onsite command and act as the IC. All persons will be required to act under the IC's directions. The vessels will maintain communications with the onshore project manager and/or other emergency services in the event of an emergency. Emergency response support can be provided by the contractor's emergency centre or WCC if requested by the IC.
- The MODU and project vessels will have on-board equipment for responding to emergencies including medical equipment, fire-fighting equipment and oil spill response equipment.

The Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation Oil Pollution First Strike Plan provides immediate actions required to commence a response (Appendix H). Vessels will have SOPEPs in accordance with the requirements of MARPOL 73/78 Annex I. These plans outline responsibilities, specify procedures and identify resources available in the event of a hydrocarbon or chemical spill from vessel activities. The Greater Western Flank 3 and Lambert Deep Drilling and Subsea Oil Pollution First Strike Plan is intended to work in conjunction with the SOPEPs, if hydrocarbons are released to the marine environment from a vessel.

Woodside has established EPOs, EPSs and MCs to be used for hydrocarbon spill response during the Petroleum Activities Program, as detailed in Appendix D.

7.8.4 Oil and Other Hazardous Materials Spill

A significant hydrocarbon spill during the proposed Petroleum Activities Program is unlikely, but should such an event occur, it has the potential to cause serious environmental and reputational damage if not managed properly. The Woodside Oil Pollution Emergency Arrangements (Australia) document, supported by the Oil Pollution First Strike Plan which provides tactical response guidance to the activity/area and **Appendix D** of this EP, cover spill response for this Petroleum Activities Program.

The Security & Emergency Management Function is responsible for the management of Woodside's hydrocarbon spill response equipment and for the maintenance of hydrocarbon spill preparedness and response documentation. In the event of a major spill, Woodside will request that AMSA (administrator of the National Plan) provides support to Woodside through advice and access to equipment, people and liaison. The55rt interface and responsibilities, as defined under the National Plan, are described in the OPEA (Australia). AMSA and Woodside have a Memorandum of Understanding in place to support Woodside in the event of a hydrocarbon spill.

The Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation Oil Pollution First Strike Plan provides immediate actions required to commence a response.

The MODU and project vessels will have SOPEPs in accordance with the requirements of MARPOL 73/78 Annex I. These plans outline responsibilities, specify procedures and identify resources available in the event of a hydrocarbon or chemical spill from vessel activities. The Oil Pollution First Strike Plan is intended to work in conjunction with the SOPEPs, if hydrocarbons are released to the marine environment from a vessel.

Woodside has established EPOs, EPSs and MCs to be used for hydrocarbon spill response during the Petroleum Activities Program, as detailed in **Appendix D**.

7.8.5 Emergency and Spill Response

Woodside categorises incidents and emergencies in relation to response requirements as follows:

- A **Level 1 incident** can be resolved using existing resources, equipment and personnel. A Level 1 incident is contained, controlled and resolved by site/regionally based teams using existing resources and functional support services.
- A **Level 2 incident** is characterised by a response that requires external operational support to manage the incident. It is triggered if the capabilities of the tactical level response are exceeded. This support is provided to the activity by activating all or part of the responsible ICC.
- A **Level 3 incident** or crisis is identified as a critical event that seriously threatens the organisation's People, the Environment, company Assets, Reputation, Livelihood or essential Services. At Woodside, the Crisis Management Team manages the strategic impacts to respond to and recover from the threat to the company (material impacts, litigation, legal & commercial, reputation, etc.). The ICC may also be activated as required to manage the operational response to the Level 3 incident.

7.8.6 Emergency and Spill Response Drills and Exercises

Testing of Woodside's capability to respond to incidents will be conducted in alignment with the Emergency and Crisis Management Procedure. The scope, frequency and objective of these tests is described in Table 7-6. Woodside's emergency response testing regime is aligned to existing or developing risks associated with Woodside's operations and activities. Corporate hazards/risks outlined in the corporate risk register, respective Safety Cases or project Risk Registers, are reference points for emergency management and crisis management to develop exercise schedules. External participants may be invited to attend exercises, such as government agencies, specialist service providers, oil spill response organisations or industry members with which we have mutual aid arrangements.

The overall objective of exercising is to test procedures, skills and teamwork of the Emergency Response and Command Teams in their ability to respond to Major Accident Events and Major Environment Events. After each exercise, the team holds a debrief session during which the exercise is reviewed. Any lessons learned or areas for improvement are identified and incorporated into revised procedures where appropriate.

Table 7-6: Testing of response capability

Response Category	Scope	Response Testing Frequency	Response Testing Objective
Level 1 Response	Exercises are MODU specific	One Level 1 'First Strike' drill conducted within two weeks of commencing drilling. [Note a Level 1 drill is not required for each well but the same commitment applies if the rig moves into a different region]	• Comprehensive exercises test elements of the Greater Western Flank 3 and Lambert Deep Drilling and Subsea Oil Pollution First Strike Plan for a Level 1 incident (Appendix H). • Emergency drills are scheduled to test other aspects of their Emergency Response Plan.
Level 2 Response	Exercises are MODU specific	A minimum of one Emergency Management exercise per MODU per campaign [must be conducted within one month of campaign commencing and at least one Level 2 exercise per 6 month hire period].	• Testing both the MODU IMT response and/or that of the CICC following handover of incident control.
Level 3 Response	Exercises are relevant to all Woodside assets	The number of CMT exercises conducted each year is determined by the Chief Executive Officer, in consultation with the Vice President of Security and Emergency Management.	• Test the ability of the company to respond to and manage a crisis level incident.

7.8.6.1 Testing of Oil Spill Response Arrangements

Woodside is required to test hydrocarbon spill response arrangements as per regulations 8B and 8C in the Environment Regulations. Woodside's arrangements for spill response are common across Australian operating assets and activities to ensure controls are consistent. The overall objective of testing these arrangements is to ensure that Woodside maintains an ability to respond to a hydrocarbon spill, specifically to:

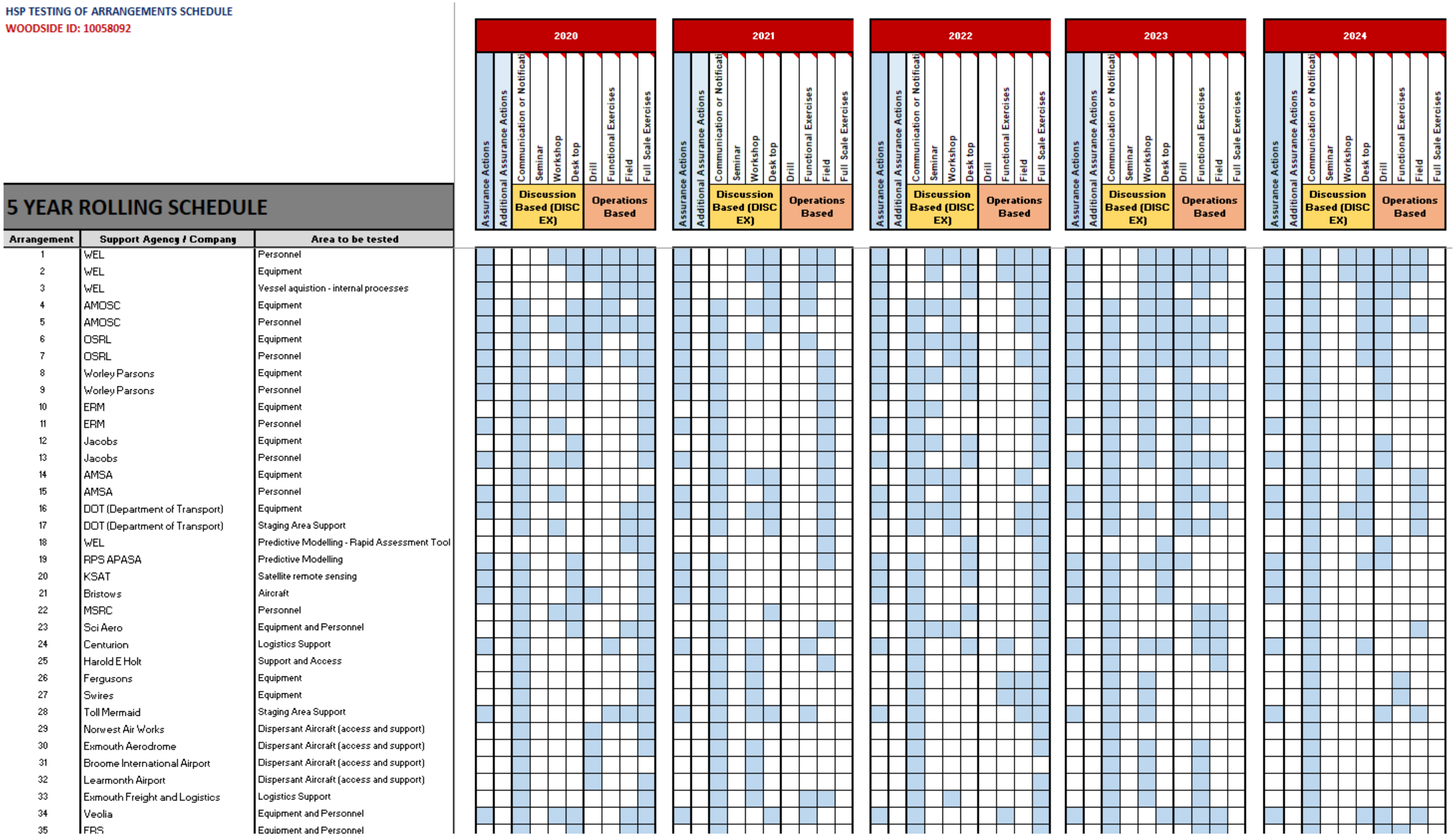
- ensure relevant responders, contractors and key personnel practise their assigned roles and responsibilities
- test response arrangements and actions to validate response plans
- ensure lessons learned are incorporated into Woodside processes and procedures and improvements made where required.

In the event that new response arrangements are introduced, or existing arrangements significantly amended, additional testing will be undertaken accordingly. Should the MODU or PIV leave the field for an extended period, testing will be undertaken when the MODU or PIV return to the Operational Area and resume activities. Additional locations and activities are not anticipated to occur; however, in the event that they do, testing relevant response arrangements will be undertaken as soon as practicable.

In addition to the testing of response capability described in Table 7-6, up to eight formal exercises are planned annually, pan-Woodside, to specifically test arrangements for responding to a hydrocarbon spill to the marine environment.

7.8.6.2 Testing of Arrangements Schedule

Woodside’s Testing of Arrangements Schedule aligns with international good practice for spill preparedness and response management; the testing is compatible with the IPIECA Good Practice Guide and the Australian Emergency Management Institute Handbook. In the event of a spill, enacting these arrangements will underpin Woodside’s ability to implement a response across its petroleum activities. Figure 7-1 provides a condensed snapshot of Woodside’s five-year rolling Testing of Arrangements Schedule.


HSP TESTING OF ARRANGEMENTS SCHEDULE
WOODSIDE ID: 10058092

5 YEAR ROLLING SCHEDULE

Arrangement	Support Agency / Company	Area to be tested
1	WEL	Personnel
2	WEL	Equipment
3	WEL	Vessel aquistion - internal processes
4	AMOSC	Equipment
5	AMOSC	Personnel
6	OSRL	Equipment
7	OSRL	Personnel
8	Worley Parsons	Equipment
9	Worley Parsons	Personnel
10	ERM	Equipment
11	ERM	Personnel
12	Jacobs	Equipment
13	Jacobs	Personnel
14	AMSA	Equipment
15	AMSA	Personnel
16	DOT (Department of Transport)	Equipment
17	DOT (Department of Transport)	Staging Area Support
18	WEL	Predictive Modelling - Rapid Assessment Tool
19	RPS APASA	Predictive Modelling
20	KSAT	Satellite remote sensing
21	Bristows	Aircraft
22	MSRC	Personnel
23	Sci Aero	Equipment and Personnel
24	Centurion	Logistics Support
25	Harold E Holt	Support and Access
26	Fergusons	Equipment
27	Swires	Equipment
28	Toll Mermaid	Staging Area Support
29	Norwest Air Works	Dispersant Aircraft (access and support)
30	Exmouth Aerodrome	Dispersant Aircraft (access and support)
31	Broome International Airport	Dispersant Aircraft (access and support)
32	Learmonth Airport	Dispersant Aircraft (access and support)
33	Exmouth Freight and Logistics	Logistics Support
34	Veolia	Equipment and Personnel
35	FRS	Equipment and Personnel

Figure 7-1: Indicative Five Yearly Testing of Arrangements Schedule (snapshot of a selection of OSR arrangemetns tested annually)

Note: schedule is subject to change, additional detail is included in live document

7.8.7 Cyclone and Dangerous Weather Preparation

As the timing of some activities associated with the Petroleum Activities Program are not yet determined, it is possible drilling and subsea installation activities will overlap with the cyclone season (November to April, with most cyclones occurring between January and March). If drilling in cyclone season, the MODU contractor and vessel contractors must have a Cyclone Contingency Plan (CCP) in place outlining the processes and procedures that would be implemented during a cyclone event, which will be reviewed and accepted by Woodside.

The MODU and project vessels will receive daily forecasts from the BoM. If a cyclone (or severe weather event) is forecast, the path and its development will be plotted and monitored using the BoM data. If there is the potential for the cyclone (severe weather event) to affect the Petroleum Activities Program, the CCP will be actioned. If required, vessels can transit from the proposed track of the cyclone (severe weather event).

7.9 Implementation Strategy and Reporting Commitments Summary

Table 7-7 provides a summary of key components within the implementation strategy.

Table 7-7: Implementation strategy and reporting commitments summary

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
PO IS-1 All crew will be aware of their roles and responsibilities regarding environmental risks throughout the Petroleum Activities Program.	**PS IS-1.1** All personnel are required to attend an induction before commencing work. These inductions cover health, safety and environmental requirements for the MODU and project vessels, and environmental information specific to the Petroleum Activities Program location.	**MC IS-1.1.1** Induction attendance records.
	PS IS-1.2 A pre-activity meeting will be held on the MODU and Primary Installation Vessels with relevant personnel before conducting the Petroleum Activities Program, focusing on any specific environmental sensitivities associated with the activity.	**MC IS-1.1.2** Pre-activity meeting attendance records and minutes.
	PS IS-1.3 During execution campaign, regular HSE meetings will be held on the MODU and project vessels which cover all crew. Recent environmental incidents will be reviewed and awareness material presented regularly.	**MC IS-1.3.1** Attendance is recorded and lists retained on the MODU/project vessels.
	PS IS-1.4 The MODU Contractor and vessel contractors must have a CCP accepted by Woodside, outlining the processes and procedures that would be implemented during a cyclone event, if drilling is to take place during cyclone season.	**MC IS-1.4.1** Record of Woodsideapproved Contractor CCP in place prior to activities commencing.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
PO IS-2 Woodside and its Contractors will perform a program of periodic monitoring during the Petroleum Activities Program – starting at mobilisation of each activity and continuing through the duration of each activity to activity completion.	**PS IS-2.1** Monitoring information will be collected using Woodside tools and systems	**MC-IS 2.1.1** Monitoring reports including daily reports, periodic reports, risk observation cards, environmental discharge reports
	PS IS-2.2 Periodic review of the Woodside Environmental Knowledge Management System to maintain currency of receptor knowledge.	**MC-IS 2.2.1** Review records Corporate Environment Baseline Database
PO IS-3 Woodside will audit environmental performance.	**PS IS-3.1** Any newly contracted MODU will have a start-up or pre-mobilisation audit performed, if not previously contracted to Woodside within the last two years.	**MC IS-3.1.1** Woodside's start up or pre-mobilisation report for the MODU.
	PS IS-3.2 Offshore Woodside personnel must conduct a minimum of monthly environmental inspections.	**MC IS-3.2.1** Completed environmental inspection checklists.
	PS IS-3.3 Woodside Environmental Adviser (or delegate) must complete at least one quarterly environment audit during the Petroleum Activities Program.	**MC IS-3.3.1** Quarterly Environment Audit report.
	PS IS-3.4 A pre-mobilisation inspection/audit report will be conducted by a relevant person prior to the commencement of subsea installation and pre-commissioning scopes.	**MC IS-3.4.1** Completed pre-mobilisation inspection/audit report.
	PS IS-3.5 At least one operational compliance audit relevant to applicable EP commitments will be conducted by a Woodside environment adviser (or delegate) for the subsea campaign	**MC IS-3.5.1** Completed Operational Compliance Audit report.
	PS IS-3.6 Contractor specific HSE audits will be conducted of the primary installation vessels and associated support vessels.	**MC IS-3.6.1** Completed HSE audits report.
	PS IS-3.7 Vessel based HSE inspections will be conducted fortnightly by vessel HSE personnel	**MC IS-3.7.1** Completed HSE inspection checklists.
	PS IS-3.8 Audit findings relevant to continuous improvement of environmental performance will be tracked through the MODU or vessel compliance action register, a contractor register between the MODU operator or vessel contractor and Woodside.	**MC IS-3.8.1** MODU or vessel compliance action register records that demonstrate tracking of audit findings.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
	PS IS-3.9 Marine assurance will be undertaken in accordance with Woodside's internal assurance process and is mandatory for all vessels hired for Woodside.	**MC IS-3.9.1** Records demonstrate marine assurance reviews conducted as required.
PO IS-4 Woodside employees and Contractors will report all environmental incidents and non-conformance with environmental performance outcomes and standards in this EP.	**PS IS-4.1** Non-conformances to be notified, investigated and reported in accordance with Woodside's event recording, investigation and learnings requirements.	**PS IS-4.1.1** Records demonstrate Non-conformances are notified, investigated and reported in accordance with Woodside's event recording, investigation and learnings requirements.
PO IS-5 Woodside will perform regular reviews to monitor environmental performance and share knowledge and learning.	**PS IS-5.1** Woodside is to hold quarterly HSE Review meetings.	**PS IS-5.1.1** Records demonstrate meetings reviewed HSE performance.
	PS IS-5.2 Woodside's Drilling and Completions Environment Team is to perform six monthly reviews of the effectiveness of the implementation strategy and associated tools.	**PS IS-4.2.1** Records demonstrate sixmonthly reviews of the effectiveness of the implementation strategy.
	PS IS-5.3 After action review conducted at the end of each well for learning and knowledge sharing, including review of environmental incidents as relevant.	**PS IS-5.3.2** After action review report
PO IS-6 Changes in activity scope, understanding of the environment and potential new advice from external stakeholders will be tracked and the EP updated as required.	**PS IS-6.2** Management of change relevant to this EP to be managed in accordance with Regulation 17 of the Environment Regulations.	**PS IS-6.2.1** Records of minor revisions to the EP tracked in an MoC Register. Revision and resubmission of the EP as required.
PO IS-7 All internal and external reporting requirements relevant to this EP will be met.	**PS IS-7.1** Regular HSE meetings Monthly and quarterly HSE performance reports	**MC IS-7.1.1** HSE performance reports. Minutes of HSE meetings
	PS IS-7.2 Woodside will submit an environmental performance report to NOPSEMA (annually, with the first report submitted within 12 months of commencing the activity).	**MC IS-7.2.1** Record of submission of environmental performance reports to NOPSEMA.
	PS IS-7.3 Woodside will submit a monthly recordable incident report to NOPSEMA.	**MC IS-7.3.1** Record of submission of monthly recordable incident report to NOPSEMA.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
PO IS-8 All external notification requirements, as applicable to this EP, will be met.	**PS IS-8.1** Woodside will notify NOPSEMA and DMIRS of the commencement of the Petroleum Activities Program at least ten days before the activity commences. Woodside will notify NOPSEMA and DMIRS within ten days of completing the activity.	**MC IS-8.1.1** Record of notification to NOPSEMA. Record of notification to DMIRS.
	PS IS-8.2 The EP will end when Woodside notifies NOPSEMA that the Petroleum Activities Program has ended and all of the obligations identified in this EP have been completed, and NOPSEMA has accepted the notification, in accordance with Regulation 25A.	**MC IS-8.2.1** Record of notification to NOPSEMA.
	PS IS-8.3 NOPSEMA will be notified of all reportable incidents, according to the requirements of Regulations 26, 26A and 26AA of the Environment Regulations.	**MC IS-8.3.1** Record of notifications to NOPSEMA
	PS IS-8.4 DAWE (if MNES affected) will be notified of oil spill incidents as soon as practicable following the occurrence.	**MC IS-8.4.1** Record of notification to DAWE if MNES is affected.
	PS IS-8.5 DPIRD and relevant commercial fishing representative bodies and licence holders will be notified prior to and upon completing the proposed activity**.**	**MC IS-8.5.1** Records of notifications sent to DPIRD and relevant commercial fishing representative bodies and licence holders.
	PS IS-8.6 Any oil pollution incidents in Commonwealth waters will be reported without delay (by the vessel master) to AMSA RCC as per the *Protection of the Sea (Prevention of Pollution from Ships) Act*, Part II, Section 11(1). The verbal report shall be made via the national emergency 24-hour notification contact, and if AMSA requests a written report, it should be provided within 24 hours of the request.	**MC IS 8.6.1** Records of notification to AMSA.
PO IS-9 Planned and unplanned emissions and discharges will be documented and records maintained.	**PS IS-9.1** The volumes of planned and unplanned emissions and discharges that could result from the risks described in **Section 6.6** and **Section 6.7** are documented in drilling, pipeline or subsea reports.	**MC IS-9.1.1** Records of planned and unplanned emissions and discharges are maintained in drilling, pipeline or subsea reports.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
PO IS-10 Personnel holding responsibilities in a response will test the arrangements supporting the activities OPEP to ensure they are effective and communicated.	**PS IS-10.1** Exercises will be conducted in alignment with the frequency identified in **Table 7-4**. These arrangements are conducted in accordance with Regulation 14(8B) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.* • Arrangements are tested when introduced. • Arrangements are tested in accordance with Woodside's Hydrocarbon Spill Arrangements Testing Schedule as per the frequency identified in **Table 7-6**. • Arrangements will be tested when the OPEP is significantly amended, and further testing will occur if a new activity location is added to the EP.	**MC IS-10.1.1** Spill response exercise reports and key participants maintained in the Woodside IMS system. Records managed in Hydrocarbon Spill Preparedness Unit (HSPU) Testing of Arrangements Register.
	PS IS-10.2 Post exercise reports will be developed for each exercise to measure performance against the objectives, and the learnings from the plan updated in the OPEP following these learnings.	**MC IS-10.2.1** Spill response exercise reports and key participants maintained in the Woodside IMS system. Records managed in HSPU Testing of Arrangements Register.
	PS IS-10.3 Close-out of HSPU actions from exercising are managed in the HSPU Testing of Arrangements Register.	**MC IS-10.3.1** Records managed in HSPU Testing of Arrangements Register.
PO IS-11 Woodside will ensure that the arrangements supporting the activities OPEP are validated.	**PS IS-11.1** Activity OPEPs will be revised at a minimum every five years.	**MC IS-11.1.1** OPEP current and available.

Implementation Strategy (IS) Performance Outcome	Implementation Strategy Performance Standard	Implementation Strategy Measurement Criteria
PO IS-12 The OPEP will only be updated under specific circumstances to ensure the information is current.	**PS IS-12.1** Relevant documents from the OPEP will be reviewed when: • implementing an improved preparedness measure • the availability of equipment stockpiles changes • the availability of personnel changes that reduces or improves preparedness and the capacity to respond • a new or improved technology is introduced that may be considered in a response for this activity • incorporating, where relevant, lessons learned from exercises or events • national or state response frameworks and Woodside's integration with these frameworks changes.	**MC IS-12.1.1** The following records will be maintained: • Woodside's HSPU Testing of arrangements register • Woodside's Internal Equipment Maintenance Register • OPEP current and available.
PO IS-13 Woodside will perform a vessel risk assessment where an OVID inspection and/or OVMSA Verification Review is not available (i.e. short term vessel hire).	**PS IS-13.1** The Marine Vessel Risk Assessment will be conducted by the Marine Assurance Superintendent, or the nominated deputy, where the vessel meets the short term hire prerequisites.	**MC IS-13.1.1** Marine Vessel Risk Assessment sheet demonstrates the assessment has been conducted.
PO IS-14 Prior to recommencing activities after a cessation period greater than 12 months, Woodside will review impacts, risks and controls.	**PS IS-14.1** Impacts and risks associated with recommencing activities (if commencing after a cessation period greater than 12 months) must remain/be reduced to ALARP and acceptable levels.	**MC IS-14.1.1** Records demonstrate impacts, risks and controls are reviewed before recommencing activities (if commencing after a cessation period greater than 12 months).

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9. LIST OF TERMS AND ACRONYMS

Acronym	Description
@	At
~	Approximately
<	Less/fewer than
>	Greater/more than
≤	Less than or equal to
≥	Greater than or equal to
°C	Degrees Celsius
24/7	24 hours a day, seven days a week
3D	Three-dimensional
ABF	Australian Border Force
ACN	Australian Company Number
AFMA	Australian Fisheries Management Authority
AHO	Australian Hydrographic Office
AHV	Anchor Handling Vessel
AIMS	Australian Institute of Marine Science
ALARP	As low as reasonably practicable
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
API	American Petroleum Institute
APPEA	Australian Petroleum Production and Exploration Association
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS/NZS	Australian Standard/New Zealand Standard
bbl	Barrel
bbl/d	Barrels per day
BIA	Biologically Important Area
BoM	Bureau of Meteorology
BOP	Blowout Preventer
BP	British Petroleum
CALM	Former Western Australian Department of Conservation and Land Management (now DBCA)
CICC	Corporate Incident Communication Centre
cm	Centimetre
cm^3	Cubic centimetre
CO	Carbon monoxide
CO2	Carbon dioxide
cP	Centipoise
CS	Cost Sacrifice

Acronym	Description
CV	Company Value
c/w	Combined with
CWLH	Cossack, Wanaea, Lambert, and Hermes
DAWR	Commonwealth Department of Agriculture and Water Resources
dB re 1 µPa	Decibels relative to one micropascal; the unit used to measure the intensity of an underwater sound
DBCA	Western Australian Department of Biodiversity, Conservation and Attractions
DEC	Former Western Australian Department of Environment and Conservation (now DBCA)
DEH	Former Commonwealth Department of the Environment and Heritage (now DoEE)
DEWHA	Former Commonwealth Department of the Environment, Water, Heritage and the Arts (now DoEE)
DIIS	Commonwealth Department of Industry, Innovation and Science
DMIRS	Western Australian Department of Mines, Industry Regulation and Safety
DNP	Director of National Parks
DoEE	Commonwealth Department of the Environment and Energy
DoT	Western Australian Department of Transport
DP	Dynamic positioning
DpaW	Former Western Australian Department of Parks and Wildlife (now DBCA)
DPIRD	Western Australian Department of Primary Industries and Regional Development
DPLH	Western Australian Department of Planning, Lands and Heritage
DRIMS	Document Retrieval Integrated Management System
DSEWPaC	Former Commonwealth Department of Sustainability, Environment, Water, Population and Communities (now DoEE)
DWH	Deepwater Horizon
EDS	Emergency Disconnect System
EEZ	Exclusive Economic Zone
EMBA	Environment that may be affected
ENVID	Environment Identification (study)
EP	Environment Plan
EPA	Western Australian Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPO	Environmental Performance Outcome
EPS	Environment Performance Standard
ERP	Emergency Response Plan
ESD	Ecologically Sustainable Development
FCGT	Flood, Control, Gauge, Test
FPSO	Floating production, storage, and offtake
g	Gram
GP	Good Practice
GWA	Goodwyn Alpha

Acronym	Description
ha	Hectare
HAZID	Hazard identification (study)
HFL	Hydraulic Flying Lead
HLV	Heavy Lift Vessel
HQ	Hazard Quotient
HSE	Health, Safety, and Environment
IC	Incident Controller
ID	Internal Diameter
IMR	Inspection, maintenance and repair
IMS	Invasive Marine Species
IOGP	International Association of Oil and Gas Producers
IPIECA	International Petroleum Industry Environmental Conservation Association
ISO	International Organization for Standardization
ITF	Indonesian Throughflow
ITOPF	International Tanker Owners Pollution Federation Ltd
IUCN	International Union for the Conservation of Nature
JRCC	Joint Rescue Coordination Centre
KEF	Key Ecological Feature
kg	Kilogram
KGP	Karratha Gas Plant
kHz	Kilohertz
km	Kilometre
kn	Knot
KO	Knock Out (drum)
KPI	Key Performance Indicator
kW	Kilowatt
L	Litre
LAT	Lowest Astronomical Tide
LCS	Legislation, Codes and Standards
LNG	Liquefied Natural Gas
m	Metre
m/s	Metres per second
m^2	Square metre
m^3	Cubic metre
MAE	Major Accident Event
MARPOL	The International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978.
MBES	Multibeam Echo Sonar
MC	Measurement Criteria

Acronym	Description
MEG	Monoethylene glycol
mg	Milligram
MGO	Marine Gas Oil
ml	Millilitre
MMscfd	Million standard cubic feet per day
MNES	Matters of National Environmental Significance
MoC	Management of Change
MOU	Memorandum of Understanding (Mutual Aid Memorandum of Understanding)
MPA	Marine Protected Area
MPRA	Marine Parks and Reserves Authority
MSIN	Maritime Safety Information Notifications
n.d.	No date
N/A	Not Applicable
NERA	National Energy Resources Australia
NIMS	Non-indigenous Marine Species
nm	Nautical mile
NMFS	National Marine Fisheries Service (US)
NTM	Notices To Mariners
NOAA	National Oceanic and Atmospheric Administration (US)
NOEC	No observed effect concentrations
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NO_X	Oxides of nitrogen
NRC	North Rankin Complex
NSW	New South Wales
NWBM	Non-Water-Based Mud
NWMR	North-west Marine Region
NWS	North West Shelf
OCIMF	Oil Companies International Marine Forum
OCNS	Offshore Chemical Notification Scheme
OIW	Oil in water
OOC	Oil on Cuttings
OPEA	Oil Pollution Emergency Arrangements
OPEP	Oil Pollution Emergency Plan
OPGGS Act	Commonwealth *Offshore Petroleum and Greenhouse Gas Storage Act 2006*
OSPAR	Oslo–Paris Convention for the Protection of the Marine Environment of the North East Atlantic
PAH	Polycyclic aromatic hydrocarbon
PAR	Photosynthetically active radiation

Acronym	Description
PC	Protection Concentration; e.g. PC99 is 99% protection concentration, PC95 is 95% protection concentration etc.
pH	Measure of acidity or basicity of a solution
PJ	Professional Judgement
PMST	Protected Matters Search Tool
POB	Personnel on Board
PPA	Pearl Producers Association
ppb	Parts per billion
ppm	Parts per million
PSM	Process Safety Management
PSRA	Process Safety Risk Assessment
PSU	Practical salinity unit
PSZ	Petroleum safety zone
PTW	Permit to Work
PW	Produced Water
RBA	Risk-based Analysis
RCC	Rescue Coordination Centre
RMR	Riserless Mud Recovery
Rms	Root Mean Square
RO	Reverse osmosis
ROV	Remotely operated vehicle
RTM	Riser turret mooring
SA	South Australia
SCE	Solids Control Equipment
SEL	Sound Exposure Level
SIMAP	Spill Impact Mapping and Analysis program
SKM	Sinclair Knight Mertz (company)
SMP	Scientific Monitoring Program
SMPEP	Spill Monitoring Programme Execution Plan
SOPEP	Ship Oil Pollution Emergency Plan
SPL	Sound Pressure Level
SSIV	Subsea Isolation Valve
SSS	Side Scan Sonar
SV	Societal Value
T	Tonne
TPS	Temporary Production System
TSS	Total Suspended Solids
UCON	Universal Connection
UK	United Kingdom

Acronym	Description
US	United States
USBL	Ultra-short baseline
USEPA	United States Environmental Protection Agency
UTA	Umbilical Termination Assembly
VOC	Volatile Organic Compound
VLS	Vertical Lay System
VP	Vice President
WA	Western Australia
WCBD	Well Control Bridging Document
WBM	Water-Based Mud
WAFIC	Western Australian Fishing Industry Council
WEL	Woodside Energy Limited
WGS84	Word Geodesic System 1984
WHA	World Heritage Area
WMS	Woodside Management System
WOMP	Well Operations Management Plan
XC Polymers	Xanthan Gum

APPENDIX A WOODSIDE HEALTH, SAFETY, ENVIRONMENT AND QUALITY AND RISK MANAGEMENT POLICIES

Health, Safety, Environment and Quality Policy

OBJECTIVES

Strong health, safety, environment and quality (HSEQ) performance is essential for the success and growth of our business. Our aim is to be recognised as an industry leader in HSEQ through managing our activities in a sustainable manner with respect to our workforce, our communities and the environment.

At Woodside we believe that process and personal safety related incidents, and occupational illnesses, are preventable. We are committed to managing our activities to minimise adverse health, safety or environmental impacts, incorporating a right first time approach to quality.

PRINCIPLES

Woodside will achieve this by:

- implementing a systematic approach to HSEQ risk management
- complying with relevant laws and regulations and applying responsible standards where laws do not exist
- setting, measuring and reviewing objectives and targets that will drive continuous improvement in HSEQ performance
- embedding HSEQ considerations in our business planning and decision making processes
- integrating HSEQ requirements when designing, purchasing, constructing and modifying equipment and facilities
- maintaining a culture in which everybody is aware of their HSEQ obligations and feels empowered to speak up and intervene on HSEQ issues
- undertaking and supporting research to improve our understanding of HSEQ and using science to support impact assessments and evidence based decision making
- taking a collaborative and pro-active approach with our stakeholders
- requiring contractors to comply with our HSEQ expectations in a mutually beneficial manner
- publicly reporting on HSEQ performance

APPLICATION

Responsibility for the application of this policy rests with all Woodside employees, contractors and joint venturers engaged in activities under Woodside operational control. Woodside managers are also responsible for promotion of this policy in non-operated joint ventures.

This policy will be reviewed regularly and updated as required.

Reviewed in December 2019

Risk Management Policy

OBJECTIVES

Woodside recognises that risk is inherent to its business and that effective management of risk is vital to delivering on our objectives, our success and our continued growth. We are committed to managing all risk in a proactive and effective manner.

Our approach to risk enhances opportunities, reduces threats and sustains Woodside's competitive advantage.

The objective of our risk management system is to provide a consistent process for the recognition and management of risks across Woodside's business. The success of our risk management system lies in the responsibility placed on everyone at all levels to proactively identify, manage, review and report on risks relating to the objectives they are accountable for delivering.

PRINCIPLES

Woodside achieves these objectives by:

- Applying a structured and comprehensive risk management system across Woodside which establishes common risk management understanding, language and methodology
- Identifying, assessing, monitoring and reporting risks to provide management and the Board with the assurance that risks, including contemporary and emerging risks, are being effectively identified and managed, and that Woodside is operating with due regard to the risk appetite set by the Board
- Ensuring risks consider impacts across the following key areas of exposure: health and safety, environment, finance, reputation and brand, legal and compliance, and social and cultural
- Understanding our exposure to risk and applying this to our decision making
- Embedding risk management into our critical business activities and processes
- Assuring the effectiveness of risk controls and of the risk management process
- Building our internal resilience to the effects of adverse business impacts in order to sustain performance.

APPLICATION

The Managing Director of Woodside is accountable to the Board of Directors for ensuring this policy is effectively implemented.

Managers are responsible for promoting and applying the Risk Management Policy. Responsibility for the effective application of this policy rests with all Woodside employees, contractors and joint venturers engaged in activities under Woodside operational control.

This policy will be reviewed regularly and updated as required.

Revised by the Woodside Petroleum Ltd Board on 6 December 2019.

APPROVED

APPENDIX B RELEVANT REQUIREMENTS

This appendix refers to Commonwealth Legislation related to the project.

Commonwealth Legislation	Legislation Summary
Air Navigation Act 1920 • *Air Navigation Regulations 1947* • *Air Navigation (Aerodrome Flight* • *Corridors) Regulations 1994* • *Air Navigation (Aircraft Engine* • *Emissions) Regulations 1995* • *Air Navigation (Aircraft Noise)* • *Regulations 1984* • *Air Navigation (Fuel Spillage) Regulations 1999*	This Act relates to the management of air navigation.
Australian Maritime Safety Authority Act 1990	This Act establishes a legal framework for the Australian Maritime Safety Authority (AMSA), which represents the Australian Government and international forums in the development, implementation and enforcement of international standards including those governing ship safety and marine environment protection. AMSA is responsible for administering the Marine Orders in Commonwealth waters.
Australian Radiation Protection and Nuclear Safety Act 1998	This Act relates to the protection of the health and safety of people, and the protection of the environment from the harmful effects of radiation.
Biosecurity Act 2015 • *Quarantine Regulations 2000* • *Biosecurity Regulation 2016* • *Australian Ballast Water Management Requirements 2017*	This Act provides the Commonwealth with powers to take measures of quarantine, and implement related programs as are necessary, to prevent the introduction of any plant, animal, organism or matter that could contain anything that could threaten Australia's native flora and fauna or natural environment. The Commonwealth's powers include powers of entry, seizure, detention and disposal. This Act includes mandatory controls on the use of seawater as ballast in ships and the declaration of sea vessels voyaging out of and into Commonwealth waters. The Regulations stipulate that all information regarding the voyage of the vessel and the ballast water is declared correctly to the quarantine officers.
Environment Protection and Biodiversity Conservation Act 1999 • *Environment Protection and Biodiversity Conservation Regulations 2000*	This Act protects matters of national environmental significance (NES). It streamlines the national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and culturally significant places. Under this Act, actions that may be likely to have a significant impact on matters of NES must be referred to the Commonwealth Environment Minister.
Environment Protection (Sea Dumping) Act 1981 • *Environment Protection (Sea Dumping) Regulations 1983*	This Act provides for the protection of the environment by regulating dumping matter into the sea, incineration of waste at sea and placement of artificial reefs.
Industrial Chemicals (Notification and Assessment Act) 1989 • *Industrial Chemicals (Notification and Assessment) Regulations 1990*	This Act creates a national register of industrial chemicals. The Act also provides for restrictions on the use of certain chemicals which could have harmful effects on the environment or health.

Commonwealth Legislation	Legislation Summary
National Environment Protection Measures (Implementation) Act 1998 • *National Environment Protection Measures (Implementation) Regulations 1999*	This Act and Regulations provide for the implementation of National Environment Protection Measures (NEPMs) to protect, restore and enhance the quality of the environment in Australia and ensure that the community has access to relevant and meaningful information about pollution. The National Environment Protection Council has made NEPMs relating to ambient air quality, the movement of controlled waste between states and territories, the national pollutant inventory, and used packaging materials.
National Greenhouse and Energy Reporting Act 2007 • *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*	This Act and associated Rule establishes the legislative framework for the NGER scheme for reporting greenhouse gas emissions and energy consumption and production by corporations in Australia.
Navigation Act 2012 • *Marine order 12 – Construction – subdivision and stability, machinery and electrical installations* • *Marine order 30 - Prevention of collisions* • *Marine order 47 - Mobile offshore drilling units* • *Marine order 57 - Helicopter operations* • *Marine order 60 - Floating offshore facilities* • *Marine order 91 - Marine pollution prevention—oil* • *Marine order 93 - Marine pollution prevention—noxious liquid substances* • *Marine order 94 - Marine pollution prevention—packaged harmful substances* • *Marine order 96 - Marine pollution prevention—sewage* • *Marine order 97 - Marine pollution prevention—air pollution*	This Act regulates navigation and shipping including Safety of Life at Sea (SOLAS). The Act will apply to some activities of the MODU and project vessels. This Act is the primary legislation that regulates ship and seafarer safety, shipboard aspects of marine environment protection and pollution prevention.
Offshore Petroleum and Greenhouse Gas Storage Act 2006 • *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* • *Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011* • *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009*	This Act is the principal Act governing offshore petroleum exploration and production in Commonwealth waters. Specific environmental, resource management and safety obligations are set out in the Regulations listed.
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 • *Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995*	This Act provides for measures to protect ozone in the atmosphere by controlling and ultimately reducing the manufacture, import and export of ozone depleting substances (ODS) and synthetic greenhouse gases, and replacing them with suitable alternatives. The Act will only apply to Woodside if it manufactures, imports or exports ozone depleting substances.

Commonwealth Legislation	Legislation Summary
Protection of the Sea (Powers of Intervention) Act 1981	This Act authorises the Commonwealth to take measures for the purpose of protecting the sea from pollution by oil and other noxious substances discharged from ships and provides legal immunity for persons acting under an AMSA direction.
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 *Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations 1994* • *Marine order 91 - Marine pollution prevention—oil* • *Marine order 93 - Marine pollution prevention—noxious liquid substances* • *Marine order 94 - Marine pollution prevention—packaged harmful substances* • *Marine order 95 - Marine pollution prevention—garbage* • *Marine order 96 - Marine pollution prevention—sewage* *Maritime Legislation Amendment (Prevention of Air Pollution from Ships) Act 2007* MARPOL Convention	This Act relates to the protection of the sea from pollution by oil and other harmful substances discharged from ships. Under this Act, discharge of oil or other harmful substances from ships into the sea is an offence. There is also a requirement to keep records of the ships dealing with such substances. The Act applies to all Australian ships, regardless of their location. It applies to foreign ships operating between 3 nautical miles (nm) off the coast out to the end of the Australian Exclusive Economic Zone (200 nm). It also applies within the 3 nm of the coast where the State/Northern Territory does not have complementary legislation. All the Marine Orders listed, except for Marine Order 95, are enacted under both the *Navigation Act 2012* and the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. This Act is an amendment to the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. This amended Act provides the protection of the sea from pollution by oil and other harmful substances discharged from ships.
Protection of the Sea (Harmful Antifouling Systems) Act 2006 • *Marine order 98—(Marine pollution prevention—anti-fouling systems)*	This Act relates to the protection of the sea from the effects of harmful anti-fouling systems. It prohibits the application or reapplication of harmful anti-fouling compounds on Australian ships or foreign ships that are in an Australian shipping facility.

APPENDIX C EPBC ACT PROTECTED MATTERS SEARCH REPORTS

Australian Government

Department of the Environment and Energy

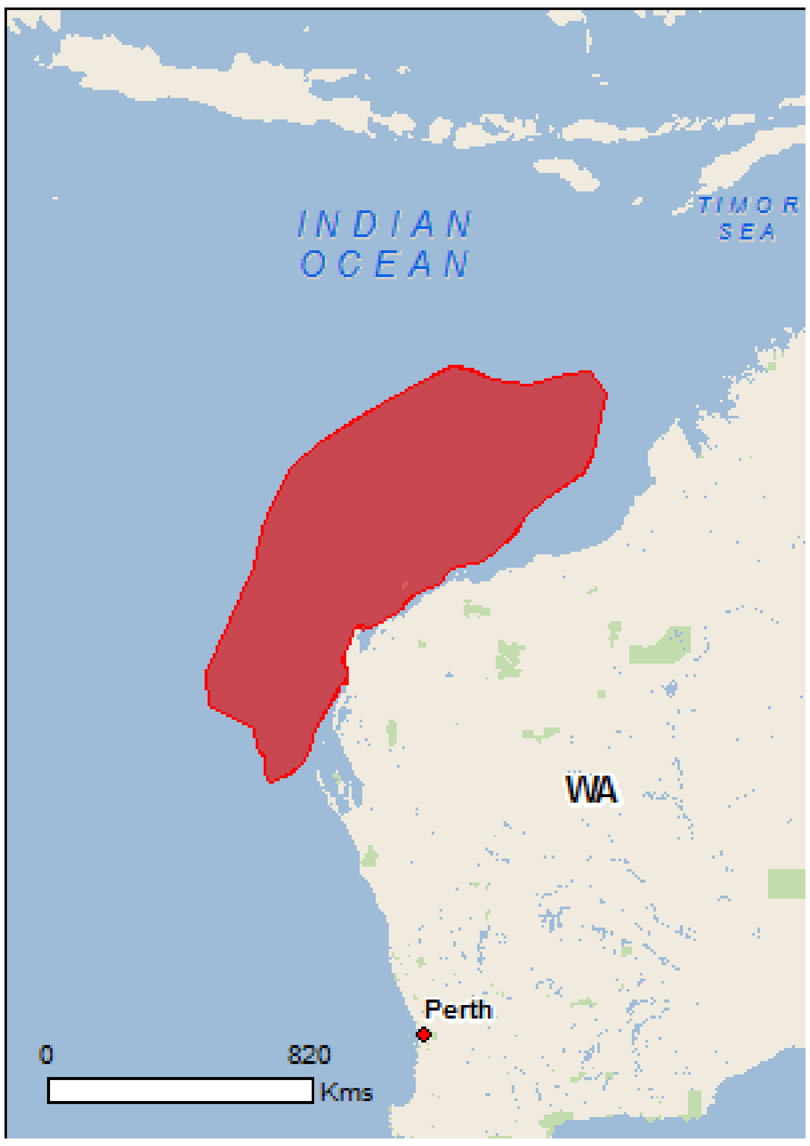
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

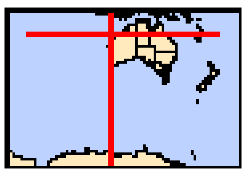
Report created: 17/04/20 14:52:28



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	2
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	49
Listed Migratory Species:	64

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	2
Commonwealth Heritage Places:	3
Listed Marine Species:	117
Whales and Other Cetaceans:	31
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	12

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	17
Regional Forest Agreements:	None
Invasive Species:	11
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	8

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
The Ningaloo Coast	WA	Listed place
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west
South-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Malurus leucopterus edouardi White-winged Fairy-wren (Barrow Island), Barrow Island Black-and-white Fairy-wren [26194]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta cauta Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia lesueur Barrow and Boodie Islands subspecies Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Isoodon auratus barrowensis Golden Bandicoot (Barrow Island) [66666]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes conspicillatus conspicillatus Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus Central Australian subspecies Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Osphranter robustus isabellinus Barrow Island Wallaroo, Barrow Island Euro [89262]	Vulnerable	Species or species habitat likely to occur within area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Ctenotus zastictus Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		

Name	Status	Type of Presence
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding likely to occur

Name	Threatened	Type of Presence
		within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Congregation or aggregation known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat likely to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Defence - EXMOUTH VLF TRANSMITTER STATION

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Learmonth Air Weapons Range Facility	WA	Listed place

Name	State	Status
Mermaid Reef - Rowley Shoals	WA	Listed place
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place

Listed Marine Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Congregation or aggregation known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur

Name	Threatened	Type of Presence
		within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area

Name	Status	Type of Presence
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea		Species or species

Name	Status	Type of Presence
populations) [78900]		habitat known to occur within area
Tursiops truncatus s. str.		
Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris		
Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Carnarvon Canyon	Habitat Protection Zone (IUCN IV)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Mermaid Reef	National Park Zone (IUCN II)
Montebello	Multiple Use Zone (IUCN VI)
Ningaloo	National Park Zone (IUCN II)
Ningaloo	Recreational Use Zone (IUCN IV)
Shark Bay	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Airlie Island	WA
Barrow Island	WA
Bessieres Island	WA
Boodie, Double Middle Islands	WA
Cape Range	WA
Jurabi Coastal Park	WA
Lowendal Islands	WA
Montebello Islands	WA
Muiron Islands	WA
Round Island	WA
Serrurier Island	WA
Unnamed WA36913	WA
Unnamed WA36915	WA
Unnamed WA40322	WA
Unnamed WA40828	WA
Unnamed WA41080	WA
Unnamed WA44665	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris		
Domestic Dog [82654]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Cape Range Subterranean Waterways	WA
Mermaid Reef	EXT

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Canyons linking the Cuvier Abyssal Plain and the	North-west
Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west
Western demersal slope and associated fish	South-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-22.71887 113.6605,-22.98292 113.7723,-23.26479 113.7295,-23.39516 113.579,-23.47225 113.5148,-24.42791 112.9026,-24.96976 112.7221,-25.29622 112.5195,-25.61579 112.1782,-25.76867 111.6248,-25.52174 111.4957,-25.15618 111.4593,-24.94286 111.2716,-24.41966 111.1974,-23.81645 109.9155,-22.99616 109.8531,-20.23772 111.1752,-19.29243 111.4044,-18.45833 111.7465,-17.65302 112.2402,-17.03898 112.9479,-16.47046 113.8887,-15.99753 114.7265,-15.27121 116.0621,-14.99787 116.7062,-15.08318 117.2652,-15.34143 117.8186,-15.4595 118.806,-15.1964 119.8388,-15.13562 120.5099,-15.67788 120.9591,-16.36016 120.845,-17.29516 120.6078,-17.79631 120.3369,-18.5053 119.2742,-18.93652 118.7191,-19.44103 118.4037,-19.94194 117.8439,-20.17555 117.3754,-20.28523 116.8349,-20.45677 116.5483,-20.63379 116.4445,-20.70607 116.3857,-20.76432 116.29,-20.83356 116.0902,-20.96246 115.6827,-21.20525 115.4032,-21.33826 115.3099,-21.46862 115.1666,-21.65081 114.8434,-21.75868 114.5771,-21.83784 114.3371,-21.91377 114.1995,-21.83933 114.1733,-21.82028 114.1875,-21.80763 114.1863,-21.7893 114.1739,-21.78656 114.154,-21.79934 114.1385,-21.80296 114.1164,-21.80289 114.1035,-21.83714 114.0472,-21.86067 114.0134,-21.88888 113.9795,-22.0108 113.9152,-22.22539 113.8308,-22.37633 113.7556,-22.53551 113.6798,-22.58955 113.6553,-22.71887 113.6605

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Department of the Environment and Energy

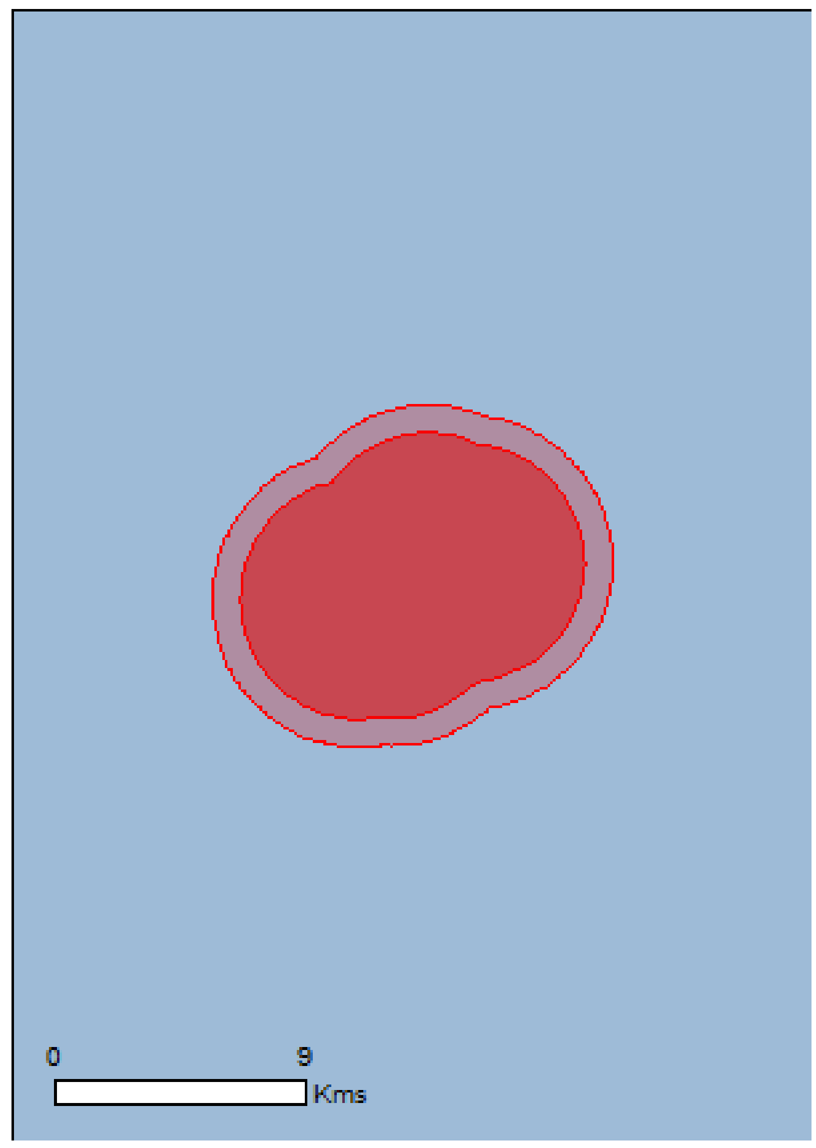
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

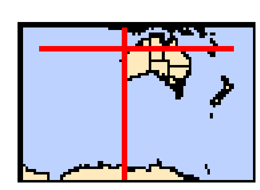
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 14/10/19 18:44:06



Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	15
Listed Migratory Species:	30

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	47
Whales and Other Cetaceans:	23
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	1

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Sharks		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas		
Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel		
Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor		
Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata		
Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat likely to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Fish		
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area

Name	Status	Type of Presence
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-19.6707086444 115.877882024,-19.6709112567 115.879997829,-19.6712222725 115.882098554,-19.6721387301 115.886238905,-19.6727161265 115.88827588,-19.6733987203 115.890276245,-19.6740149401 115.891844354,-19.6743772658 115.894370386,-19.6748028047 115.896448703,-19.6753354478 115.898499369,-19.6759789639 115.900514378,-19.6767241978 115.902489924,-19.6775725323 115.904418682,-19.678524819 115.906292662,-19.6795694302 115.908110899,-19.6807110654 115.909862984,-19.6819462604 115.911542794,-19.6832635814 115.913151328,-19.6846649905 115.914679005,-19.6861440509 115.916122716,-19.6877003706 115.91747275,-19.6893227074 115.918732887,-19.691012645 115.919889571,-19.6927528704 115.920960274,-19.6945533883 115.921913501,-19.6982875278 115.923505049,-19.7002123202 115.924131201,-19.702167479 115.924641485,-19.7041450855 115.925044044,-19.7061414805 115.925326355,-19.7081498048 115.925486573,-19.7101633222 115.925537277,-19.7121764683 115.925462165,-19.7141822524 115.925267462,-19.7161753409 115.924960305,-19.7181485011 115.92453311,-19.7200967271 115.923993064,-19.722013372 115.923338851,-19.7238919603 115.922571333,-19.7257265569 115.921693276,-19.7275129519 115.920710753,-19.7292449915 115.919624999,-19.7325227969 115.917154842,-19.7340613884 115.915781932,-19.735523084 115.914318222,-19.7369042496 115.912769845,-19.7382038504 115.911144557,-19.7394115105 115.909442029,-19.7405337173 115.907675426,-19.7415553824 115.905842072,-19.7424820305 115.903953278,-19.743306213 115.902012135,-19.744026313 115.900025443,-19.7446406974 115.89799962,-19.7451496552 115.895941404,-19.7455460618 115.893855745,-19.7459028778 115.891067934,-19.7468493753 115.890030017,-19.7481775233 115.888431074,-19.7494278119 115.886763283,-19.750583444 115.885020649,-19.7526238429 115.881352875,-19.753508929 115.879442172,-19.7543007343 115.877486132,-19.7549835203 115.875484683,-19.7555544877 115.873444352,-19.7563779943 115.869281291,-19.7566261824 115.86717011,-19.7567569962 115.865047257,-19.7567749557 115.862920588,-19.7566352446 115.860083412,-19.7568509455 115.858688805,-19.7570874714 115.856576336,-19.7572307502 115.854454539,-19.7572548595 115.852327616,-19.7571670343 115.850201934,-19.7569628708 115.848085289,-19.7566485414 115.845983883,-19.7562233882 115.843904431,-19.755686229 115.841854192,-19.7550471225 115.839836903,-19.7534563672 115.835929615,-19.7525063191 115.83405372,-19.751459404 115.832236234,-19.750316801 115.830484312,-19.7490848128 115.82880137,-19.7477667509 115.827192772,-19.74636526 115.825664928,-19.7448858932 115.824221094,-19.743331799 115.822867727,-19.7417099788 115.821606224,-19.7382775753 115.819382487,-19.7364792996 115.818424061,-19.7346341665 115.817570976,-19.7327449323 115.816833297,-19.7308210722 115.816203775,-19.7268880438 115.815292235,-19.7248917769 115.815009807,-19.7228837644 115.814844037,-19.720870505 115.814798048,-19.7188574959 115.814872683,-19.7168518163 115.815067211,-19.7148585404 115.815372726,-19.7109381346 115.816342954,-19.7090208767 115.816994554,-19.7071419829 115.817761001,-19.7053071117 115.818638051,-19.7017890367 115.820706278,-19.7001153279 115.821889439,-19.6984945036 115.823152606,-19.6954666281 115.825955655,-19.6940583721 115.827475746,-19.6927404905 115.829083962,-19.6915072525 115.830765214,-19.6893112481 115.834328797,-19.6883586404 115.836202363,-19.6875031286 115.838127401,-19.6867543539 115.840101445,-19.6861121326 115.842116585,-19.6855395909

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Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government
Department of the Environment and Energy

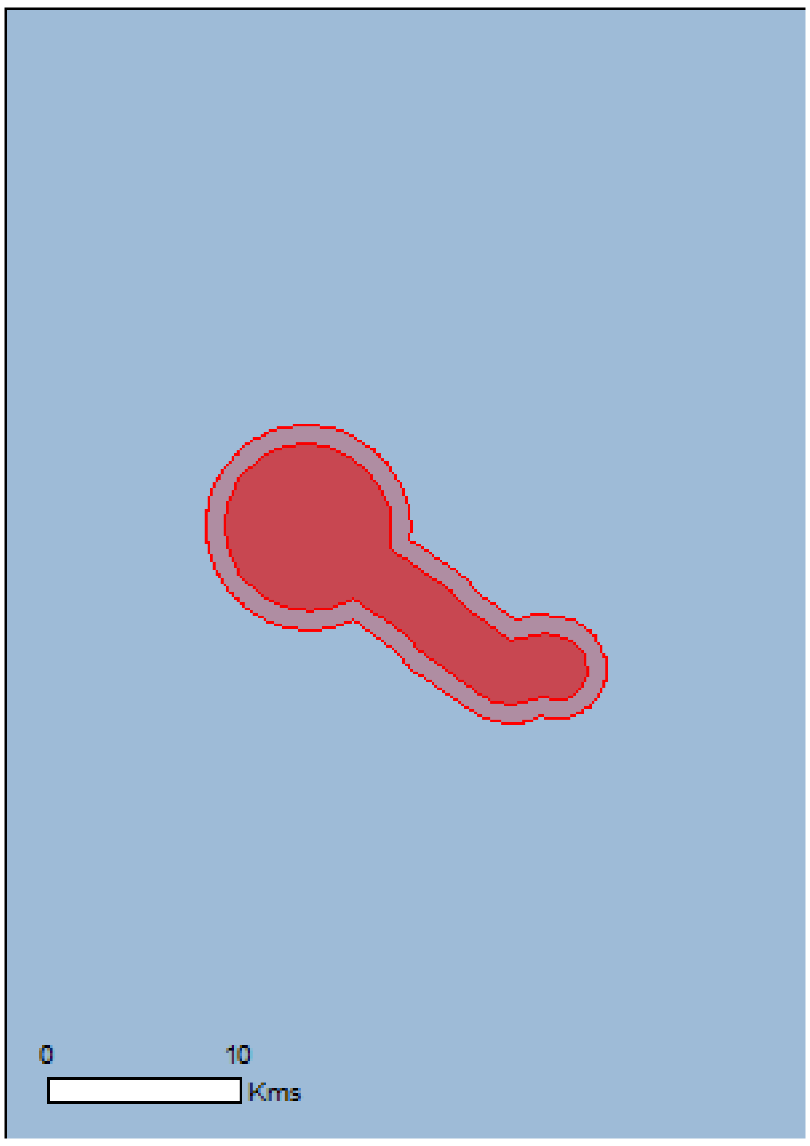
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

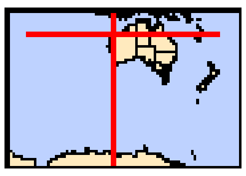
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 14/10/19 18:14:50



Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	16
Listed Migratory Species:	31

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	55
Whales and Other Cetaceans:	23
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	1

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Fish		

Name	Threatened	Type of Presence
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans

[Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area

Name	Status	Type of Presence
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-19.3993036581 116.484148738,-19.3996768027 116.487236892,-19.4002811443 116.490284277,-19.4011199883 116.493269637,-19.4021959408 116.496169262,-19.4034891509 116.498968296,-19.404992933 116.501647873,-19.4066356822 116.504236266,-19.4084253472 116.506713276,-19.4103946684 116.509033496,-19.4125264056 116.511189039,-19.4148294123 116.513139125,-19.4172776593 116.514880842,-19.4198480654 116.516414805,-19.4225236157 116.517734373,-19.4252983941 116.518803166,-19.4281473319 116.519625839,-19.4310491129 116.520206839,-19.4339855388 116.520548339,-19.4369390829 116.52061999,-19.4398873312 116.520429082,-19.4428128506 116.520000747,-19.4446570939 116.519602799,-19.4469818324 116.523069543,-19.4503935529 116.528157594,-19.4538051338 116.533245859,-19.4572165751 116.538334338,-19.4606278767 116.543423032,-19.4623334751 116.545967459,-19.4641091426 116.548456025,-19.4662179385 116.550633795,-19.4685435229 116.552556172,-19.4708765575 116.554468749,-19.4726621202 116.556925047,-19.4743334032 116.559494854,-19.4776758621 116.564634628,-19.481018178 116.569774613,-19.4843603509 116.574914812,-19.4861121897 116.577609279,-19.4853075242 116.580450788,-19.4844619211 116.583436658,-19.4836513426 116.586432777,-19.4831543052 116.589502193,-19.4830411561 116.592613777,-19.4833141058 116.595714339,-19.4839287569 116.598761463,-19.4847615666 116.601747659,-19.4860768916 116.604533298,-19.4878375763 116.60703208,-19.4899811003 116.609170477,-19.4924755493 116.61082991,-19.4952537795 116.611873033,-19.498179009 116.612264286,-19.501116061 116.611983188,-19.5039226643 116.611028154,-19.5064697015 116.60946142,-19.5086386314 116.607353998,-19.5103219633 116.6048002,-19.5114465135 116.601925568,-19.5119610469 116.598863053,-19.5118233941 116.595756214,-19.5110569182 116.592753441,-19.5107291529 116.591925411,-19.5121770238 116.586812799,-19.5130226709 116.583826434,-19.5136963573 116.580793963,-19.5139963241 116.577695532,-19.5139160564 116.574582164,-19.5134576979 116.571505428,-19.5126290481 116.568516044,-19.5114425967 116.565663938,-19.5099198216 116.562995353,-19.5082485831 116.560424956,-19.5065773088 116.557854611,-19.5049059988 116.55528432,-19.5015632714 116.550143897,-19.4982204009 116.545003687,-19.4948773876 116.53986369,-19.4931987613 116.537298985,-19.4913163676 116.534899552,-19.489157368 116.532774897,-19.4868295299 116.530855216,-19.4846431972 116.529063238,-19.4828299322 116.5263584,-19.4794181528 116.521269393,-19.4760062337 116.516180599,-19.472594175 116.511092021,-19.4691819767 116.506003657,-19.4670108526 116.502766238,-19.4680975394 116.500811275,-19.4694086163 116.498020513,-19.4705102477 116.495130969,-19.4713824633 116.492154977,-19.4720100103 116.489111482,-19.4724009229 116.486024609,-19.4725561705 116.482915085,-19.4724819156 116.479801646,-19.4721490341 116.476706796,-19.4715832163 116.473649956,-19.4707822298 116.470652174,-19.4697584683 116.467730647,-19.4685012062 116.464912074,-19.4670732527 116.462184992,-19.4654877402 116.459556814,-19.4637050596 116.45707335,-19.4617391137 116.454748957,-19.4596032365 116.452597379,-19.4573070886 116.450637575,-19.4548882995 116.448849145,-19.4523371722 116.447279119,-19.4496776896 116.445923719,-19.4469207187 116.444804608,-19.4440854548 116.443929817,-19.4411921652 116.44330042,-19.438259873 116.442921399,-19.4353080762 116.442797437,-19.432356703 116.442930943,-19.4294247898 116.443312344,-19.426533366 116.443950161,

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- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX D OIL SPILL PREPAREDNESS AND RESPONSE STRATEGY SELECTION AND EVALUATION

Oil Spill Preparedness and Response Mitigation Assessment for the Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation Environment Plan

Security & Emergency Management
Hydrocarbon Spill Preparedness Unit

October 2020

Revision: 0b

TABLE OF CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

Woodside Energy (Julimar) Pty Ltd (Woodside) has developed its oil spill preparedness and response position for the Greater Western Flank 3 (GWF3) and Lambert Deep Drilling and Subsea Installation, hereafter known as the Petroleum Activities Program (PAP).

This document demonstrates that the risks and impacts from an unplanned hydrocarbon release, and the associated response operations, are controlled to As Low As Reasonably Practicable (ALARP) and Acceptable levels. It achieves this by evaluating response options to address the potential environmental impacts resulting from an unplanned loss of hydrocarbon containment associated with the PAP described in the Environment Plan (EP). This document then outlines Woodside's decisions and techniques for responding to a hydrocarbon release event and the process for determining its level of hydrocarbon spill preparedness.

A summary of the key facts and references to additional detail within this document are presented below.

Table 0-1: Summary of the key details for assessment

Key details of assessment	Summary	Reference to additional detail
Worst Case Credible Scenarios	**Credible Scenario-01: Unplanned hydrocarbon release of GWF3 Condensate – loss of well containment during drilling of development well GDA05** 382,486 m^3 release of GWF3 Condensate over 71 days from GDA05 well (19° 43' 15.968" S, 115° 51' 10.743" E) comprising a 5-day surface release of 29,655 m^3 followed by a 66-day release of 352,831 m^3. 0.8% residual component of 3059.9 m^3	Section 2.2
	Credible Scenario-02: Unplanned hydrocarbon release of Lambert Deep Condensate – loss of well containment during drilling of development well LDA01 67,822 m^3 release of Lambert Deep Condensate over 77 days[1] from Lambert Deep LDA01 well (19° 26' 7.220" S, 116° 28' 51.314" E) comprising a 5-day surface release of 4710 m^3 followed by a 72-day subsurface release of 63,112 m^3. 8.2% residual component of 5561.4 m^3	
	Credible Scenario-03: Hydrocarbon release of marine diesel caused by vessel collision close to GDA05 well – breach of installation vessel fuel tanks due to collision with third party vessel, including commercial shipping/ fisheries. Instantaneous release of 1000 m^3. Residue of 50 m^3 (5%)	
Hydrocarbon Properties	**GWF3 Condensate** GWF-3 Condensate is a mixture of volatile and persistent hydrocarbons with high proportions of highly volatile and low proportions of residual components. In general, about 65.9% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 22.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 10.8% should evaporate over several days (265 °C < BP < 380 °C). Approximately 0.8% of the oil is shown to be persistent. **Lambert Deep Condensate** Lambert Deep Condensate is a mixture of volatile and persistent hydrocarbons with moderate proportions of both highly volatile and residual components. In general, about 18.8% of the oil mass should evaporate within	Section 2.2.1 Section 6.7 of the EP Appendix A of the First Strike Plan

[1] Timing variation between the two wells is due to the relief wells' casing program differences.

	the first 12 hours (BP < 180 °C); a further 56.1% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 16.9% should evaporate over several days (265 °C < BP < 380 °C). Approximately 8.2% of the oil is shown to be persistent. **Marine Diesel** Marine diesel is a mixture of volatile and persistent hydrocarbons with low proportions of highly volatile and residual components. In general, about 6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 35% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 54% should evaporate over several days (265 °C < BP < 380 °C). Approximately 5% of the oil is shown to be persistent.	
Modelling Results	**Stochastic modelling** A quantitative, stochastic assessment has been undertaken for credible spill scenarios to help assess the environmental risk of a hydrocarbon spill. A total of 100 replicate simulations were completed for the scenarios to test for trends and variations in the trajectory and weathering of the spilled oil, with an even number of replicates completed using samples of metocean data that commenced within each calendar quarter (25 simulations per quarter).	Section 2.3
	Deterministic modelling Deterministic modelling was then undertaken for scenarios Credible Scenario-01 and Credible Scenario-02 (Table 2-1) as the worst-case credible scenarios (WCCS) to establish the following for response planning purposes: • Minimum time to commencement of oil accumulation at any shoreline receptor (at a threshold of 100 g/m^2) • Maximum cumulative oil volume accumulated at any individual shoreline receptor (at concentrations in excess of 100 g/m^2) • Maximum cumulative oil volume accumulated across all shoreline receptors (at concentrations in excess of 100 g/m^2) Deterministic modelling was not undertaken for Credible Scenario-03 but the stochastic results have been included here to ensure complete response planning. Results as follows:	

	Credible Scenario-01: Hydrocarbon release caused by loss of well containment (382,486 m^3 of GWF3 Condensate over 71 days)	**Credible Scenario-02: Hydrocarbon release caused by loss of well containment** (67,822 m^3 of Lambert Deep Condensate over 77 days)	**Credible Scenario-03: Hydrocarbon release caused by vessel collision** (instantaneous release of 1000 m^3 marine diesel)
Minimum time to commencement of oil accumulation at any shoreline receptor (at a threshold of 100 g/m^2)	Model 21, Q2 22.6 days at Pilbara Islands – Southern Island Group (5 m^3)	Model 21, Q2 27 m^3 at Barrow Island (day 17)	*No contact at threshold*
Maximum cumulative oil volume accumulated at any individual shoreline receptor (at concentrations in excess of 100 g/m^2)	Model 7, Q2 70 m^3 at Pilbara Islands – Southern Island Group (day 49.5)	Model 20, Q1 86.7 m^3 at Montebello Islands (day 61)	*No contact at threshold*

	Maximum cumulative oil volume accumulated across all shoreline receptors (at concentrations in excess of 100 g/m^2)	Model 7, Q2 72.2 m^3(Pilbara Islands – Southern Island Group)	Model 20, Q1 204.4 m^3 (Montebello Islands)	*No contact at threshold*	
Net Environmental Benefit Assessment	Monitor and evaluate, source control via capping stack, source control via relief well drilling, source control (vessel), subsea dispersant injection, surface dispersant spraying, containment and recovery, protection and deflection, shoreline clean-up, oiled wildlife response, are all identified as potentially having a net environmental benefit (dependent on the actual spill scenario) and carried forward for further assessment.				Section 4
ALARP evaluation of selected response techniques	The evaluation of the selected response techniques shows the proposed controls reduced the risk to an ALARP and Acceptable level for the risks and impacts presented in Section 2 and Section 3, including the implementation of considered additional, alternative or improved control measures.				Section 5 Section 6

1 INTRODUCTION

1.1 Overview

Woodside has developed its oil spill preparedness and response position for the GWF3 and LD Drilling and Subsea Installation, hereafter known as the PAP. This document outlines Woodside's decisions and techniques for responding to a hydrocarbon loss of containment event and the process for determining its level of hydrocarbon spill preparedness.

1.2 Purpose

This document, together with the documents listed below, meet the requirements of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Environment Regulations) relating to hydrocarbon spill response arrangements:

- the GWF3 and Lambert Deep Drilling and Subsea Installation EP
- Oil Pollution Emergency Arrangements (OPEA) (Australia)
- the GWF3 and Lambert Deep Drilling and Subsea Installation Oil Pollution Emergency Plan (OPEP) including:
  - First Strike Plan (FSP)
  - relevant Operations Plans
  - relevant Tactical Response Plans (TRPs)
  - relevant Supporting Plans
  - Data Directory.

1.3 Scope

This document evaluates response options to address the potential environmental risks and impacts resulting from an unplanned loss of hydrocarbon containment associated with the PAP described in the EP. It then outlines Woodside's decisions and techniques for responding to a hydrocarbon release event and the process for determining its level of hydrocarbon spill preparedness. It should be read in conjunction with the documents listed in Table 1-1. The location of the PAP is shown in Figure 3.2 of the EP.

1.4 Oil spill response document overview

The documents outlined in Table 1-1 and Figure 1-1 are collectively used to manage the preparedness and response for a hydrocarbon release.

ANNEX A contains a pre-operational Net Environmental Benefit Analysis (NEBA) summary, outlining the selected response techniques for this PAP. Relevant Operational Plans to be initiated for associated response techniques are identified in the FSP and relevant forms to initiate a response are appended to the FSP.

The process to develop an Incident Action Plan (IAP) begins once the FSP is underway. The IAP includes inputs from the monitor and evaluate operations and the operational NEBA (Section 4). Planning, coordination and resource management are initiated by the Incident Management Team (IMT). In some instances, technical specialists may be utilised to provide expert advice. The planning may also involve liaison officers from supporting government agencies.

During each operational period, field reports are continually reviewed to evaluate the effectiveness of response operations. In addition, the operational NEBA is continually reviewed and updated to ensure the response techniques implemented continue to result in a net environmental benefit (see Section 4). The response will continue as described in Section 5 until the response termination criteria have been met as set out in ANNEX B: Operational Monitoring Activation and Termination Criteria.

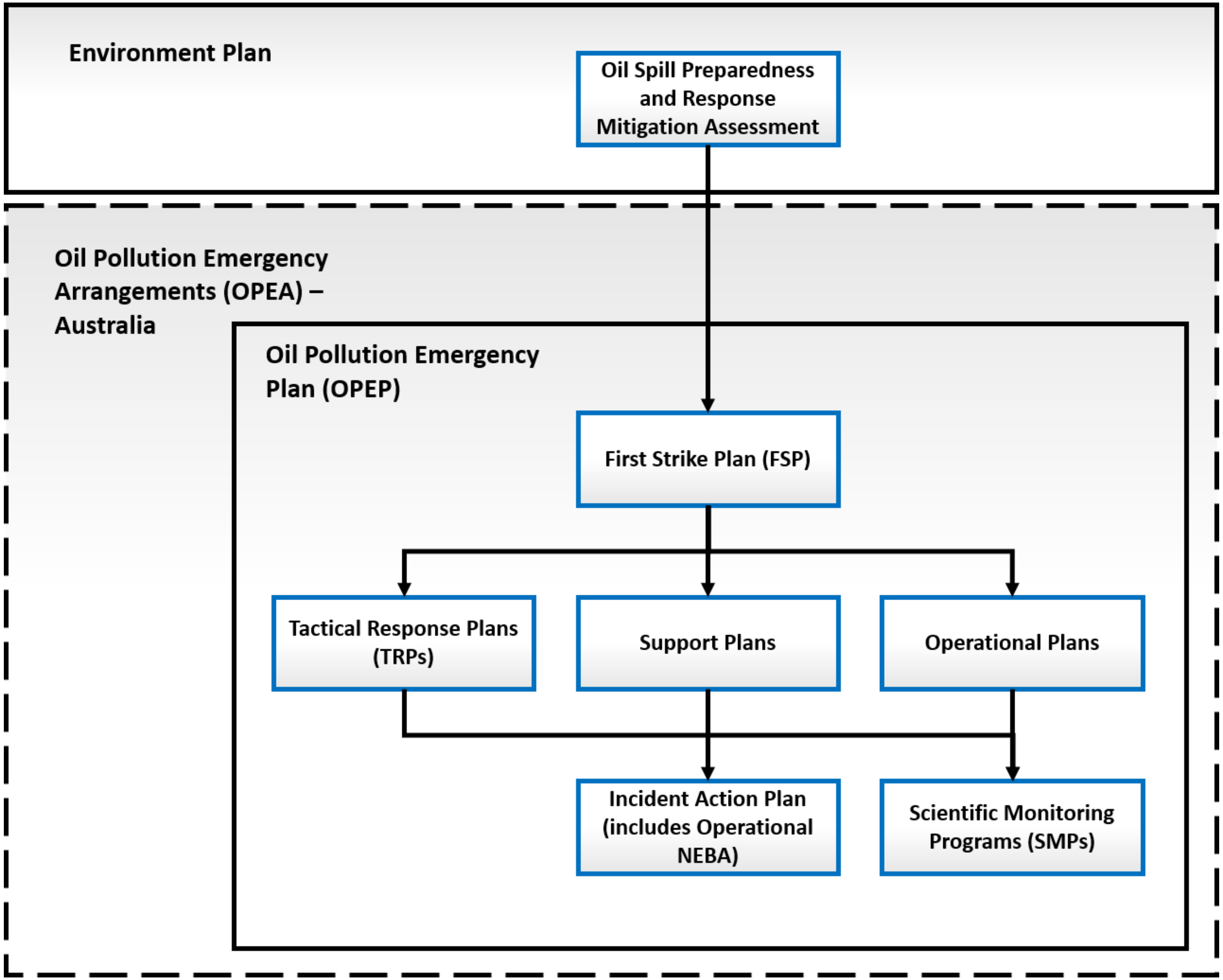


Figure 1-1: Woodside hydrocarbon spill document structure

Table 1-1: Hydrocarbon spill preparedness and response – document references

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
GWF3 and Lambert Deep Drilling and Subsea Installation EP	Demonstrates that potential adverse impacts on the environment associated with the GWF3 and Lambert Deep Drilling and Subsea Installation (during both routine and non-routine operations) are mitigated and managed to ALARP and will be of an acceptable level.	NOPSEMA Woodside internal	EP Section 6 (Environmental Risk Assessment, Performance Outcomes, Standards and Measurement Criteria). EP Section 7 (Implementation strategy – including emergency preparedness and response). EP Section 7 (Reporting and compliance).	
OPEA Australia	Describes the arrangements and processes adopted by Woodside when responding to a hydrocarbon spill from a petroleum activity.	Regulatory agencies Woodside internal	All sections	
Oil Spill Preparedness and Response Mitigation Assessment for the GWF3 and Lambert Deep Drilling and Subsea Installation (this document)	Evaluates response options to address the potential environmental impacts resulting from an unplanned loss of hydrocarbon containment associated with the PAP described in the EP.	Regulatory agencies Corporate Incident Control Centre (CICC): Control function in an ongoing spill response for activity-specific response information.	All performance outcomes, standards and measurement criteria related to hydrocarbon spill preparedness and response are included in this document.	
GWF3 and Lambert Deep Drilling and Subsea Installation Oil Pollution FSP	Facility specific document providing details and tasks required to mobilise a first strike response. Primarily applied to the first 24 hours of a response until a full IAP specific to the event is developed. Oil Pollution FSPs are intended to be the first document used to provide immediate guidance to the responding IMT.	Site-based IMT for initial response, activation and notification. CICC for initial response, activation and notification. CICC: Control function in an ongoing spill response for	Initial notifications and reporting required within the first 24 hours of a spill event. Relevant spill response options that could be initiated for mobilisation in the event of a spill. Recommended pre-planned tactics. Details and forms for use in immediate response. Activation process for oil spill trajectory	

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
		activity-specific response information.	modelling, aerial surveillance and oil spill tracking buoy details.	
Operational Plans	Lists the actions required to activate, mobilise and deploy personnel and resources to commence response operations. Includes details on access to equipment and personnel (available immediately) and steps to mobilise additional resources depending on the nature and scale of a release. Relevant operational plans will be initially selected based on the Oil Pollution First Strike Plan; additional operational plans will be activated depending on the nature and scale of the release.	CICC: Operations and Logistics functions for first strike activities. CICC: Planning Function to help inform the IAP on resources available.	Locations from where resources may be mobilised. How resources will be mobilised. Details of where resources may be mobilised to and what facilities are required once the resources arrive. Details on how to implement resources to undertake a response.	Operational Monitoring Plan Source Control Emergency Response Planning Guideline Protection and Deflection Shoreline Clean-up Oiled Wildlife Scientific Monitoring
Tactical Response Plans	Provides options for response techniques in selected Response Protection Areas (RPAs). Provides site, access and deployment information to support a response at the location.	CICC: Planning Function to help develop IAPs, and Logistics function to assist with determining resources required.	Indicative response techniques. Access requirements and/or permissions. Relevant information for undertaking a response at that site. Where applicable, may include equipment deployment locations and site layouts.	Barrow and Lowendal Islands Montebello Island – Stephenson Channel Nth TRP Montebello Island – Champagne Bay and Chippendale channel TRP Montebello Island – Claret Bay TRP Montebello Island – Hermite/Delta Island Channel TRP Montebello Island – Hock Bay TRP Montebello Island – North and Kelvin Channel TRP Montebello Island – Sherry Lagoon Entrance TRP Pilbara Islands – Southern Island Group Rankin Bank & Glomar Shoals Muiron Islands Dampier region OWRP

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
Support Plans	Support Plans detail Woodside's approach to resourcing and the provision of services during a hydrocarbon spill response.	CICC: Operations, Logistics and Planning functions.	Strategy for mobilising and managing additional resources outside of Woodside's immediate preparedness arrangements.	Marine Logistics People and Global Capability Surge Labour Requirement Plan Health and Safety Aviation IT (First Strike Response) IT (Extended Response) Communications (First Strike Response) Communications (Extended Response) Stakeholder Engagement Accommodation and Catering Waste Management Guidance for Oil Spill Claims Management (Land based) Security Support Plan Hydrocarbon Spill Responder Health Monitoring Guideline

2 RESPONSE PLANNING PROCESS

This document details Woodside's process for identifying potential response options for the hydrocarbon release scenarios, identified in the EP. Figure 2-1 outlines the interaction between Woodside's response, planning/preparedness and selection process.

This structure has been used because it shows how the planning and preparedness activities inform a response and provides indicative guidance on what activities would be undertaken, in sequential order, if a real event were to occur. The process also evaluates alternative, additional and/or improved control measures specific to the PAP.

The GWF3 and Lambert Deep Drilling and Subsea Installation FSP then summarises the outcome of the response planning process and provides initial response guidance and a summary of ongoing response activities, if an incident were to occur.

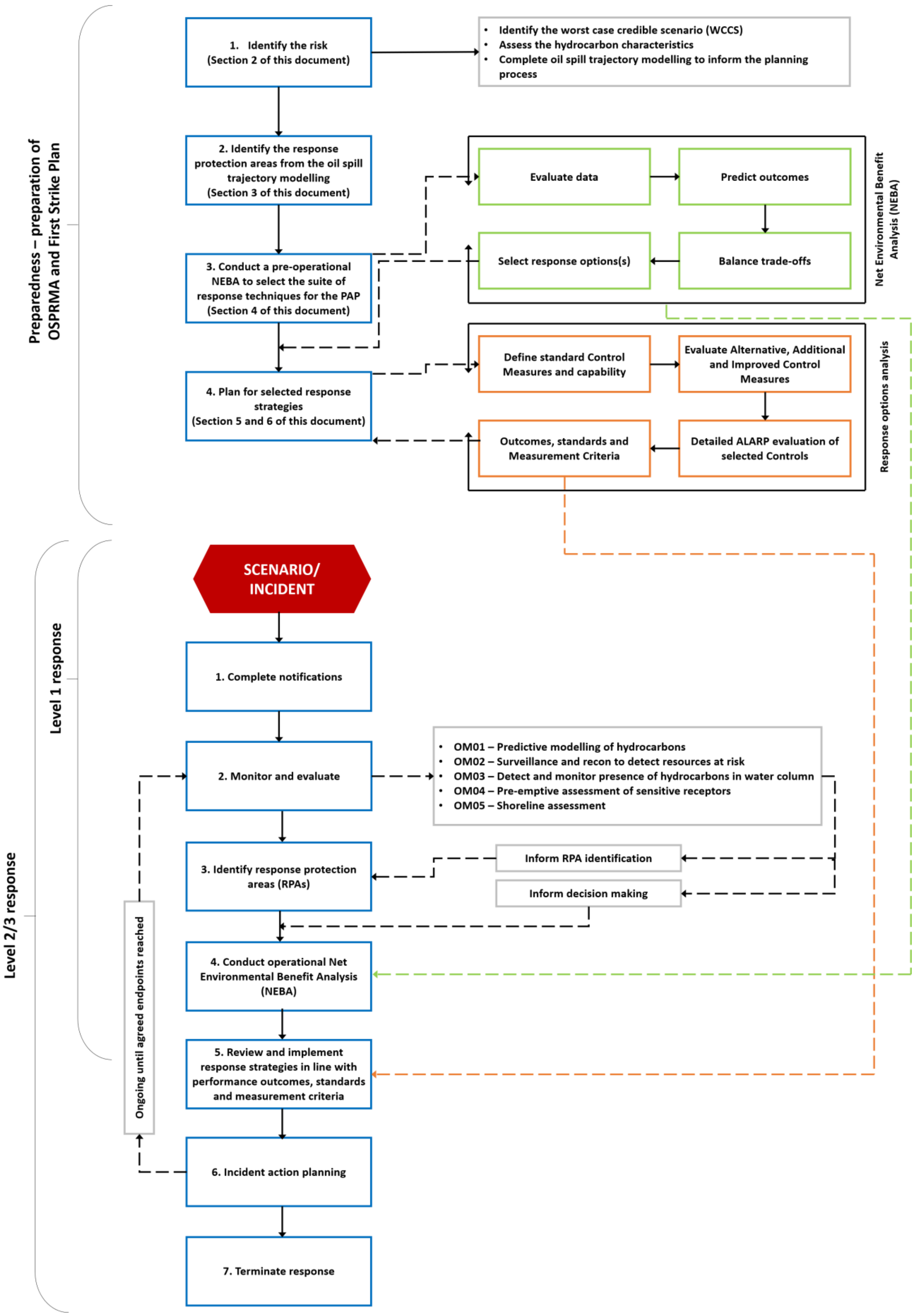


Figure 2-1: Response planning and selection process

2.1 Response planning process outline

This document is expanded below to provide additional context on the key steps in determining capability, evaluating ALARP and hydrocarbon spill response requirements.

Section 1. INTRODUCTION

Section 2. RESPONSE PLANNING PROCESS

- identification of worst-case credible scenario(s) (WCCS)
- spill modelling for WCCS

Section 3. IDENTIFY RESPONSE PROTECTION AREAS (RPAs)

- areas predicted to be contacted at concentration >100g/m^2.

Section 4. NET ENVIRONMENTAL BENEFIT ANALYSIS (NEBA)

- pre-operational NEBA (during planning/ALARP evaluation): this must be reviewed during the initial response to an incident to ensure its accuracy
- selected response techniques prioritised and carried forward for ALARP assessment

Section 5. HYDROCARBON SPILL ALARP PROCESS

- determines the response need based on predicted consequence parameters.
- details the environmental performance of the selected response options based on the need.
- sets the environmental performance outcomes, environmental performance standards and measurement criteria.

Section 6. ALARP EVALUATION

- evaluates alternative, additional, and improved options for each response technique to demonstrate the risk has been reduced to ALARP.
- provides a detailed ALARP assessment of selected control measure options against:
  - predicted cost associated with implementing the option
  - predicted change to environmental benefit
  - predicted effectiveness / feasibility of the control measure

Section 7. ENVIRONMENTAL RISK ASSESSMENT OF SELECTED RESPONSE TECHNIQUES

- evaluation of impacts and risks from implementing selected response options

Section 8. ALARP CONCLUSION

Section 9. ACCEPTABILITY CONCLUSION

2.1.1 Response Planning Assumptions – Timing, Resourcing and Effectiveness

Figure 2-2 illustrates the initial steps of a response to an oil spill event and, where available, the indicative timing. For the latter stages, the timing will be specific to the selective response option.

IMT Call-out/ Notification	Contract Activation	Response Option Mobilisation	Response Option Deployment	Response Option Effectiveness
This is the time taken from call-out to mobilise the IMT to the designated Incident Control Centre	This is the time taken once the IMT has been mobilised to activate specific contracts for resources (SFRT, FWADC, AMOSC, AMSA, OSRL, etc)	This is the time taken to mobilise resources from home location to laydown/staging area (expected to be airport or sea port) close to response area	This is the time taken to deploy resources from laydown/staging area (expected to be airport or sea port) to response area/field	This relates to the performance of equipment/response option as well as required personnel resourcing (Specialists/Supervisors + support personnel)
Approx 2-4 hours	Approx 2-4 hours	Response Technique specific	Field/Location specific	Response Strategy specific

Figure 2-2: Response Planning Assumptions – Timing, Resourcing and Effectiveness

2.2 Environment plan risk assessment (credible spill scenarios)

Potential hydrocarbon release scenarios from the PAP have been identified during the risk assessment process (Section 6 of the EP). Further descriptions of risk, impacts and mitigation measures (which are not related to hydrocarbon preparedness and response) are provided in Section 6 of the EP. Three unplanned events or credible spill scenarios for the PAP have been selected as representative across types, sources and incident/response levels, up to and including the WCCS. The WCCS for the activity is then used for response planning purposes, as all other scenarios are of a lesser scale and extent. By demonstrating capability to manage the response to the WCCS, Woodside assumes other scenarios that are smaller in nature and scale can also be managed by the same capability. Response performance measures have been defined based on a response to the WCCS.

Table 2-1 presents the credible scenarios for the PAP. Two loss of well containment scenarios (Credible Scenario-01 and Credible Scenario-02) were both deterministically modelled.

Table 2-1: Petroleum Activities Program credible spill scenarios

MEE No. [2]	Scenario selected for planning purposes	Scenario description	Maximum credible volume released (liquid m^3)[1]	Incident Level	Hydrocarbon (HC) type	Residual proportion	Residual volume (liquid m^3)
Credible Scenario-01	Yes	Loss of well containment during drilling of development well GDA05. A long-term (71-day) uncontrolled surface/subsurface release of GWF3 Condensate representing loss of containment after a loss of well containment.	Surface: 5-day release of 29,655 m^3 Subsurface: 66-day release of 352,831 m^3 Total: 382,486 m^3 over 71 days	3	GWF3 Condensate	0.8%	3059.9 m^3
Credible Scenario-02	Yes	Loss of well containment during drilling of development well LDA01. A long-term (77-day) uncontrolled surface/subsurface release of Lambert Deep Condensate representing loss of containment after a loss of well containment.	Surface: 5-day release of 4710 m^3 Subsurface: 72-day release of 63,112 m^3 Total: 67,822 m^3 over 77 days	3	Lambert Deep Condensate	8.2%	5528.6 m^3
Credible Scenario-03	No	An instantaneous surface release of marine diesel near the GDA05 Well, representing loss of fuel tank integrity after a vessel collision.	Surface: instantaneous release of 1000 m^3 of marine diesel.	2	Marine diesel	5%	50 m^3

[2] A full description of MEEs used in this document is included in EP Section 6.8.

2.2.1 Hydrocarbon characteristics

More detailed hydrocarbon characteristics, including modelled weathering data and ecotoxicity, are included in Section 6 of the EP.

GWF3 Condensate

GWF3 Condensate is a mixture of volatile and persistent hydrocarbons with high proportions of highly volatile and low proportions of residual components. In general, about 65.9% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 22.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 10.8% should evaporate over several days (265 °C < BP < 380 °C). Approximately 0.8% of the oil is shown to be persistent. The aromatic content of the oil is approximately 16.3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 88% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

Lambert Deep Condensate

Lambert Deep Condensate is a mixture of volatile and persistent hydrocarbons with moderate proportions of both highly volatile and residual components. In general, about 18.8% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 56.1% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 16.9% should evaporate over several days (265 °C < BP < 380 °C). Approximately 8.2% of the oil is shown to be persistent. The aromatic content of the oil is approximately 16.3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 75% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

Marine diesel

Marine diesel is a mixture of volatile and persistent hydrocarbons with low proportions of highly volatile and residual components. In general, about 6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 35% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 54% should evaporate over several days (265 °C < BP < 380 °C). Approximately 5% of the oil is shown to be persistent. The aromatic content of the oil is approximately 3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 41% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

2.3 Hydrocarbon spill modelling

Oil spill trajectory modelling (OSTM) tools are used for environmental impact assessment and during response planning to understand spatial scale and timeframes for response operations. Woodside recognises that there is a degree of uncertainty related to the use of modelling data and has subsequently utilised conservative approaches to volumes, weathering, spatial areas, timing and response effectiveness to scale capability to need.

The Oil Spill Model and Response System (OILMAP) and Integrated Oil Spill Impact Model System (SIMAP) models are both used for stochastic and deterministic trajectory modelling. They have been developed over three decades of planning, exercises, actual responses, several peer reviews, and validation studies. OILMAP was originally derived from the United States Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Type A model (French et al. 1996), for assessing marine transport, biological impact and economic damage that was also used under the United States Oil Pollution Act 1990 Natural Resource

Damage Assessment (NRDA) regulations. Notable spills where the model has been used and validated against actual field observations include, Exxon Valdez (French McCay 2004), North Cape Oil Spill (French McCay 2003), along with an assessment of 20 other spills (French McCay and Rowe, 2004). In addition, test spills designed to verify fate, weathering and movement algorithms have been conducted regularly and in a range of climate conditions (French and Rines 1997; French et al. 1997; Payne et al. 2007; French McCay et al. 2007).

Further to this, the algorithms have been updated using the latest findings from the Macondo/Deepwater Horizon well blowout in the Gulf of Mexico and validated according to the Deepwater Horizon (DWH) oil spill in support of the NRDA (Spaulding et al. 2015; French McCay et al. 2015, 2016). Finally, the OILMAP and SIMAP models have been used extensively in Australia to prosecute pollution offences, predict discharge locations and likely spill volumes based on weathering and surveillance observations, and has been used as expert witness evidence in Australian court proceedings, aiding the prosecution to determine spill quantum estimates.

2.3.1 Stochastic modelling

Quantitative, stochastic assessments have been undertaken for credible spill scenarios Credible Scenario-01, Credible Scenario-02 and Credible Scenario-03 (Table 2-1) to help assess the environmental consequences of a hydrocarbon spill.

A total of 100 replicate simulations were completed for each of the scenarios to test for trends and variations in the trajectory and weathering of the spilled oil, with an even number of replicates completed using samples of metocean data that commenced within each calendar quarter (25 simulations per quarter). Further details relating to the assessments for the scenarios can be found in Section 6 of the EP.

2.3.1.1 Environmental impact thresholds – Environment that May Be Affected (EMBA) and hydrocarbon exposure

The outputs of the stochastic spill modelling are used to assess the potential environmental impact from the credible scenarios. The stochastic modelling results are used to delineate areas of the marine and shoreline environment that could be exposed to hydrocarbon levels exceeding environmental impact threshold concentrations. The summary of all the locations where hydrocarbon thresholds could be exceeded by any of the simulations modelled is defined as the EMBA and is discussed further in Section 6 of the EP. As the weathering of different fates of hydrocarbons (surface, entrained and dissolved) differs due to the influence of the metocean mechanism of transportation, a different EMBA is presented for each fate within the EP.

A conservative approach – adopting accepted contact thresholds for impacts on the marine environment – is used to define the EMBA. These hydrocarbon thresholds are presented in Table 2-2 below and described in Section 6 of the EP.

Table 2-2: Summary of thresholds applied to the stochastic hydrocarbon spill modelling to determine the EMBA and environmental impacts

	Surface hydrocarbon (g/m^2)	Dissolved hydrocarbon (ppb)	Entrained hydrocarbon (ppb)	Accumulated hydrocarbon (g/m^2)
Condensate	10	50	100	100
Diesel	10	500	500	100

2.3.2 Deterministic modelling

Woodside uses deterministic modelling results to evaluate risks and impacts and response capability requirements. These results are provided in both shapefile and data table format with each row of the data table representing a 1 km^2 cell. This cell size has been used as it represents the approximate area that a single containment and recovery operation or surface dispersant operation (single sortie or vessel spraying) can effectively treat in one ten (10) hour day. Smaller cell sizes have been considered but would not change the response need as the potential distance between cells would not allow multiple cells to be treated per day by response operations. Additionally, a 1 km^2 cell is expected to allow averaging of threshold concentrations and mass across the spatial extent to represent a conservative approach (patches of oil and windrows) to response planning that simulates operational monitoring feedback in a real event.

Deterministic modelling was carried out on scenarios Credible Scenario-01 and Credible Scenario-02 (both loss of well containment scenarios) as they were determined to be WCCS and thus used for response planning purposes. A sample of these deterministic results is provided below as an indication of the data format and content.

- Column A and B provide the latitude and longitude of the cell
- Column C is the elapsed time since the release occurred
- Column D represents the average concentration across the cell in g/m^2
- Column E represents the viscosity of the hydrocarbon in centistokes (cSt) at sea surface temperature
- Column F and G represents the mass of hydrocarbon across the entire cell in kg and tons respectively.

Table 2-3: Example Deterministic modelling data

Latitude A	Longitude B	Time_hour C	Conc_gm^2 D	Visc_cSt E	Mass_kg F	Mass_tons G
-19.711226	115.814366	6	6.413877	81.007389	6429.693282	6.413877
-19.702194	115.814366	6	1.740181	81.300190	1744.571745	1.740181
-19.720258	115.823922	6	1.869578	76.440503	1874.078751	1.869578
-19.711226	115.823922	6	51.471109	80.668490	51597.969472	51.471109
-19.702194	115.823922	6	4.734574	80.068396	4746.515274	4.734574
-19.720258	115.833477	6	4.879617	58.780817	4891.356945	4.879617
-19.711226	115.833477	6	36.161301	70.992921	36250.382543	36.161301

The deterministic modelling data provides an indication of the response need by displaying the potential surface area and volume that may be treated or recovered by response operations. Existing capability is reviewed to approximate the surface area and volumes that can be treated or removed and a range of alternate, improved and additional options to reduce risks and impacts to ALARP are considered.

Woodside recognises that no single response technique will treat all available subsea or surface oil and that a combination of response techniques will be required for the identified scenario. Even with the significant resources available to Woodside through existing capability and third-party resources, the primary offshore response techniques of surface dispersant application and containment and recovery will only treat or recover a minor proportion (<30%) of the available surface hydrocarbons based on previous response experience.

Woodside is committed to a realistic, scalable response capability that is commensurate to the level of risk and able to be practically implemented and feasibly sustained.

2.3.2.1 Response planning thresholds for surface and shoreline hydrocarbon exposure

Thresholds to determine the EMBA are used to predict and assess environmental impacts and inform the Scientific Monitoring Program (SMP), however they do not appropriately represent the thresholds at which an effective response can be implemented. Additional response thresholds are used for response planning and to determine areas where response techniques would be most effective. The deterministic modelling is then used to assess the nature and scale of a response.

In the event of an actual response, existing deterministic modelling would be reviewed for suitability and additional modelling would be conducted using real-time data and field information to inform IMT decisions.

The deterministic spill modelling outputs are presented at response planning thresholds for surface hydrocarbons for the WCCS. Surface spill concentrations are expressed as grams per square metre (g/m^2) (Section 2.2). The thresholds used are derived from oil spill response planning literature and industry guidance and are summarised below.

2.3.2.1.1 Surface hydrocarbon concentrations

Table 2-4: Surface hydrocarbon thresholds for response planning

Surface hydrocarbon threshold (g/m^2)	Description	Bonn Agreement Oil Appearance Code	Mass per area (m^3/km^2)
>10	Predicted minimum threshold for commencing operational monitoring[3]	Code 3 – Dull metallic colours	5 to 50
50	Predicted minimum floating oil threshold for containment and recovery and surface dispersant application [4]	Code 4 – Discontinuous true oil colour	50 to 200
100	Predicted optimum floating oil threshold for containment and recovery and surface dispersant application	Code 5 – Continuous true oil colour	>200
Shoreline hydrocarbon threshold (g/m^2)	**Description**	**National Plan Guidance on Oil Contaminated Foreshores**	**Mass per area (m^3/km^2)**
100	Predicted minimum shoreline accumulation threshold for shoreline assessment operations	Stain	>100
250	Predicted minimum threshold for commencing shoreline cleanup operations	Level 3 – Thin Coating	200 to 1000

The surface thickness of oil at which dispersants are typically effective is approximately 100 g/m^2. However, substantial variations occur in the thickness of the oil within the slick, and most fresh crude oils spread within a few hours, so that overall the average thickness is 0.1 mm (or approx. 100 g/m^2) (International Tanker Owners Pollution Federation [ITOPF] 2011). Additionally, the recommended rate of application for surface dispersant is typically 1-part dispersant to 20 or 25 parts of spilled oil. These figures assume a 0.1 mm slick thickness, averaged over the thickest part of the spill, to calculate a litres/hectare application rate from vessels and aircraft. In practice this can be difficult to achieve as it is not possible to accurately assess the thickness of the floating oil.

Some degree of localised over-dosage and under-dosage is inevitable in dispersant response. An average oil layer thickness of 0.1 mm is often assumed, although the actual thickness can vary over a wide range (from less than 0.0001 mm to more than 1 mm) over short distances (International Petroleum Industry Environment Conservation Association [IPIECA] 2015).

Guidance from the Australian Maritime Safety Authority (AMSA, 2015) indicates that spreading of spills of Group II or III products will rapidly decrease slick thickness over the first 24 hours of a spill resulting in the potential requirement of up to a ten (10) fold increase in capability on day 2 to achieve the same level of performance.

Further guidance from the European Maritime Safety Authority (EMSA) states that spraying the ‘metallic’ looking area of an oil slick (Bonn Agreement Oil Appearance Code [BAOAC] 3, approx. 5 – 50 µm) with dispersant from spraying gear designed to treat an oil layer 0.1 mm (100 µm) thick, will inevitably cause dispersant over-treatment by a factor of 2 to 20 times (EMSA 2012).

Therefore, dispersant application should be concentrated on the thickest areas of an oil slick and Woodside intends on applying surface dispersants to only BAOAC 4 and 5. Spraying areas of oil designated as BAOAC

[3] Operational monitoring will be undertaken from the outset of a spill whether or not this threshold has been reached. Monitoring is needed throughout the response to assess the nature of the spill, track its location and inform the need for any additional monitoring and/or response techniques. It also informs when the spill has entered State Waters and control of the incident passes to statutory authorities e.g. Western Australia Department of Transport (WA DoT) or AMSA.
[4] At 50g/m^2, containment and recovery and surface dispersant application operations are not expected to be particularly effective. This threshold represents a conservative approach to planning response capability and containing the spread of surface oil.

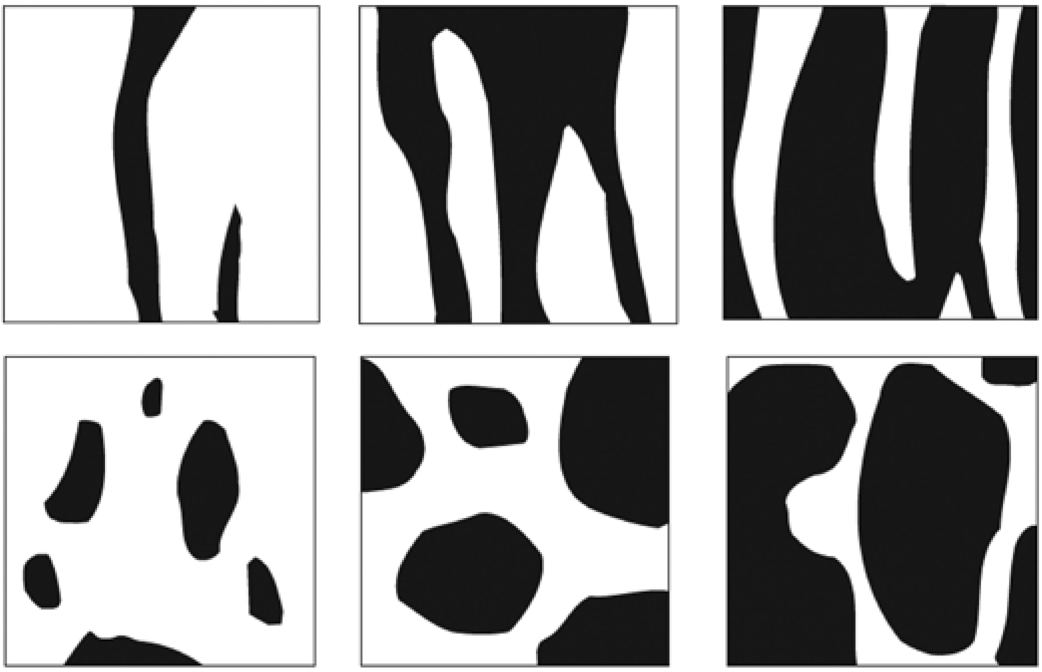
Code 4 (Discontinuous true oil colour) with dispersant will, on average, deliver approximately the recommended treatment rate of dispersant.

Spraying areas of oil designated as BAOAC Code 5 with dispersant (Continuous true oil colour and more than 0.2 mm thick) will, on average, deliver approximately half the recommended treatment rate of dispersant. Repeated application of these areas of thicker oil, or increased dosage ratios, will be required to achieve the recommended treatment rate of dispersant (EMSA 2012).

Guidance from NOAA in the United States is found in the document: *Characteristics of Response Strategies: A Guide for Spill Response Planning in Marine Environments 2013 (NOAA 2013).* This guide outlines advice for response planning across all common techniques, including surface dispersant spraying and containment and recovery. It states that oil thickness can vary by orders of magnitude within distinct areas of a slick, thus the actual slick thickness and oil distribution of target areas are crucial for determining response method feasibility. Further to this, ITOPF also states that in terms of oil spill response, sheen can be disregarded as it represents a negligible quantity of oil, cannot be recovered or otherwise dealt with to a significant degree by existing response techniques, and is likely to dissipate readily and naturally (ITOPF, 2014).

Figure 2-3 below from AMSA's Identification of Oil on Water – Aerial Observation and Identification Guide (AMSA, 2014) shows expected percent coverage of surface hydrocarbons as a proportion of total surface area. Wind-rows, heavy oil patches and tar balls, for example, must be considered, as they influence oil encounter rates, chemical dosages and ignition potential. Each method has different thickness thresholds for effective response.

From this information and other relevant sources (Allen and Dale, 1996, EMSA, 2012, Spence, 2018) the surface threshold of 50g/m^2 was chosen as an average/equilibrium thickness for offshore response operations (50 g/m^2 is an average of 50% coverage of 0.1mm Bonn Agreement Code 4 – discontinuous true oil colour, or 25% coverage of 0.2mm Bonn Agreement Code 5 – continuous true oil colour which would represent small patches of thick oil or wind-rows).



25% 50% 75%

Figure 2-3: Proportion of total area coverage (AMSA, 2014)

Figure 2-4 illustrates the general relationships between on-water response techniques and slick thickness. Wind-rows, heavy oil patches and tar balls, for example, must be considered, as they influence oil encounter rates, chemical dosages and ignition potential. Each method has different thickness thresholds for effective response.

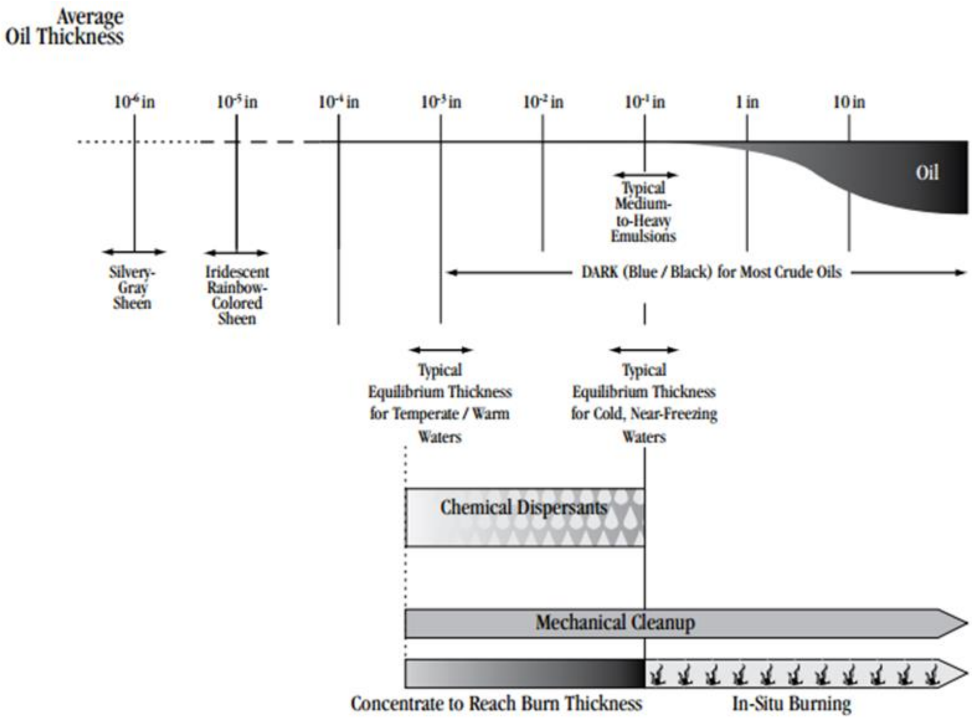


Figure 2-4: Oil thickness versus potential response options (from Allen & Dale 1996)

Wind and wave influence on the feasibility of response operations are also considered below (adapted from NOAA 2013):

- Mechanical Clean-up: Effectiveness drops significantly because of entrainment and/or splash-over as short period waves develop beyond 2–3 ft. (0.6–0.9m) in height. The ability to contain and recover oil decreases rapidly as the slick thickness becomes less than a thousandth of an inch (0.025 mm) (i.e., very low oil encounter rates). Waves and wind can also be limiting factors for the safe operation of vessels and aircraft.
- Dispersants: Effective dispersion requires a threshold amount of surface mixing energy (typically a few knots of wind and a light chop) to be effective. At higher wind and sea conditions, dispersant evaporation and wind-drift will limit chemical dispersion application effectiveness; and, there is a point (~25-kt winds, 10-ft waves) where natural dispersion forces become greater, particularly for light oils. Because of droplet size versus slick thickness constraints and application dose-rate limitations, dispersants work best on slick thicknesses of a few thousandths (approx. 50 g/m^2) to hundredths of an inch (approx. 250 g/m^2). Improved dispersants, higher dose rates, and multiple-pass techniques may extend the thickness limitation to 0.1 inch (2.5 mm) or more.

As offshore response operations (surface dispersant and containment and recovery) are intended to be undertaken at the thickest part of the slick, 50 g/m^2 and 100 g/m^2 (aligning with the lower limit of BAOAC 4 and midpoint of BAOAC 5) have been utilised by Woodside in deterministic modelling to identify the most likely locations for surface dispersant application and containment and recovery operations.

2.3.2.1.2 <u>Surface hydrocarbon viscosity</u>

Table 2-5: Surface hydrocarbon viscosity thresholds

Surface viscosity threshold (cSt)	Description	European Maritime Safety Authority (EMSA)	Viscosity at sea temperature (cSt)
5,000*	Predicted optimum viscosity for surface dispersant operations	Generally possible to disperse	500-5,000

15,000*	Predicted maximum viscosity for effective surface dispersant operations	Sometimes possible to disperse	5,000-15,000

*Measured at sea surface temperature

Further to the required thickness for surface dispersant application and containment and recovery to be deployed effectively as outlined above, changes to viscosity will also limit the treatment of offshore response techniques. As outlined in the EMSA Manual on the Applicability of Oil Spill Dispersants (EMSA, 2012), guidance around changes to viscosity and likely effectiveness of surface dispersant application is provided.

This includes the following statements: “It has been known for many years that it is more difficult to disperse a high viscosity oil than a low or medium viscosity oil. Laboratory testing had shown that the effectiveness of dispersants is related to oil viscosity, being highest for modern ‘Concentrate, UK Type 2/3’ dispersants at an oil viscosity of about 1,000 or 2,000 mPa (1,000 – 2,000 cSt) and then declining to a low level with an oil viscosity of 15,000 mPa (15,000 cSt). It was considered that some generally applicable viscosity limit, such as 2,000 or 5,000 mPa (2,000 – 5,000 cSt), could be applied to all oils.”

However, modern oil spill dispersants are generally effective up to an oil viscosity of 5,000 mPa (5,000 cSt) or more, and their performance gradually decreases with increasing viscosity; oils with a viscosity of more than 15,000 are in most cases, no longer dispersible. Guidance from CEDRE (EMSA, 2012) also indicates that products with a range of 500 – 5,000 cSt at sea temperature are generally possible to disperse, while 5,000 – 15,000 cSt at sea temperature above pour point are sometimes possible to disperse, with products beyond 15,000 cSt at sea temperature below pour point are generally impossible to disperse.

To support decision making and response planning, a threshold of 15,000 cSt at sea temperature was chosen as a conservative estimate of maximum viscosity for surface dispersant spraying operations.

The thresholds described above are compared with the modelling results for the WCCS (Table 2-6).

2.3.3 Spill modelling results

The selected deterministic runs used to represent the WCCS are based on response thresholds:

- Minimum time to floating hydrocarbon contact with the offshore edge(s) of any shoreline receptor polygon (at a threshold of 10 g/m^2).
- Minimum time to commencement of hydrocarbon accumulation at any shoreline receptor (at a threshold of 100 g/m^2).
- Maximum cumulative hydrocarbon volume accumulated at any individual shoreline receptor (at a threshold of 100 g/m^2).
- Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors (at a threshold of 100 g/m^2).
- Minimum time to entrained/dissolved hydrocarbon contact with the offshore edges of any receptor polygon (at a threshold of 500 ppb).

The volumes as presented in Table 2-6 are the worst case volumes resulting from the deterministic modelling and have been used to determine appropriate level of response. Deterministic modelling was not undertaken for Credible Scenario-03 but the stochastic results have been included here to ensure complete response planning:

Table 2-6: Worst case credible scenario modelling results

Response parameter	Modelled result		
	Credible Scenario-01: Hydrocarbon release caused by loss of well containment (GWF3)	**Credible Scenario-02: Hydrocarbon release caused by loss of well containment (Lambert Deep)**	**Credible Scenario-03: Hydrocarbon release due to vessel collision**
Maximum continuous liquid hydrocarbon release rate and duration	382,486 m^3 of GWF3 Condensate over 71 days	67,822 m^3 of Lambert Deep Condensate over 77 days	Instantaneous release of 1000 m^3 of marine diesel
Maximum residual surface hydrocarbon after weathering	0.8% residual component of 3059.9 m^3	8.2% residual component of 5561.4 m^3	5% residual component of 50 m^3
Deterministic modelling results			
Minimum time to floating hydrocarbon contact with the offshore edge(s) of any shoreline receptor polygon (at a concentration of 10 g/m^2)	*No contact at threshold*	*No contact at threshold*	*No contact at threshold*
Minimum time to commencement of hydrocarbon accumulation at any shoreline receptor (at a concentration of 100 g/m^2)	Model 21, Q2 22.6 days at Pilbara Islands – Southern Island Group (5 m^3)	Model 21, Q2 17 days at Barrow Island (27 m^3)	*No contact at threshold*
Maximum cumulative hydrocarbon volume accumulated at any individual shoreline receptor (at a concentration of 100 g/m^2).	Model 7, Q2 70 m^3 at Pilbara Islands – Southern Island Group (day 49.5)	Model 20, Q1 86.7 m^3 at Montebello Islands (day 61)	*No contact at threshold*
Maximum cumulative hydrocarbon volume accumulated across all shoreline receptors contacted by accumulated hydrocarbons (at a concentration of 100 g/m^2)	Model 7, Q2 72.2 m^3 (Pilbara Islands – Southern Island Group)	Model 20, Q1 204.4 m^3 (Montebello Islands)	*No contact at threshold*
Minimum time to entrained/dissolved hydrocarbon contact with the offshore edges of any receptor polygon (at a threshold of 500 ppb)	Model 15, Q2 4.9 days at Montebello State Marine Park	Model 19, Q3 15.2 days at Pilbara Island – Southern Island Group	Timeframe not available from stochastic modelling – contact of >500 ppb occurs up to 354 km from the spill site. The maximum is at Montebello MP

The map below displays the predicted surface concentration of oil at 0-50 g/m^2 (BAOAC Code 1-3 sheen – blue), and 50–100 g/m^2 and 100-150 g/m^2 (both BAOAC Code 4 – discontinuous true oil colour – yellow) over the initial seven days of the spill for Credible Scenario-01. Modelling for Credible Scenario-02 and Credible Scenario-03 does not predict any surface hydrocarbon at response thresholds and thus has not been mapped.

As shown in Figure 2-5 below and from analysis of the deterministic results, modelling predicts the following:

- The subsea release results in surface concentrations (>50g/m^2) suitable for some containment and recovery and surface dispersant operations.
- Viscosity remains within the range suitable for dispersant application (<15,000 cSt) throughout the modelled spill duration.

Response operations cannot be implemented if the safety of response personnel cannot be guaranteed. Safety circumstances that limit the execution of this control measure include volatile concentrations of hydrocarbons in the atmosphere, high winds (>20 knots), waves and/or sea states (>1.5m waves) and high ambient temperatures. Due to the volatile nature of GWF3 condensate and very low residue (0.8%) an offshore response would only be mounted if operational monitoring detects hydrocarbon concentrations at thresholds appropriate for effective dispersant and containments and recovery operations, and that such operations would provide a net environmental benefit. Furthermore, as noted above, atmospheric volatiles in the early stages of a spill event may be at unsafe levels for responders to undertake an offshore response.

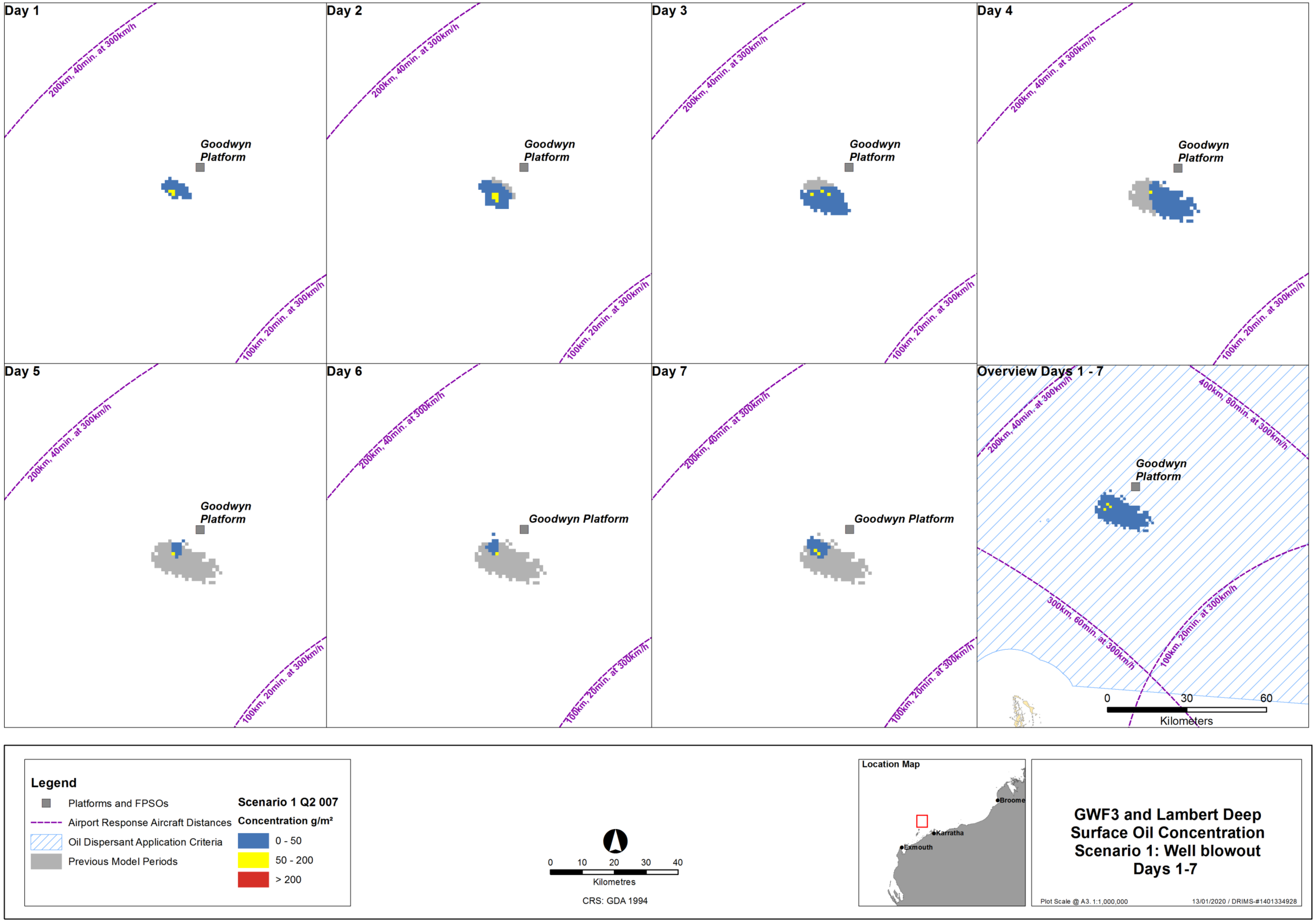


Figure 2-5: GWF3 loss of well containment (Credible Scenario-01) – Day 1-7 – Surface oil concentration

3 IDENTIFY RESPONSE PROTECTION AREAS

In a response, operational monitoring programs – including trajectory modelling and vessel/aerial observations – would be used to predict RPAs that may be impacted. For the purposes of planning and appropriately scaling a response, modelling has been used to identify RPAs as outlined below in Figure 3-1.

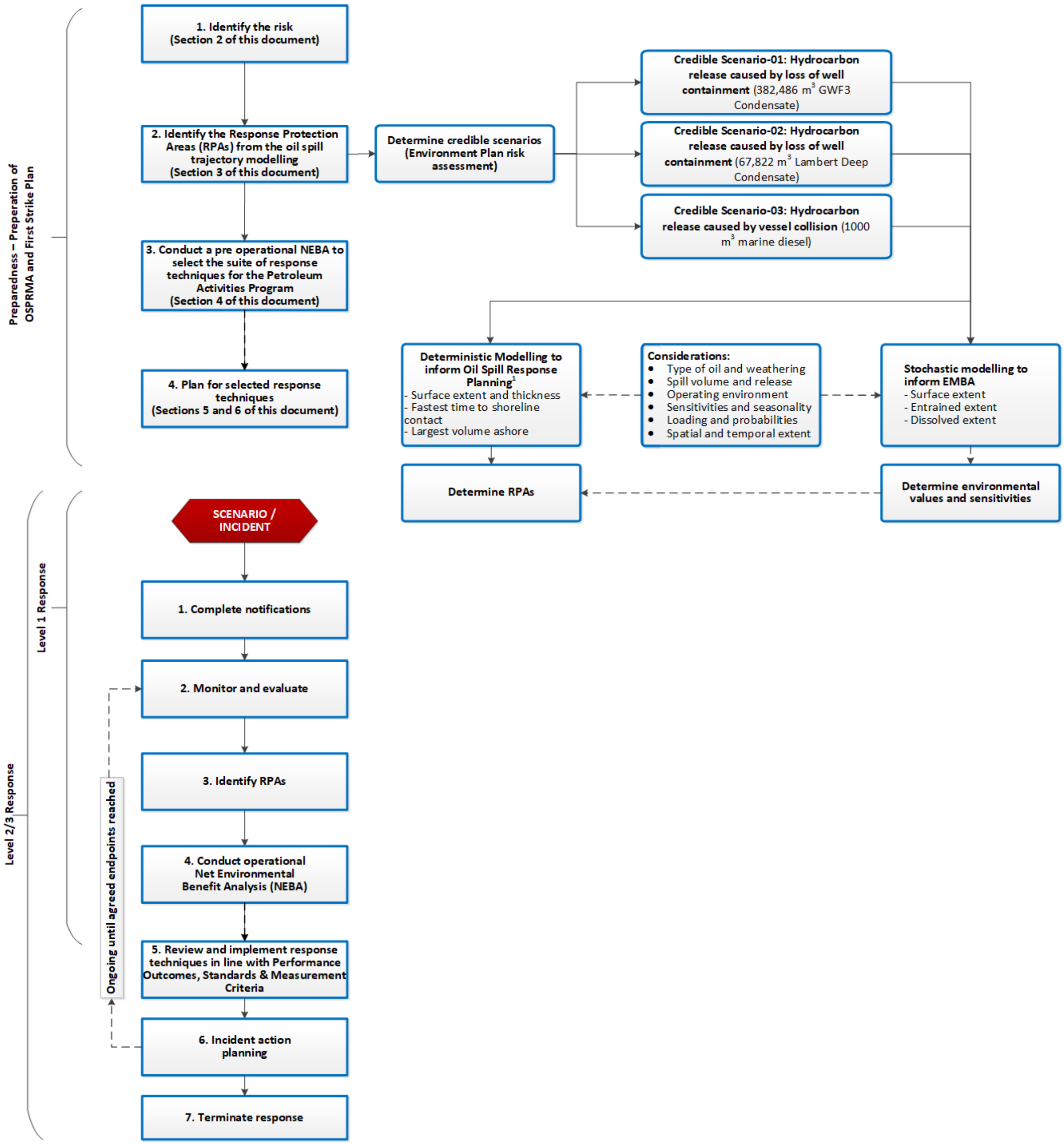


Figure 3-1: Identify Response Protection Areas flowchart

3.1 Identified sensitive receptor locations

Section 4 of the EP includes the list of sensitive receptor locations that have been identified by stochastic modelling as meeting the requirements outlined below:

- Receptors with the potential to incur surface, entrained or shoreline accumulation contact above environmental impact thresholds
- Receptors within the EMBA which meet the following:
  - a number of priority protection criteria/categories
  - International Union for Conservation of Nature (IUCN) marine protected area categories
  - high conservation value habitat and species
  - important socio-economic/heritage value.

3.2 Identify Response Protection Areas

RPAs have been selected on the basis of their environmental ecological, social, economic, cultural and heritage values and sensitivities and the ability to conduct a response based on the minimum response thresholds (Section 2.3.2.1). It is important to note that the figures outlined in Table 3-1 are the combined results of the individual worst-case runs and do not indicate a single WCCS (where the timings and volumes are all expected from one release).

From the identified sensitive receptors described in Section 4 of the EP, only those which a shoreline response could feasibly be conducted (accumulation >100 g/m^2 for shoreline assessment and/or contact with surface slicks >10 g/m^2 for operational monitoring[5]) have been selected for response planning purposes. While not discounting other sensitivities, these RPAs have been used as the basis for demonstrating the capability to respond to the nature and scale of a spill from the WCCS and prioritising response techniques.

Table 3-1 outlines locations which were identified from the modelling runs for the WCCS but does not constitute the full list of RPAs potentially contacted from stochastic modelling (as per EMBA definition) (see Section 4 of the EP). Other RPA outliers were identified from the modelling and have been included in the assessment of capability in Sections 5 and 6.

Additional sensitive receptors are presented the existing environment description (Section 4 of the EP) and impact assessment section (Section 6 of the EP) for each respective spill scenario. The pre-operational NEBA (Section 4) considers the results from the stochastic modelling to ensure all feasible response techniques are considered in the planning phase, therefore additional receptors are also included in the pre-operational NEBA.

The RPAs identified in Table 3-1 are used to plan for the nature and scale of a shoreline response.

[5] Operational monitoring will be undertaken from the outset of a spill whether or not this threshold has been reached. Monitoring is needed throughout the response to assess the nature of the spill, track its location and inform the need for any additional monitoring and/or response techniques. It also informs when the spill has entered State Waters and/or control of the incident passes to statutory authorities e.g. WA DoT or AMSA.

Table 3-1: Response Protection Areas (RPAs) from deterministic modelling

Areas of coastline contacted	Conservation status	IUCN protection category	Minimum time to shoreline contact (above 100g/m^2) in days [6]	Maximum shoreline accumulation (above 100g/m^2) in m^3 [7]	Minimum time to shoreline contact (above 100g/m^2) in days	Maximum shoreline accumulation (above 100g/m^2) in m^3	Minimum time to shoreline contact (above 100g/m^2) in days [8]	Maximum shoreline accumulation (above 100g/m^2) in m^3 [9]
			Credible Scenario-01		Credible Scenario-02		Credible Scenario-03	
Montebello Islands and State Marine Park	State Marine Park Australian Marine Park	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone IUCN II and IV – Recreational Use Zone IUCN II – Marine National Park Zone	58.2 days (2 m^3)	2 m^3 (58.2 days)	45 days (4 m^3)	86.7 m^3 (61.3 days)	*No contact at threshold*	*No contact at threshold*
Barrow Island	Australian Marine Park Marine Management Area	IUCN IA – Strict Nature Reserve IUCN IV – Recreational Use Zone IUCN VI – Multiple Use Zone	*No contact at threshold*	*No contact at threshold*	17 days (27 m^3)	27 m^3 (17 days)	*No contact at threshold*	*No contact at threshold*
Lowendal Islands	State Marine Park	IUCN VI – Multiple Use Zone	*No contact at threshold*	*No contact at threshold*	65.3 days (33 m^3)	33 m^3 (65.3 days)	*No contact at threshold*	*No contact at threshold*
Pilbara Islands – Southern Islands Group	State Marine Park Australian Marine Park	IUCN IV – Recreational Use Zone	22.6 days (5 m^3)	70 m^3 (49.6 days)	21.5 days (18 m^3)	48 m^3 (68.5 days)	*No contact at threshold*	*No contact at threshold*

[6] This volume and time represent the first time to contact on defined shoreline polygon and the maximum volume ashore for that 24 hour period.
[7] This volume and time represent the maximum volume ashore on defined shoreline polygon for any 24 hour time period
[8] This volume and time represent the first time to contact on defined shoreline polygon and the maximum volume ashore for that 24 hour period.
[9] This volume and time represent the maximum volume ashore on defined shoreline polygon for any 24 hour time period

Areas of coastline contacted	Conservation status	IUCN protection category	Minimum time to shoreline contact (above 100g/m^2) in days (6)	Maximum shoreline accumulation (above 100g/m^2) in m^3 (7)	Minimum time to shoreline contact (above 100g/m^2) in days	Maximum shoreline accumulation (above 100g/m^2) in m^3	Minimum time to shoreline contact (above 100g/m^2) in days (8)	Maximum shoreline accumulation (above 100g/m^2) in m^3 (9)
			Credible Scenario-01		Credible Scenario-02		Credible Scenario-03	
Muiron Islands Marine Management Area & World Heritage Area	Marine Management Area World Heritage Area	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone	51.7 days (3 m^3)	4 m^3 (65.7 days)	70.5 days (9 m^3)	9 m^3 (70.5 days)	*No contact at threshold*	*No contact at threshold*
Dampier Archipelago	National Heritage Property	N/A	*No contact at threshold*	*No contact at threshold*	55.5 days (10 m^3)	10 m^3 (55.5 days)	*No contact at threshold*	*No contact at threshold*
Pilbara – Northern Pilbara – Islands & Shoreline	Australian Marine Park	IUCN IA – Strict Nature Reserve	*No contact at threshold*	*No contact at threshold*	70.3 days (5 m^3)	5 m^3 (70.3 days)	*No contact at threshold*	*No contact at threshold*

4 NET ENVIRONMENTAL BENEFIT ANALYSIS

A Net Environmental Benefit Analysis (NEBA) is a structured process to consider which response techniques are likely to provide the greatest net environmental benefit.

The NEBA process typically involves four key steps outlined in Figure 4-1: evaluate data, predict outcomes, balance trade-offs, and select response options. These steps are followed in the planning/preparedness process and would also be followed in a response.

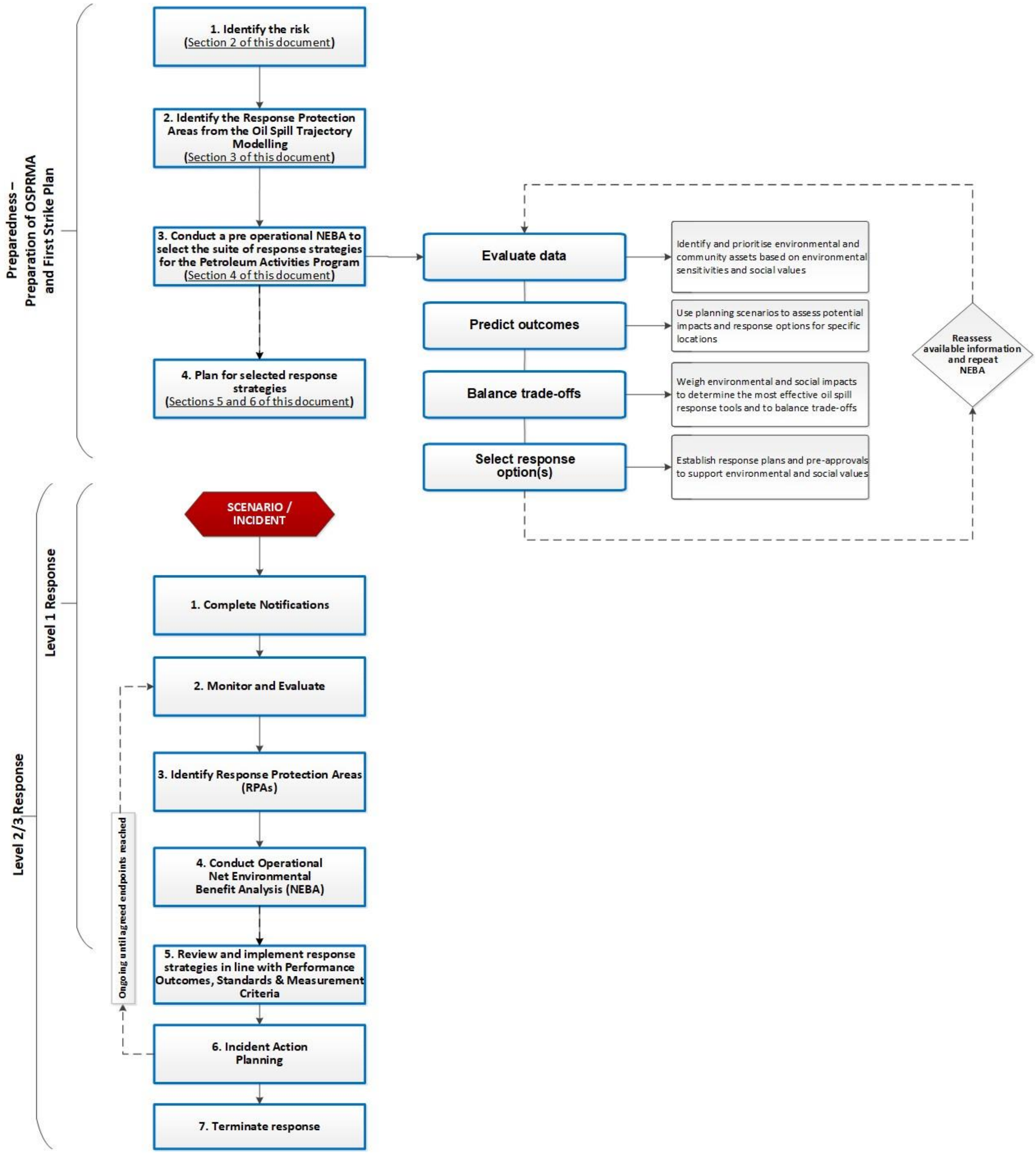


Figure 4-1: Net Environmental Benefit Analysis (NEBA) flowchart

4.1 Pre-operational / Strategic NEBA

The pre-operational NEBA identifies positive and negative impacts to sensitive receptors from implementing the response techniques. Feasibility is considered by assessing the receptors potentially impacted above response thresholds (Section 2.3.2.1) and the surface concentrations (Section 2.3.2.1.1) from the deterministic modelling.

Completing a pre-operational NEBA is a key response planning control that reduces the environmental risks and impacts of implementing the selected response techniques. Comprehensive details of the pre-operational NEBA for this PAP are contained in ANNEX A: Net Environmental Benefit Analysis detailed outcomes.

4.2 Stage 1: Evaluate data

Woodside identifies and prioritises environmental and community assets based on environmental sensitivities and social values, informed through the use of trajectory modelling. Interpretation of stochastic oil spill modelling determines the EMBA for the release, which defines the spatial area that may be potentially impacted by the PAP activities.

4.2.1 Define the scenario(s)

Woodside uses scenarios identified from the risk assessment in the EP to assess potential impacts and response options for specific locations. The overall WCCS is then selected for deterministic modelling and is used for this pre-operational NEBA. Outlier locations with potential environmental impacts, selected from the stochastic modelling may also be included for assessment. The worst-case diesel scenario is also analysed to meet regulatory requirements. Response thresholds and deterministic modelling are then used to assess the feasibility/effectiveness and scale of the response.

Table 4-1: Scenario summary information (WCCS)

Scenario summary information (Credible Scenario-01)	
Scenario	Hydrocarbon release caused by loss of well containment – GDA05 well
Location	Lat: 19° 43' 15.968" S Long: 115° 51' 10.743" E
Oil Type	GWF3 Condensate
Fate and Weathering	65.9% of the mass should evaporate within the first 12 hours (BP < 180 °C) 22.5% of the mass should evaporate within the first 24 hours (180 °C < BP < 265 °C) 10.8% of the mass should evaporate over several days (265 °C < BP < 380 °C) 0.8% residue
Volume and duration of release	382,486 m^3 over 71 days
Scenario summary information (Credible Scenario-02)	
Scenario	Hydrocarbon release caused by loss of well containment – LDA01 well
Location	Lat: 19° 26' 7.220" S Long: 116° 28' 51.314" E
Oil Type	Lambert Deep Condensate
Fate and Weathering	18.8% of the mass should evaporate within the first 12 hours (BP < 180 °C) 56.1% of the mass should evaporate within the first 24 hours (180 °C < BP < 265 °C) 16.9% of the mass should evaporate over several days (265 °C < BP < 380 °C) 8.2% residue
Volume and duration of release	67,822 m^3 over 77 days
Scenario summary information (Credible Scenario-03)	
Scenario	Hydrocarbon release caused by vessel collision
Location	Lat: 19° 45' 10.681" S Long: 115° 52' 42.898" E
Oil Type	Marine diesel
Fate and Weathering	6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C) 35% should evaporate within the first 24 hours (180 °C < BP < 265 °C) 54% should evaporate over several days (265 °C < BP < 380 °C) 5% residue
Volume and duration of release	1000 m^3 (instantaneous)

4.2.1.1 Hydrocarbon characteristics

GWF3 Condensate

GWF-3 Condensate is a mixture of volatile and persistent hydrocarbons with high proportions of highly volatile and low proportions of residual components. In general, about 65.9% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 22.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 10.8% should evaporate over several days (265 °C < BP < 380 °C). Approximately 0.8% of the oil is shown to be persistent. The aromatic content of the oil is approximately 16.3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 88% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves, but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

Lambert Deep Condensate

Lambert Deep Condensate is a mixture of volatile and persistent hydrocarbons with moderate proportions of both highly volatile and residual components. In general, about 18.8% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 56.1% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 16.9% should evaporate over several days (265 °C < BP < 380 °C). Approximately 8.2% of the oil is shown to be persistent. The aromatic content of the oil is approximately 16.3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 75% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves, but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

Subsea release – GWF3 and Lambert Deep Condensates

The results of the OILMAP simulation predict that the discharges will generate a cone of rising gas that will entrain the oil droplets and ambient sea water up to the water surface. This outcome was calculated by the model for both scenarios at all discharge rates specified throughout the blowout period. The mixed plume is initially forecast to jet towards the water surface with a vertical velocity of between 15 m/s and 17 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone of rising water and oil at the point of surfacing is predicted to be approximately 16 m for both scenarios.

The high discharge velocity and turbulence generated by the expanding gas plume is predicted to generate relatively small oil droplets between 94 μm and 432 μm in diameter for Credible Scenario-01 and between 94 μm and 390 μm in diameter for Credible Scenario-02. These droplets will be subject to mixing due to turbulence generated by the lateral displacement of the rising plume, as well as vertical mixing induced by wind and breaking waves. Therefore, despite reaching the surface due to the lift produced by the rising plume, the droplets will then tend to remain within the wave-mixed layer of the water column (3-10 m deep, depending on the conditions), where they can resist surfacing due to their weak buoyancy relative to other mixing processes.

The ongoing nature of the release combined with the potential for the plume to breach the water surface may present other hazards, including conditions that may lead to high local concentrations of atmospheric volatiles. These issues should be considered when evaluating the practicality of response operations at or near the blowout site. The results suggest that beyond the immediate vicinity of the blowout the majority of the released hydrocarbons will be present in the upper layers of the ocean, with the potential for oil to form floating slicks under sufficiently calm local wind conditions.

Marine diesel

Marine Diesel Oil is typically classed as an International Tanker Owners Pollution Federation (ITOPF) Group I/II oil. Marine diesel is a mixture of volatile and persistent hydrocarbons with low proportions of highly volatile and residual components. In general, about 6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 35% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 54% should evaporate over several days (265 °C < BP < 380 °C). Approximately 5% of the oil is shown to be persistent. The aromatic content of the oil is approximately 3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 41% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

Table 4-2: Oil fate, behaviour and impacts

Modelling results			
	Credible Scenario-01	**Credible Scenario-02**	**Credible Scenario-03**
Surface area of hydrocarbons (>50g/m^2 and <15,000cSt)	Surface hydrocarbons at response threshold (>50 g/m^2 and <15,000 cSt) are predicted to be present in the open water within 9 km of the well as follows: • 3 km^2 (175 m^3) on day 1 • 5 km^2 (366 m^3) on day 2 • 2 km^2 (162 m3) on day 3 • 1 km^2 (55 m^3) on day 4 • 1 km^2 (54 m^3) on day 5 • 1 km^2 (58 m^3) on day 6 • 2 km^2 (145 m^3) on day 7 • 2 km^2 (111 m^3) on day 18 • 1 km^2 (59 m^3) on day 27 • 1 km^2 (51 m^3) on day 30 • 1 km^2 (75 m^3) on day 32 • Surface hydrocarbons return to 0 km^2 and 0 m^3 thereafter	Nil	Nil
Minimum time to commencement of oil accumulation at any shoreline receptor (at concentrations >100 g/m^2)	Model 21, Q2 22.6 days at Pilbara Islands – Southern Island Group (5 m^3)	Model 21, Q2 Day 17 at Barrow Island (27 m^3)	*No contact at threshold*
Maximum cumulative oil volume accumulated at any individual shoreline receptor (at concentrations >100 g/m^2)	Model 7, Q2 70 m^3 at Pilbara Islands – Southern Island Group (day 49.5)	Model 20, Q1 86.7 m^3 at Montebello Islands (day 61.3)	*No contact at threshold*
Maximum cumulative oil volume accumulated across all shoreline receptors (at concentrations >100 g/m^2)	Model 7, Q2 72.2 m^3 (Pilbara Islands – Southern Island Group)	Model 20, Q1 204.4 m^3 (Montebello Islands)	*No contact at threshold*

Response Protection Areas (RPAs)						
	Credible Scenario-01		**Credible Scenario-02**		**Credible Scenario-03**	
	Minimum time to shoreline contact (above 100g/m^2) in days	**Maximum shoreline accumulation (above 100g/m^2) in m^3**	**Minimum time to shoreline contact (above 100g/m^2) in days**	**Maximum shoreline accumulation (above 100g/m^2) in m^3**	**Minimum time to shoreline contact (above 100g/m^2) in days**	**Maximum shoreline accumulation (above 100g/m^2) in m^3**
Montebello Islands and State Marine Park	58.2 days (2 m^3)	2 m^3 (58.2 days)	45 days (4 m^3)	86.7 m^3 (61.3 days)	*No contact at threshold*	*No contact at threshold*
Barrow Island	*No contact at threshold*	*No contact at threshold*	17 days (27 m^3)	27 m^3 (17 days)	*No contact at threshold*	*No contact at threshold*
Lowendal Islands	*No contact at threshold*	*No contact at threshold*	65.3 days (33 m^3)	33 m^3 (65.3 days)	*No contact at threshold*	*No contact at threshold*

Pilbara Islands – Southern Islands Group	22.6 days (5 m^3)	70 m^3 (49.6 days)	21.5 days (18 m^3)	48 m^3 (68.5 days)	*No contact at threshold*	*No contact at threshold*
Muiron Islands Marine Management Area & World Heritage Area	51.7 days (3 m^3)	4 m^3 (65.7 days)	70.5 days (9 m^3)	9 m^3 (70.5 days)	*No contact at threshold*	*No contact at threshold*
Dampier Archipelago	*No contact at threshold*	*No contact at threshold*	55.5 days (10 m^3)	10 m^3 (55.5 days)	*No contact at threshold*	*No contact at threshold*
Pilbara - Northern Pilbara - Islands & Shoreline	*No contact at threshold*	*No contact at threshold*	70.3 days (5 m^3)	5 m^3 (70.3 days)	*No contact at threshold*	*No contact at threshold*

4.2.2 Determining potential response options

The available response techniques based on current technology can be summarised under the following headings:

- monitor and evaluate (including operational monitoring)
- source control
  - remotely operated vehicle (ROV) intervention
  - debris clearance and/or removal
  - capping stack
  - relief well drilling
- source control on the vessel
- subsea dispersant injection
- surface dispersant application:
  - aerial dispersant application
  - vessel dispersant application
- mechanical dispersion
- in-situ burning
- containment and recovery
- shoreline protection and deflection:
  - protection
  - deflection
- shoreline clean-up:
  - phase 1 – mechanical clean-up
  - phase 2 – manual clean-up
  - phase 3 – final polishing
- oiled wildlife response.

Support functions may include:

- waste management
- post spill monitoring/ scientific monitoring.

Assessments of which response options are feasible for the scenarios are included below in Table 4-3, Table 4-4 and Table 4-5. These options are evaluated against each scenario's parameters including oil type, volume and characteristics, prevailing weather conditions, logistical support, and resource availability to determine their deployment feasibility.

A shortlist of the feasible response options is then carried forward for the ALARP assessment with a justification for the exclusion of other response techniques included in Section 4.2.3. This assessment will typically result in a range of available options that are deployed at different areas (at-source, offshore, nearshore and onshore) and times through the response. The NEBA process assists in prioritising which options to use where, when and timings throughout the response.

Table 4-3: Response technique evaluation – GWF3 Condensate release from loss of well containment (Credible Scenario-01)

Response technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: GWF3 Condensate				
Monitor and evaluate	Will be effective in tracking the location of the spill, informing when it has entered State Waters, predicting potential impacts and triggering further monitoring and response techniques as required. Monitoring techniques include: • OM01 Predictive modelling of hydrocarbons – used throughout spill. 'Ground-truthed' using the outputs of all other monitoring techniques. • OM02 Surveillance and reconnaissance to detect hydrocarbons and resources at risk – from outset of spill. • OM03 Monitoring of hydrocarbon presence, properties, behaviour and weathering in water – from outset of spill. • OM04 Pre-emptive assessment of sensitive receptors at risk – triggered once OM01, OM02 and OM03 inform likely RPAs at risk. • OM05 Shoreline assessment – once OM02, OM03 and OM04 inform which RPAs have been impacted.	Monitoring of a GWF3 Condensate spill is a feasible response technique and an essential element of all spill response incidents. Outputs will be used to guide decision making on the use of other monitoring/response techniques and providing required information to regulatory agencies including AMSA and Western Australia Department of Transport (WA DoT).	Yes	Monitoring the spill will be necessary to: • validate trajectory and weathering models • determine the behaviour of the oil in water • determine the location and state of the slick • provide forecasts of spill trajectory • determine appropriate response techniques • determine effectiveness of response techniques • confirm impact pathways to receptors • provide regulatory agencies with required information.
Source control via blowout preventer (BOP) intervention	Controlling a loss of well containment at source via BOP intervention would be the most effective way to limit the quantity of hydrocarbon entering the marine environment.	In the event of the worst-case scenario with a loss of well containment during drilling operations, ROV operations to locally operate the BOP would be attempted.	Yes	The use of source control intervention via ROV may be feasible (depending on local concentration of atmospheric volatiles) and would reduce quantity of hydrocarbons entering the marine environment.
Source control via debris clearance and capping stack	Controlling a loss of well containment at source via capping stack would be an effective way to limit the quantity of hydrocarbon entering the marine environment.	Woodside has developed a project specific capping stack deployment plan and also commissioned an independent, subsea site-specific plume and gas dispersion study for the GWF3 and Lambert Deep wells (Wild Well Control Inc (WWCI), 2020). The study indicates that shallow water in combination with high absolute open hole flow rates in the event of a worst-case blowout prohibit the safe deployment of a capping stack for the GWF3 and Lambert Deep Drilling and Subsea Installation project. Various options for safe and effective deployment of a capping stack in these conditions were assessed but due to the complex nature of implementation or inability to implement were deemed as not ALARP. These are detailed in Section 6.2.7.1. Though all capping stack deployment technologies are unproven, in the event of a loss of well containment at less than the WCCS (plume radius is ~25 m), the use of a proven subsea deployment method such as a heavy lift vessel, which is more commonly used in industry, is a more reliable and, in turn, ALARP approach. If environmental conditions permit (wind speed, wave height, current and plume radius), deployment of a capping stack would be attempted with a heavy lift vessel. Woodside maintains several frame agreements with various vessel service providers and maintains the ability to call off services with a capping stack and debris clearance agreement. The location of suitable vessels for capping stack deployment are monitored monthly. The supply arrangements and reliability to achieve the required mobilisation time will be revalidated prior to spud. Consideration to mobilise the capping stack from the supplier on a suitable vessel but then hand over to another vessel to conduct the capping activity will also be made to meet response time frames. A site-specific landing force analysis through computational fluid dynamic (CFD) modelling confirms the ability to land the capping stack on either a xmas tree or BOP.	Yes	Conventional/vertical capping stack deployment with a heavy lift vessel will be attempted at the discretion of the vessel master on the day, giving due regard to the safety of the vessel and crew and consideration to the factors that may influence a safe deployment such as: plume radius ~25 m and acceptable environmental conditions (e.g. wind speed, wave height, current and plume radius).
Source control via relief well drilling	A subsea release of condensate will be over approximately 71 days. Relief well drilling will be the primary option to stop the release.	For a spill from the GDA05 well, relief well drilling will be the only feasible means of controlling of well containment event. Relief well drilling is a widely accepted and utilised technique.	Yes	Relief well drilling will be the main technique employed to control a loss of well containment event.

Response technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: GWF3 Condensate				
Subsea Dispersant Injection (SSDI)	Application of subsea dispersant may reduce the scale and extent of hydrocarbons reaching the surface and thus reduce spill volumes contacting predicted RPAs. SSDI can increase dispersed/entrained hydrocarbons which can potentially have higher toxicity to biota in shallow water than naturally dispersed hydrocarbons. Entrained oil could potentially impact on sensitive shallow-water receptors e.g. corals, which may be otherwise unaffected. Entrained oil plume likely to be increased resulting in greater spatial extent of entrained oil.	Predicted to be feasible for the subsea hydrocarbon release due to properties of GWF3 Condensate. Furthermore, SSDI could potentially be applied from outside the exclusion zone thus could be deployed even when there are high VOC levels at the spill source. This response technique may not be feasible in the event of a worst-case blow-out due to potential high gas flow rates.	Yes	Potentially can treat large volumes of oil at source that could cause secondary contamination of wildlife or shorelines. Enhances biodegradation of hydrocarbons in water. Will be deployed if gas flow rate is established to be at an appropriate level.
Surface dispersant application	Application of surface dispersant would likely reduce the volumes of hydrocarbons contacting sensitive surface receptors. Dispersant can also enhance biodegradation and may reduce VOCs in some circumstances therefore reducing potential health and safety risk to responders. Dispersant can increase dispersed/entrained hydrocarbons which can potentially have higher toxicity to biota in shallow water than naturally dispersed hydrocarbons. Subsurface oil plume likely to increase in size resulting in greater spatial extent of entrained oil. Entrained oil could potentially impact on sensitive shallow-water receptors e.g. corals, which otherwise may have been unaffected.	Dispersants are not generally considered a feasible response technique when applied on thin surface films such as condensate as the dispersant droplets tend to pass through the surface films without binding to the hydrocarbon. Modelling of a GWF3 Condensate spill for the GWF3 drilling project predicts that floating oil will be prone to rapid spreading and evaporation and will not reach the required threshold (>50 g/m^2) for surface dispersant to be effective within any RPA. However, floating oil >50 g/m^2 is predicted in open waters (within 9 km of the GDA05 well) thus, if operational monitoring detects hydrocarbons at sufficient concentrations, it's use would provide a net environmental benefit and a response can safely be undertaken, surface dispersant may be an appropriate technique. This technique may be prevented from being undertaken due to personnel safety issues arising from predicted high local concentrations of atmospheric volatiles.	Yes	Use of surface dispersant may potentially be an appropriate technique if operational monitoring detects surface hydrocarbons present at appropriate concentrations, a net environmental benefit can be determined, and the safety of response personnel can be ensured. Outside of these parameters, the use of surface dispersant would be unwarranted and could unnecessarily introduce additional chemical substances to the marine environment. The additional entrainment would also increase exposure of subsea species and habitats to hydrocarbons without any net environmental benefit.
Mechanical dispersion	Mechanical dispersion involves the use of a vessel's prop wash and/or fire hose to target surface hydrocarbons to achieve dispersion into the water column. However, this technique is of limited benefit in an open ocean environment where wind and wave action are likely to deliver similar advantages.	Although the technique is feasible, highly volatile hydrocarbons are likely to weather, spread and evaporate quickly. The volatile nature of the oil likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon. Additionally, any vessel used for mechanical dispersion activities would be contaminated by the hydrocarbon and could potentially cause secondary contamination of unimpacted areas when exiting the spill area. The decontamination of a vessel used for mechanical dispersion activities would result in additional quantities of oily waste requiring appropriate handling and treatment.	No	Given the limited benefit of mechanical dispersion over natural wind and wave action, secondary contamination and waste issues, and the associated safety risk of implementing the response for this activity, this strategy is deemed unsuitable.
In-situ burning	In-situ burning is only effective where minimum slick thickness can be achieved and where calm metocean conditions can be ensured. Use of this technique would also cause an increase the release of atmospheric pollutants.	There is a limited window of opportunity in which this technique can be applied (prior to evaporation of the volatiles) which would be difficult to achieve. Furthermore, this technique may be prevented from being undertaken due to personnel safety issues arising from predicted high local concentrations of atmospheric volatiles.	No	The safety concerns and the predicted low effectiveness associated with implementing an in-situ burning response outweigh the potential environmental benefit.
Containment and recovery	Containment and recovery has an effective recovery rate of 5-10% when a hydrocarbon encounter rate of 25-50% is achieved at BAOAC 4 and 5. It has the potential to reduce the magnitude, probability, extent, contact and accumulation of hydrocarbon on shorelines receptors when suitable encounter rates can be achieved. It also has the potential to reduce the magnitude and extent of contact with submerged receptors by removing oil before further natural entraining/dissolving of hydrocarbons occurs.	Modelling of a GWF3 Condensate spill for the GWF3 drilling project predicts that floating oil will be prone to rapid spreading and evaporation and will not reach the required threshold (>50 g/m^2) for containment and recovery to be feasible within any RPA. However, floating oil >50 g/m^2 is predicted in open waters (within 9 km of the GDA05 well) thus, if operational monitoring detects hydrocarbons at sufficient concentrations, its use would provide a net environmental benefit and a response can safely be undertaken, containment and recovery may be an appropriate technique. Predicted low effectiveness – typical expectation is less than 10% of hydrocarbon released can be contained and recovered. Deepwater Horizon/Macondo was approx. 3–5% with the largest containment and recovery operation ever conducted. Meteorological conditions and sea-state must allow the deployment of booms and skimmers. Surface hydrocarbon would need to be corralled to a sufficient thickness to permit efficient recovery by skimmers.	Yes	Potential to slightly reduce the magnitude, probability of, extent of, contact with and accumulation on shorelines receptors if and when appropriate encounter rates can be achieved and in conditions that are safe for response personnel.

Response technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: GWF3 Condensate				
		Volatile nature of the hydrocarbon likely to lead to unsafe conditions near release location.		
Shoreline protection and deflection	Shoreline protection and deflection can be effective at preventing contamination of sensitive resources and can be used to corral oil into slicks thick enough to skim effectively.	If real-time Operational Monitoring activities (OM01, OM02 and OM03) indicate surface hydrocarbons are moving toward shorelines, pre-emptive assessments of sensitive receptors at risk (OM04) and existing TRPs will be utilised to guide shoreline protection and deflection operations, in agreement with WA DoT (for Level 2/3 spills). For Credible Scenario-01, first shoreline contact is predicted from floating surface hydrocarbon on Day 22.6 (5 m^3 at Pilbara Islands – Southern Island Group) allowing adequate time to deploy this technique. Protection strategies can be used for targeted protection of sensitive resources. Access to sensitive areas may cause more negative impact than benefit.	Yes	RPAs predicted to be contacted are based on modelling outputs and thus may differ under the prevailing conditions of a real event. If RPAs are deemed to be at risk, based on real-time modelling during a spill event, shoreline protection and deflection techniques will be employed to minimise hydrocarbon contact providing net environmental benefit.
Shoreline clean-up	Shoreline clean-up is an effective means of hydrocarbon removal from contaminated shorelines where coverage is at an optimum level of 250 g/m^2.	If real-time Operational Monitoring activities (OM01, OM02 and OM03) indicate hydrocarbons will contact shorelines, pre-emptive assessments of sensitive receptors at risk (OM04), shoreline assessments (OM05) and existing TRPs will be utilised to guide shoreline protection and deflection operations, in agreement with WA DoT (for Level 2/3 spills). For Credible Scenario-01, first shoreline contact is predicted from floating surface hydrocarbon on Day 22.6 (5 m^3 at Pilbara Islands – Southern Island Group) allowing adequate time to deploy this technique. Can reduce or prevent impact on sensitive receptors in most cases. Must ensure, through shoreline assessment, that sensitive sites will benefit from clean-up activities as the response itself may cause more negative impact than benefit through disturbance of habitats and species.	Yes	Response Protection Areas predicted to be contacted are based on modelling outputs and thus may differ under the prevailing conditions of a real event. If RPAs are at risk, based on real-time modelling during a spill event, shoreline clean-up techniques will be deployed to expedite clean-up of the impacted sites. Removal of hydrocarbons will help shorten the recovery window unless shoreline type is of a sensitive nature. This technique can help prevent remobilisation of hydrocarbon and impact on shorelines.
Oiled wildlife response	Oiled wildlife response is an effective response technique for reducing the overall impact of a spill on wildlife. This is mostly achieved through hazing to prevent additional wildlife from being contaminated and through rehabilitation of those already subject to contamination.	In the event that wildlife are at risk of contamination, oiled wildlife response will be undertaken in accordance with the Wildlife Response Operational Plan as and where required. In addition, any rehabilitation could only be undertaken by trained specialists. Due to the likely volatile atmospheric conditions surrounding a GWF3 Condensate spill, response options may be limited to hazing to ensure the safety of response personnel.	Yes	This technique may prevent impact to and/or treat oiled wildlife providing net environmental benefit.

Table 4-4: Response technique evaluation – Lambert Deep Condensate release from loss of well containment (Credible Scenario-02)

Response technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Lambert Deep Condensate				
Monitor and evaluate	Will be effective in tracking the location of the spill, informing when it has entered State Waters, predicting potential impacts and triggering further monitoring and response techniques as required. Monitoring techniques include: • OM01 Predictive modelling of hydrocarbons – used throughout spill. 'Ground-truthed' using the outputs of all other monitoring techniques. • OM02 Surveillance and reconnaissance to detect hydrocarbons and resources at risk – from outset of spill. • OM03 Monitoring of hydrocarbon presence, properties, behaviour and weathering in water – from outset of spill. • OM04 Pre-emptive assessment of sensitive receptors at risk – triggered once OM01, OM02 and OM03 inform likely RPAs at risk. • OM05 Shoreline assessment – once OM02, OM03 and OM04 inform which RPAs have been impacted.	Monitoring of a Lambert Deep Condensate spill is a feasible response technique and an essential element of all spill response incidents. Outputs will be used to guide decision making on the use of other monitoring/response techniques and providing required information to regulatory agencies including AMSA and WA DoT.	**Yes**	Monitoring the spill will be necessary to: • validate trajectory and weathering models • determine the behaviour of the oil in water • determine the location and state of the slick • provide forecasts of spill trajectory • determine appropriate response techniques • determine effectiveness of response techniques • confirm impact pathways to receptors • provide regulatory agencies with required information.
Source control via blowout preventer (BOP) intervention	Controlling a loss of well containment at source via BOP intervention would be the most effective way to limit the quantity of hydrocarbon entering the marine environment.	In the event of the worst-case scenario with a loss of well containment during drilling operations, ROV operations to locally operate the BOP would be attempted.	**Yes**	The use of source control intervention via ROV may be feasible (depending on local concentration of atmospheric volatiles) and would reduce quantity of hydrocarbons entering the marine environment.
Source control via debris clearance and capping stack	Controlling a loss of well containment at source via capping stack would be an effective way to limit the quantity of hydrocarbon entering the marine environment.	Woodside has developed a project specific capping stack deployment plan and also commissioned an independent, subsea site-specific plume and gas dispersion study for the GWF3 and Lambert Deep wells (WWCI, 2020). The study indicates that shallow water in combination with high absolute open hole flow rates in the event of a worst-case blowout prohibit the safe deployment of a capping stack for the GWF3 and Lambert Deep Drilling and Subsea Installation project. Various options for safe and effective deployment of a capping stack in these conditions were assessed but due to the complex nature of implementation or inability to implement were deemed as not ALARP. These are detailed in Section 6.2.7.1. Though all capping stack deployment technologies are unproven, in the event of a loss of well containment at less than the WCCS (plume radius is ~25 m), the use of a proven subsea deployment method such as a heavy lift vessel, which is more commonly used in industry, is a more reliable and, in turn, ALARP approach. If environmental conditions permit (wind speed, wave height, current and plume radius), deployment of a capping stack would be attempted with a heavy lift vessel. Woodside maintains several frame agreements with various vessel service providers and maintains the ability to call off services with a capping stack and debris clearance agreement. The location of suitable vessels for capping stack deployment are monitored monthly. The supply arrangements and reliability to achieve the required mobilisation time will be revalidated prior to spud. Consideration to mobilise the capping stack from the supplier on a suitable vessel but then hand over to another vessel to conduct the capping activity will also be made to meet response time frames. A site-specific landing force analysis through computational fluid dynamic (CFD) modelling confirms the ability to land the capping stack on either a xmas tree or BOP.	**Yes**	Conventional/vertical capping stack deployment with a heavy lift vessel will be attempted at the discretion of the vessel master on the day, giving due regard to the safety of the vessel and crew and consideration to the factors that may influence a safe deployment such as: plume radius ~25 m and acceptable environmental conditions (e.g. wind speed, wave height, current and plume radius).
Source control via relief well drilling	A subsea release of condensate will be over approximately 77 days. Relief well drilling will be the primary option to stop the release.	For a spill from the LDA01 well, relief well drilling will be the only feasible means of controlling of well containment event. Relief well drilling is a widely accepted and utilised technique.	**Yes**	Relief well drilling will be the main technique employed to control a loss of well containment event.

Response technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Lambert Deep Condensate				
Subsea Dispersant Injection	Application of subsea dispersant may reduce the scale and extent of hydrocarbons reaching the surface and thus reduce spill volumes contacting predicted RPAs. SSDI can increase dispersed/entrained hydrocarbons which can potentially have higher toxicity to biota in shallow water than naturally dispersed hydrocarbons. Entrained oil could potentially impact on sensitive shallow-water receptors e.g. corals, which may be otherwise unaffected. Entrained oil plume likely to be increased resulting in greater spatial extent of entrained oil.	Predicted to be feasible for the subsea hydrocarbon release due to properties of Lambert Deep Condensate. Furthermore, SSDI could potentially be applied from outside the exclusion zone thus could be deployed even when there are high VOC levels at the spill source. This response technique may not be feasible in the event of a worst-case blow-out due to potential high gas flow rates.	**Yes**	Potentially can treat large volumes of oil at source that could cause secondary contamination of wildlife or shorelines. Enhances biodegradation of hydrocarbons in water. Will be deployed if gas flow rate is established to be at an appropriate level.
Surface dispersant application	Application of surface dispersant would likely reduce the volumes of hydrocarbons contacting sensitive surface receptors. Dispersant can also enhance biodegradation and may reduce VOCs in some circumstances therefore reducing potential health and safety risk to responders. Dispersant can increase dispersed/entrained hydrocarbons which can potentially have higher toxicity to biota in shallow water than naturally dispersed hydrocarbons. Subsurface oil plume likely to increase in size resulting in greater spatial extent of entrained oil. Entrained oil could potentially impact on sensitive shallow-water receptors e.g. corals, which otherwise may have been unaffected.	Dispersants are not generally considered a feasible response technique when applied on thin surface films such as condensate as the dispersant droplets tend to pass through the surface films without binding to the hydrocarbon. Modelling of a Lambert Deep Condensate spill for the Lambert Deep drilling project predicts that floating oil will be prone to rapid spreading and evaporation and will not reach the required threshold (>50 g/m^2) for surface dispersant to be effective within any RPA or in open waters. Its use would, thus, be unwarranted and would not provide a net environmental benefit Furthermore, this technique may be prevented from being undertaken due to personnel safety issues arising from predicted high local concentrations of atmospheric volatiles.	**No**	As there is no surface oil predicted at the required concentration threshold (>50 g/m^2), the use of surface dispersant would be unwarranted and could unnecessarily introduce additional chemical substances to the marine environment. The additional entrainment would also increase exposure of subsea species and habitats to hydrocarbons.
Mechanical dispersion	Mechanical dispersion involves the use of a vessel's prop wash and/or fire hose to target surface hydrocarbons to achieve dispersion into the water column. However, this technique is of limited benefit in an open ocean environment where wind and wave action are likely to deliver similar advantages.	Although the technique is feasible, highly volatile hydrocarbons are likely to weather, spread and evaporate quickly. The volatile nature of the oil likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon. Additionally, any vessel used for mechanical dispersion activities would be contaminated by the hydrocarbon and could potentially cause secondary contamination of unimpacted areas when exiting the spill area. The decontamination of a vessel used for mechanical dispersion activities would result in additional quantities of oily waste requiring appropriate handling and treatment.	No	Given the limited benefit of mechanical dispersion over natural wind and wave action, secondary contamination and waste issues, and the associated safety risk of implementing the response for this activity, this strategy is deemed unsuitable.
In-situ burning	In-situ burning is only effective where minimum slick thickness can be achieved and where calm metocean conditions can be ensured. Use of this technique would also cause an increase the release of atmospheric pollutants.	There is a limited window of opportunity in which this technique can be applied (prior to evaporation of the volatiles) which would be difficult to achieve. Furthermore, this technique may be prevented from being undertaken due to personnel safety issues arising from predicted high local concentrations of atmospheric volatiles.	**No**	The safety concerns and the predicted low effectiveness associated with implementing an in-situ burning response outweigh the potential environmental benefit.
Containment and recovery	Containment and recovery has an effective recovery rate of 5-10% when a hydrocarbon encounter rate of 25-50% is achieved at BAOAC 4 and 5. It has the potential to reduce the magnitude, probability, extent, contact and accumulation of hydrocarbon on shorelines receptors when suitable encounter rates can be achieved. It also has the potential to reduce the magnitude and extent of contact with submerged receptors by removing oil before further natural entraining/dissolving of hydrocarbons occurs.	Modelling of a Lambert Deep Condensate spill for the Lambert Deep drilling project predicts that floating oil will be prone to rapid spreading and evaporation and will not reach the required threshold (>50 g/m^2) for containment and recovery to be feasible within any RPA or in open waters. Predicted low effectiveness – typical expectation is less than 10% of hydrocarbon released can be contained and recovered. Deepwater Horizon/Macondo was approx. 3–5% with the largest containment and recovery operation ever conducted. Meteorological conditions and sea-state must allow the deployment of booms and skimmers. Surface hydrocarbon would need to be corralled to a sufficient thickness to permit efficient recovery by skimmers. Volatile nature of the hydrocarbon likely to lead to unsafe conditions near release location.	No	In addition to low effectiveness and potential safety issues from predicted high local concentrations of atmospheric volatiles, the modelling results show that surface hydrocarbons would not meet the minimum concentration thresholds required making containment and recovery an unsuitable response technique.

Response technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Lambert Deep Condensate				
Shoreline protection and deflection	Shoreline protection and deflection can be effective at preventing contamination of sensitive resources and can be used to corral oil into slicks thick enough to skim effectively.	If real-time Operational Monitoring activities (OM01, OM02 and OM03) indicate surface hydrocarbons are moving toward shorelines, pre-emptive assessments of sensitive receptors at risk (OM04) and existing TRPs will be utilised to guide shoreline protection and deflection operations, in agreement with WA DoT (for Level 2/3 spills). For Credible Scenario-02, first shoreline contact is predicted from floating surface hydrocarbon on day 17 (27 m^3 at Barrow Island) allowing adequate time to deploy this technique. Protection strategies can be used for targeted protection of sensitive resources. Access to sensitive areas may cause more negative impact than benefit.	Yes	RPAs predicted to be contacted are based on modelling outputs and thus may differ under the prevailing conditions of a real event. If RPAs are deemed to be at risk, based on real-time modelling during a spill event, shoreline protection and deflection techniques will be employed to minimise hydrocarbon contact providing net environmental benefit.
Shoreline clean-up	Shoreline clean-up is an effective means of hydrocarbon removal from contaminated shorelines where coverage is at an optimum level of 250 g/m^2.	If real-time Operational Monitoring activities (OM01, OM02 and OM03) indicate hydrocarbons will contact shorelines, pre-emptive assessments of sensitive receptors at risk (OM04), shoreline assessments (OM05) and existing TRPs will be utilised to guide shoreline protection and deflection operations, in agreement with WA DoT (for Level 2/3 spills). For Credible Scenario-02, first shoreline contact is predicted from floating surface hydrocarbon on day 17 (27 m^3 at Barrow Island) allowing adequate time to deploy this technique. Can reduce or prevent impact on sensitive receptors in most cases. Must ensure, through shoreline assessment, that sensitive sites will benefit from clean-up activities as the response itself may cause more negative impact than benefit through disturbance of habitats and species.	**Yes**	Response Protection Areas predicted to be contacted are based on modelling outputs and thus may differ under the prevailing conditions of a real event. If RPAs are at risk, based on real-time modelling during a spill event, shoreline clean-up techniques will be deployed to expedite clean-up of the impacted sites. Removal of hydrocarbons will help shorten the recovery window unless shoreline type is of a sensitive nature. This technique can help prevent remobilisation of hydrocarbon and impact on shorelines.
Oiled wildlife response	Oiled wildlife response is an effective response technique for reducing the overall impact of a spill on wildlife. This is mostly achieved through hazing to prevent additional wildlife from being contaminated and through rehabilitation of those already subject to contamination.	In the event that wildlife are at risk of contamination, oiled wildlife response will be undertaken in accordance with the Wildlife Response Operational Plan as and where required. In addition, any rehabilitation could only be undertaken by trained specialists. Due to the likely volatile atmospheric conditions surrounding a Lambert Deep Condensate spill, response options may be limited to hazing to ensure the safety of response personnel.	**Yes**	This technique may prevent impact to and/or treat oiled wildlife providing net environmental benefit.

Table 4-5: Response technique evaluation – marine diesel release from vessel collision (Credible Scenario-03)

Response Technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Marine Diesel				
Monitor and evaluate	Will be effective in tracking the location of the spill, predicting potential impacts and triggering further monitoring and response techniques as required. Monitoring techniques include: • OM01 Predictive modelling of hydrocarbons – used throughout spill. 'Ground-truthed' using the outputs of all other monitoring techniques. • OM02 Surveillance and reconnaissance to detect hydrocarbons and resources at risk – from outset of spill. • OM03 Monitoring of hydrocarbon presence, properties, behaviour and weathering in water – from outset of spill. • OM04 Pre-emptive assessment of sensitive receptors at risk – triggered once OM01, OM02 and OM03 inform likely RPAs at risk. • OM05 Shoreline assessment – once OM02, OM03 and OM04 inform if any RPAs have been impacted.	Monitoring of a marine diesel spill is a feasible response technique and outputs will be used to guide decision making on the use of other monitoring/response techniques and providing information to regulatory agencies including AMSA and WA DoT. Practicable techniques that could be used for this scenario include predictive modelling (OM01), surveillance and reconnaissance OM02) and monitoring of hydrocarbon presence in water (OM03). Modelling does not predict impact of any shoreline receptors at threshold, however, pre-emptive assessment of sensitive receptors at risk (OM04) and monitoring of contaminated resources (OM05) would be utilised if any sensitive shoreline receptors are deemed to be at risk of impact.	**Yes**	Monitoring the spill will be necessary to: • validate trajectory and weathering models • determine the behaviour of the oil in water • determine the location and state of the slick • provide forecasts of spill trajectory • determine appropriate response techniques • determine effectiveness of response techniques • confirm impact pathways to receptors • provide regulatory agencies with required information.
Source control via vessel SOPEP	Controlling the spill of diesel at source would be the most effective way to limit the quantity of hydrocarbon entering the marine environment.	A spill of diesel from a vessel collision will be instantaneous and source control will be limited to what the vessel or facility can safely achieve whilst responding to the incident.	**Yes**	Ability to stop the spill at source will be dependent upon the specific spill circumstances and whether or not it is safe for response personnel to access/isolate the source of the spill.
Surface dispersant application	Dispersants are not considered effective when applied on thin surface films such as marine diesel as the dispersant droplets tend to pass through the surface films without binding to the hydrocarbon resulting in the unnecessary addition of chemicals to the marine environment	Marine diesel is prone to rapid spreading and evaporation and is not suitable for surface dispersant application. Furthermore, modelling predicts that floating oil will not reach the required threshold (>50 g/m^2) for containment and recovery to be feasible within any RPA or in open waters. The volatile nature of marine diesel is also likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon thus this response technique is deemed inappropriate.	**No**	The application of dispersant to marine diesel is unnecessary as the diesel will rapidly evaporate and would thus unnecessarily introduce additional chemical substances to the marine environment. The additional entrainment would also increase exposure of subsea species and habitats to hydrocarbons.
Mechanical dispersion	Mechanical dispersion involves the use of a vessel's prop wash and/or fire hose to target surface hydrocarbons to achieve dispersion into the water column. However, this technique is of limited benefit in an open ocean environment where wind and wave action are likely to deliver similar advantages.	Although the technique is feasible, highly volatile hydrocarbons are likely to weather, spread and evaporate quickly. The volatile nature of the oil likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon. Additionally, any vessel used for mechanical dispersion activities would be contaminated by the hydrocarbon and could potentially cause secondary contamination of unimpacted areas when exiting the spill area. The decontamination of a vessel used for mechanical dispersion activities would result in additional quantities of oily waste requiring appropriate handling and treatment.	**No**	Given the limited benefit of mechanical dispersion over natural wind and wave action, secondary contamination and waste issues, and the associated safety risk of implementing the response for this activity, this strategy is deemed unsuitable.
In-situ burning	In-situ burning is only effective where minimum slick thickness can be achieved.	Use of in-situ burning as a response technique for marine diesel is unfeasible as the minimum slick thickness cannot be attained due to rapid spreading. In addition, there is a limited window of opportunity in which this technique can be applied (prior to evaporation of the volatiles) which is unlikely to be achieved. Furthermore, entering a volatile environment to undertake this technique would be unsafe for response personnel and its used would unnecessarily cause an increase the release of atmospheric pollutants.	**No**	Diesel characteristics are not appropriate for the use of in-situ burning and would unnecessarily cause an increase the release of atmospheric pollutants.
Containment and recovery	Containment and recovery has an effective recovery rate of 5-10% when a hydrocarbon encounter rate of 25-50% is achieved at BAOAC 4 and 5 with a 50-100% coverage of 100 g/m^2 to 200 g/m^2.	Marine diesel is prone to rapid spreading and evaporation and is deemed unsuitable for effective containment and recovery operations. Furthermore, modelling predicts that floating oil will not	**No**	Containment and recovery would be an inappropriate response technique for a spill of marine diesel. In addition to the safety issues, most of the spilled diesel would have been subject to rapid

Response Technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: Marine Diesel				
		reach the required threshold (>50 g/m^2) for containment and recovery to be feasible within any RPA or in open waters. The volatile nature of marine diesel is also likely to lead to unsafe conditions in the vicinity of the hydrocarbon thus this response technique is deemed inappropriate.		evaporation prior to the commencement of containment and recovery operations.
Shoreline protection and deflection	Shoreline protection and deflection can be effective at preventing contamination of at-risk areas.	A marine diesel spill would be prone to rapid spreading and evaporation and modelling predicts that no shoreline receptors will be contacted at threshold. The maximum accumulated volume is predicted to be <1 m^3. Furthermore, the volatile nature of marine diesel is also likely to lead to unsafe conditions in the vicinity of the hydrocarbon. Operational monitoring will, however, be deployed from the outset of a spill to track the spill location and fate in real-time.	**No**	In addition to safety issues and the rapid spreading and evaporation of the diesel, the modelling undertaken predicts that no shoreline receptors would be contacted by floating oil concentrations at any of the assessed thresholds.
Shoreline clean-up	Shoreline clean-up is an effective means of hydrocarbon removal from contaminated shorelines where coverage is at an optimum level of 250 g/m^2.	A marine diesel spill would be prone to rapid spreading and evaporation and the modelling predicts that no shoreline receptors will be contacted at threshold – any minor contact is significantly below any threshold concentration that would allow a response to be feasible. The maximum accumulated volume is predicted to be <1 m^3. Furthermore, the volatile nature of marine diesel is also likely to lead to unsafe conditions in the vicinity of the hydrocarbon. Operational monitoring will, however, be deployed from the outset of a spill to track the spill location and fate in real-time.	**No**	In addition to safety issues, the modelling undertaken predicts that no shoreline receptors would be contacted by floating oil concentrations at a recoverable threshold and a spill of marine diesel is unlikely to accumulate at concentrations appropriate for shoreline clean-up techniques.
Oiled wildlife response	Oiled wildlife response is an effective response technique for reducing the overall impact of a spill on wildlife. This is mostly achieved through hazing to prevent additional wildlife from being contaminated and through rehabilitation of those already subject to contamination.	Due to the likely volatile atmospheric conditions surrounding a diesel spill, response options may be limited to hazing to ensure the safety of response personnel. The modelling undertaken predicts that no sensitive areas will be impacted thus it is unlikely that this technique would be required. Monitor and evaluate will, however, be deployed from the outset of a spill to track the spill location and fate in real-time. Thus, in the event that wildlife are at risk of contamination, oiled wildlife response will be undertaken in accordance with the Wildlife Response Operational Plan as and where required. In addition, any rehabilitation could only be undertaken by trained specialists.	**Yes**	The modelling undertaken predicts that no sensitive areas will be impacted thus it is unlikely that this technique would be required. However, in the event that wildlife are at risk of contamination, oiled wildlife response will be undertaken as and where required.

4.2.3 Exclusion of response techniques

Response techniques that are not feasible for all scenarios for this PAP are detailed in the subsections below and are excluded from further assessment within this document.

4.2.3.1 Mechanical dispersion

Mechanical dispersion involves the use of a vessel's propeller wash and/or fire hose to target surface hydrocarbons to achieve dispersion into the water column. This technique is of limited benefit in an open ocean environment where wind and wave action are likely to deliver similar advantages. Additionally, the volatile nature of the oil likely to lead to unsafe conditions in the vicinity of fresh hydrocarbon.

Any vessel used for mechanical dispersion activities would become contaminated by the hydrocarbon and could potentially cause secondary contamination of unimpacted areas when exiting the spill area. The decontamination of a vessel used for mechanical dispersion activities would result in additional quantities of oily waste requiring appropriate handling and treatment.

4.2.3.2 In-situ burning

This technique requires calm sea state conditions as is required for containment and recovery operations, which limits its feasibility in the region. Optimum weather conditions are <20 knot wind speed and waves <1 to 1.5 m with oil collected to a minimum 3mm thick layer. Due to the conditions in the region it is expected that the ability to contain oil may be limited as the sea state may exceed the optimum conditions. It is preferable that oil is fresh and does not emulsify to maximise burn efficiency and reduce residue thickness.

There are health and safety risks for response personnel associated with the containment and subsequent burning of hydrocarbons. It is also suggested that the residue from attempts to burn would sink, thereby posing a risk to the environment. The longer-term effects of burn residues on the marine environment are not fully understood and therefore, no assessment of the potential environmental impact can be determined.

Until further operational and environmental information becomes available, Woodside will not consider this option.

4.3 Stage 2: Predict outcomes

Woodside uses planning scenarios to assess potential impacts and response options for specific locations. Locations with potential environmental impacts, selected from the stochastic modelling are included for assessment. Response thresholds and deterministic modelling are then used to assess the feasibility/effectiveness of a response.

4.4 Stage 3: Balance trade-offs

Woodside considers environmental impacts and response effectiveness/feasibility to determine the most effective oil spill response tools and balance trade-offs, using an automated NEBA tool. The tool considers potential benefits and impacts associated with a response at sensitive receptors and then considers the effectiveness/feasibility of the response to select the response techniques carried forward to the ALARP assessment (ANNEX A: Net Environmental Benefit Analysis detailed outcomes).

4.5 Stage 4: Select Best Response Options

To select the response technique, all the other stages in the NEBA process are considered and used to establish response plans and any pre-approvals to support protection of identified environmental and social values.

The response techniques implemented may vary according to a particular spill. The hydrocarbon type released and the sensitivities of the receptors (both ecological and socio-economic) may influence the response. The pre-operational NEBA broadly evaluates each response technique and supports decisions on whether they are feasible and of net environmental benefit. Response techniques that are not feasible or beneficial are rejected at this stage and not progressed to planning.

Further risks and impacts from implementing these selected response options are outlined in Section 7.

Table 4-6: Selection and prioritisation of response techniques

Response planning scenario	Key characteristics for response planning (times are minimum times to contact for first receptor and/or shoreline contacted above response threshold)	Feasibility of response techniques: Monitor and evaluate	Debris clearance	Source control – capping stack	Source control on the vessel	Source control – relief well drilling	Subsea dispersant injection	Surface dispersant application	Mechanical dispersion	In-situ burning	Containment and recovery	Shoreline protection and deflection	Shoreline cleanup	Oiled wildlife response	Outline response technique
Credible Scenario-01: Hydrocarbon release caused by loss of well containment 382,486 m^3 of GWF3 Condensate over 71 days (residual component of 3059.9 m^3).	Fastest time to shoreline accumulation >100 g/m^2 – 22.6 days at Pilbara Islands Southern Group (5 m^3) Maximum shoreline accumulation – 70 m^3 at Pilbara Islands Southern Island Group (day 49.6)	Yes	Yes	Yes*	N/A	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Monitor and evaluate. Initiate debris clearance. Initiate source control via capping stack if plume radius permits. Initiate relief well drilling. Consider subsea dispersant injection if gas flow rate appropriate. Consider surface dispersant application viability and implement if net environmental benefit determined. Consider containment and recovery and implement if viable. Initiate shoreline protection and deflection (in liaison with WA DoT) if there is potential contact predicted. Initiate shoreline monitoring and clean-up (in liaison with WA DoT) if potential contact is predicted. Plan for oiled wildlife response and implement if oiled wildlife is observed.
Credible Scenario-02: Hydrocarbon release caused by loss of well containment 67,822 m^3 of Lambert Deep Condensate over 77 days (residual component of 5561.4 m^3).	Fastest time to shoreline accumulation >100 g/m^2 – 17 days at Barrow Island (27 m^3) Maximum shoreline accumulation – 86.7 m^3 at Montebello Islands (day 61.3)	Yes	Yes	Yes*	N/A	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Monitor and evaluate. Initiate debris clearance. Initiate source control via capping stack if plume radius permits. Initiate relief well drilling. Consider subsea dispersant injection if gas flow rate appropriate. Initiate shoreline protection and deflection (in liaison with WA DoT) if there is potential contact predicted. Initiate shoreline monitoring and clean-up (in liaison with WA DoT) if potential contact is predicted. Plan for oiled wildlife response and implement if oiled wildlife is observed.
Credible Scenario-03: Instantaneous release of up to 1000 m^3 marine diesel from a vessel collision (residual component of 50 m^3)	Fastest time to shoreline accumulation >100 g/m^2 – no contact Maximum shoreline accumulation – <1 m^3	Yes	N/A	N/A	Yes	N/A	N/A	No	No	No	No	No	No	Yes	Monitor and evaluate. Initiate source control if feasible. Plan for oiled wildlife response and implement if oiled wildlife is observed.

**NB This option would only viable for a loss of well containment of a lower magnitude than the worst case credible scenario where the plume radius is ~25 m.*

From the NEBA undertaken on the WCCSs identified (loss of well containment – Credible Scenario-01 and Credible Scenario-02), and marine diesel from a support vessel collision (Credible Scenario-03), the recommended response techniques are;

- monitor and evaluate (all scenarios)
- debris clearance (Credible Scenario-01 and Credible Scenario-02)
- source control (capping stack) if lower magnitude than the worst case credible scenario where the plume radius is ~25 m (Credible Scenario-01 and Credible Scenario-02)
- source control via relief well drilling (Credible Scenario-01 and Credible Scenario-02)
- source control on the vessel (Credible Scenario-03)
- subsea dispersant injection if gas flow rate is appropriate (Credible Scenario-01 and Credible Scenario-02)
- surface dispersant application (Credible Scenario-01).
- containment and recovery (Credible Scenario-01)
- shoreline protection and deflection (Credible Scenario-01 and Credible Scenario-02)
- shoreline clean-up (Credible Scenario-01 and Credible Scenario-02)
- oiled wildlife response (all scenarios).

Support functions include:

- waste management (all scenarios)
- scientific monitoring programs (all scenarios).

5 HYDROCARBON SPILL ALARP PROCESS

Woodside's hydrocarbon spill ALARP process is aligned with guidance provided by NOPSEMA in *Guidelines N-04300-GN0166 (2015)* and *N-04300-GN1488 (2018)* and is set out in the 'Woodside Oil Spill Preparedness and Response Mitigation Assessment (OSPRMA) Guidelines'.

From the identified response planning need and pre-operational NEBA, Woodside conducts a structured, semi-quantitative hydrocarbon spill process which has the following steps:

1. considers the response planning need identified in terms of surface area (km^2) and available surface hydrocarbon volumes (m^3) against existing Woodside capability
2. considers alternative, additional, and improved options for each response technique/control measure by providing an initial and, if required, detailed evaluation of:
    - predicted cost associated with adopting the control measure
    - predicted change/environmental benefit
    - predicted effectiveness/feasibility of the control measure.
3. evaluates the risks and impacts of implementing the proposed response techniques, and any further control measures with associated environmental performance to manage these additional risks and impacts.

Woodside considers the risks and impacts from a hydrocarbon spill to have been reduced to ALARP when:

1. a structured process for identifying and considering alternative, additional, and improved options has been completed for each selected response technique
2. the analysis of alternate, additional, and improved control measures meets one of the following criteria:
    - all identified, reasonably practicable control measures have been adopted
    - no identified reasonably practicable additional, alternative and/or improved control measures would provide further overall increased proportionate environmental benefit; or
    - no reasonably practical additional, alternative, and/or improved control measures have been identified.
3. where an alternative, additional and/or improved control measure is adopted, a measurable level of environmental performance has been assigned
4. higher order impacts/ risks have received more comprehensive alternative, additional, and improved control measure evaluations and do not just compare the cost of the adopted control measures to the costs of an extreme or clearly unreasonable control measure
5. cumulative effects have been analysed when considered in combination across the whole activity.

The response technique selection is based on the risk assessment conducted in the EP. The risk assessment identifies the type of oil, volume of release, duration of release, predicted fate, weathering and the EMBA (along with other requirements such as time to impact and predicted volumes ashore). Modelling is then used to inform the NEBA and the prioritisation of suitable response options. The scale of the response techniques selected in the pre-operational NEBA is informed through the assessment of results from deterministic modelling.

For the purpose of the ALARP assessment, the following terms and definitions have been used:

- Response techniques are considered the control measures that reduce consequences from hydrocarbon spill events. The terms 'response technique' and 'control measure' are used interchangeably.
- Cost is defined as the time, effort and/or trouble taken in financial, safety, design/storage/installation, capital/lease, and/or operations/maintenance terms to adopt a control measure.

- Where the predicted change to environmental impact is compared against standard environmental values and sensitivities impacts using positive or negative criteria from the NEBA Impact Ranking Classification Guidance in ANNEX A: Net Environmental Benefit Analysis detailed outcomes.

5.1 Monitor and Evaluate (including operational monitoring)

Monitor and evaluate includes the gathering and evaluation of data to inform the oil spill response planning and operations. It includes fate and trajectory modelling, spill tracking, weather updates and field observations. This response option is deployed in some capacity for every event.

The table below provides the operational monitoring plans that support the successful execution of this response technique.

Table 5-1: Description of supporting operational monitoring plans

ID	Title
OM01	Predictive modelling of hydrocarbons to assess resources at risk
OM02	Surveillance and reconnaissance to detect hydrocarbons and resources at risk
OM03	Monitoring of hydrocarbon presence, properties, behaviour and weathering in water
OM04	Pre-emptive assessment of sensitive receptors at risk
OM05	Shoreline assessment

Woodside maintains an *Operational Monitoring Operational Plan*. If shoreline contact is predicted, Response Protection Areas (RPAs) will be identified and assessed before contact. If shorelines are contacted, a shoreline assessment survey will be completed to guide effective shoreline clean-up operations. This plan includes the process for the IMT to mobilise resources depending on the nature and scale of the spill.

The proximity of Karratha/Dampier to the spill event location means that multiple logistical options are available to monitor the spill in relatively short timeframes.

5.1.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which a response need can be based:

- Operational monitoring will be undertaken from the outset of a spill. This is needed to assess the nature of the spill and track its location. The data collected from the operational monitoring will inform the need for any additional operational monitoring, deployment of response techniques and may assist post-spill scientific monitoring. It also informs when the spill has entered State Waters and control of the incident passes to WA DoT.
- Surface hydrocarbons at >10 g/m^2 are predicted to be present in open water within 81 km of GDA05 well (Credible Scenario-01), 19 km of LDA01 well (Credible Scenario-02) and 48 km of the spill site (Credible Scenario-03).
- The shortest timeframes that shoreline contact from floating oil at >100 g/m^2 is predicted to be 17 days at Barrow Island (27 m^3, Credible Scenario-02) and 22.6 days at Pilbara Islands – Southern Island Group (5 m^3, Credible Scenario-01). No shoreline contact is predicted at threshold concentrations for Credible Scenario-03.
- The shortest time to contact for oil at concentrations of entrained hydrocarbons greater than 500 ppb at shoreline receptors is 4.9 days at Montebello State Marine Park (Credible Scenario-01), 15.2 days at Pilbara Island – Southern Island Group (Credible Scenario-02) and up to 354 km from the spill site, with a maximum at Montebello Marine Park,(Credible Scenario-03 – timeframe not available).
- Arrangements for support organisations who provide specialist services or resources should be tested regularly.
- Plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.

- The duration of the spill may be up to 71 days (Credible Scenario-01) and 77 days (Credible Scenario-02) with response operations completing in month 3 for both Credible Scenario-01 and Credible Scenario-02 based on the predicted time to complete shoreline clean-up operations.
- The location, trajectory and fate of the spill will be verified by real-time spill tracking via modelling, direct observation and remote sensing (OM01, OM02, OM03, OM04 and OM05).

5.1.2 Environmental performance based on need

Table 5-2: Environmental Performance – Monitor and Evaluate

Environmental Performance Outcome		To gather information from multiple sources to establish an accurate common operating picture as soon as possible and predict the fate and behaviour of the spill to validate planning assumptions and adjust response plans as appropriate to the scenario.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.12)**
1	Oil spill trajectory modelling	1.1	Initial modelling available within 6 hours using the Rapid Assessment Tool.	1, 3B, 3C, 4
		1.2	Detailed modelling available within 4 hours of APASA receiving information from Woodside.	
		1.3	Detailed modelling service available for the duration of the incident upon contract activation.	
2	Tracking buoy	2.1	Tracking buoy located on facility/vessel and ready for deployment 24/7.	1, 3A, 3C, 4
		2.2	Deploy tracking buoy from facility within 2 hours as per the First Strike Plan.	1, 3A, 3B, 4
		2.3	Contract in place with service provider to allow data from tracking buoy to be received 24/7 and processed.	1, 3B, 3C, 4
		2.4	Data received to be uploaded into Woodside COP daily to improve the accuracy of other monitor and evaluate strategies.	1, 3B, 4
3	Satellite imagery	3.1	Contract in place with 3rd party provider to enable access and analysis of satellite imagery. Imagery source/type requested on activation of service.	1, 3C, 4
		3.2	3rd party provider will confirm availability of an initial acquisition within 2 hours.	1, 3B, 3C, 4
		3.3	First image received with 24 hours of Woodside confirming to 3rd party provider its acceptance of the proposed acquisition plan.	1
		3.4	3rd party provider to submit report to Woodside per image. Report is to include a polygon of any possible or identified slick(s) with metadata.	1
		3.5	Data received to be uploaded into Woodside COP daily to improve accuracy of other monitor and evaluate strategies.	1, 3B, 4
		3.6	Satellite Imagery services available and employed during response.	1, 3C, 4
4	Aerial surveillance	4.1	2 trained aerial observers available to be deployed by day 1 from resource pool.	1, 2, 3B, 3C, 4
		4.2	1 aircraft available for 2 sorties per day, available for the duration of the response from day 1.	1, 3C, 4
		4.3	Observer to compile report during flight as per First Strike plan. Observers report available to the IMT within 2 hours of landing after each sortie.	1, 2, 3B, 4
		4.4	Unmanned Aerial Vehicles/Systems (UAV/UASs) to support Shoreline Clean-up Assessment Technique (SCAT), containment and recovery and surface dispersal and pre-emptive assessments as contingency if required.	1, 2
5	Hydrocarbon detections in water	5.1	Activate 3rd party service provider as per First Strike plan. Deploy resources within 3 days: • 3 specialists in water quality monitoring • 2 monitoring systems and ancillaries • 1 vessel for deploying the monitoring systems with a dedicated winch, A-frame or Hiab and ancillaries to deploy the equipment.	1, 2, 3C, 3D, 4
		5.2	Water monitoring services available and employed during response.	1, 3C, 4
		5.3	Preliminary results of water sample as per contractor's implementation plan within 7 days of receipt of samples at the accredited lab.	
		5.4	Daily fluorometry reports as per service provider's implementation plan will be provided to IMT to validate modelling and monitor presence/absence of entrained hydrocarbons.	
		5.5	Use of Autonomous Underwater Vehicles (AUVs) for hydrocarbon presence and detection may be used as a contingency if the	1, 2, 3C, 4

			operational SIMA confirms conventional methods are unsafe or not possible.	
6	Pre-emptive assessment of sensitive receptors	6.1	10 days prior to any predicted impact, in agreement with WA DoT (for Level 2/3 incidents), deployment of 2 specialists from resource pool in establishing the status of sensitive receptors.	1, 2, 3B, 3C, 4
		6.2	Daily reports provided to IMT on the status of the receptors to prioritise Response Protection Areas (RPAs) and maximise effective utilisation of resources.	1, 3B, 4
7	Shoreline assessment	7.1	10 days prior to any predicted impact, in agreement with WA DoT (for Level 2/3 incidents), deployment of 1 specialist(s) in SCAT from resource pool for each of the Response Protection Areas (RPAs) with predicted impacts	1, 2, 3B, 3C, 4
		7.2	SCAT reports provided to IMT daily detailing the assessed areas to maximise effective utilisation of resources.	1, 3B, 4
		7.3	Shoreline access routes with the least environmental impact identified will be selected by a specialist in SCAT operations.	1

The control measures and capability of Woodside and its third-party service providers are shown to support Monitor and Evaluate activities up to and including the identified WCCS. This is demonstrated by the following:

- Woodside has a documented, structured and tested capability for Monitor and Evaluate operations including internal trajectory modelling capabilities, tracking buoys located offshore and contracted aerial observation platforms with access to trained observers.
- Woodside and its third-party service providers ensure there is sufficient capability for the duration of the response.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.1.
- The health and safety, financial, capital and operations/maintenance costs of implementing the alternative, additional or improved control measures identified and not carried forward are considered clearly disproportionate to the environmental benefit gained and/or not reasonably practicable for this PAP.

The Monitor and Evaluate capability outlined in this section is part of the response developed to manage potential risks and impacts associated with the scenarios to ALARP, and there are no further additional, alternative and improved control measures other than those implemented that would provide further benefit.

5.2 Source control and well intervention

The worst-case credible scenario for a loss of well containment is considered to be loss of well control during drilling operations. This scenario would result in an uncontrolled flow from the well as outlined in the EP. In the event of a loss of well containment, the primary response would be source control and well intervention.

The Woodside *Source Control Response Procedure* includes the process for the IMT to mobilise resources for BOP intervention, Subsea First Response Toolkit (SFRT) support, and capping support. This plan has pre-identified vessel specifications and contracts required for SFRT debris clearance work and Woodside monitors the availability and location of these vessels.

Woodside is a signatory to a MoU between Australian offshore operators to provide mutual aid to facilitate and expedite mobilising a MODU and drilling a relief well, if a loss of well containment incident were to occur. The MoU commits the signatories to share rigs, equipment, personnel and services to assist another operator in need. Moored MODUs are suitable for the GWF3 and Lambert Deep PAPs and have been used as the basis for the analysis within this document.

Source control operations cannot be implemented if the safety of response personnel cannot be guaranteed. Circumstances that limit the safe execution of this control measure include lower explosive limit (LEL) concentrations, volatile concentrations of hydrocarbons in the atmosphere, weather window, waves and/or sea states (>1.5m waves) and high ambient temperatures.

5.2.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which a response need can be based:

- Prior to any source control activities, Woodside will implement protocols to ensure that the site is safe including subsea ROV surveys and surface air monitoring.
- Hydrocarbons will flow from the well until one of the following interventions can be made:
  - closure of the tubing retrievable safety valve (TRSV) if present (only present after installation of the completion)
  - a relief well is drilled and first attempt at well kill within 71 days (Credible Scenario-01) and 77 days (Credible Scenario-02)
  - a capping stack is in place (only feasible for a lower magnitude event with a plume radius of ~25 m).
- Arrangements for support organisations who provide specialist services or resources should be tested regularly.
- Plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.
- The duration of the spill may be up to 71 days (Credible Scenario-01) and 77 days (Credible Scenario-02) with response operations completing in month 3 (Credible Scenario-01 and Credible Scenario-02) based on the predicted time to complete shoreline clean-up operations.

In addition, a number of assumptions are required to estimate the response need for source control. These assumptions have been described in the table below.

Table 5-3: Response Planning Assumptions – Source Control

Response planning assumptions	
Capping stack feasibility	Woodside has developed a project specific capping stack deployment plan and also commissioned an independent, subsea site-specific plume and gas dispersion study for the GWF3 and Lambert Deep wells (WWCI, 2020). . WWCI analysed the plume and reported that with the WCCSs (Credible Scenario-01 and Credible Scenario-02) surface gas boil could extend up to 90 m from the well centre and, hence, conventional vertical deployment is not feasible based on safety grounds. The model was based on a current speed of 0.2 m/s and a wind speed of 3.0 m/s to 6.5 m/s to present the worst case scenario.

	Various options for safe and effective deployment of a capping stack in these conditions were assessed but due to the complex nature of implementation or inability to implement were deemed as not ALARP. These are detailed in Section 6.2.7.1.
Safety considerations	Source control operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site, in accordance with the Woodside Management System (WMS). Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • high winds, waves and/or sea states • high ambient temperatures.
Feasibility considerations	Woodside's primary source control option would be ROV intervention and relief well drilling for the GWF3 and Lambert Deep Drilling and Subsea Installation project. Capping stack may be viable where a loss of well containment of a lower magnitude than the worst case credible scenario occurs with a plume radius is ~25 m. The following approaches outline Woodside's hierarchy for relief well drilling; • Primary relief well – review internal drilling programs and MODU availability to source an appropriate rig operating within Australia with an approved Safety Case; • Alternate relief well – source and contract a MODU through APPEA MOU that is operating within Australia with an approved Safety Case; • Contingency relief well – ~~if required,~~ source and contract a MODU outside Australia with an approved Australian Safety Case

5.2.2 Environmental performance based on need

Table 5-4: Environmental Performance – Source Control

Environmental Performance Outcome		To stop the flow of hydrocarbons into the marine environment.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.12)**
8	Subsea First Response Toolkit (SFRT)	8.1	Oceaneering support staff available all year round, via contract, to assist with the mobilisation, deployment, and operation of the SFRT equipment.	1, 3B, 3C
		8.2	Intervention vessel with minimum requirement of a working class ROV and operator.	1, 3C
		8.3	Mobilised to site for deployment within 11 days.	1, 3B, 3C
		8.4	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
9	Well intervention	9.1	Frame agreements with ROV providers in place to be mobilised upon notification. ROV equipment deployed within 7 days.	1, 3B, 3C
		9.2	Source control vessel will have the following minimum specifications: • active heave compensated crane, rated to at least 120 T • at least 90 m in length • deck has water/electricity supply • deck capacity to hold at least 110 T of capping stack.	1, 3B, 3C
		9.3	Identify source control vessel availability within 24 hours and begin contracting process. Vessel mobilised to site for deployment within 16 days for conventional capping.	1, 3B, 3C
		9.4	ROV available on MODU ready for deployment within 48 hours to attempt initial BOP well intervention.	1, 3B, 3C
		9.5	Staged deployment of multiple BOP SFRTs in the event the first system deployed fails.	1, 3B, 3C
		9.6	Hot Stab and/or well intervention attempt made using ROV and SFRT within 11 days.	1, 3B, 3C
		9.7	Staged deployment of additional capping and well intervention equipment in the event the first system deployed fails.	1, 3B, 3C
		9.8	Capping stack on suitable vessel mobilised to site within 16 days. Deployment and well intervention attempt will be made once plume size is acceptable and safety and metocean conditions are suitable.	1, 3C
		9.9	Wild Well Control Inc (WWCI) staff available all year round to assist with the mobilisation, deployment, and operation of the capping stack and well intervention equipment.	1, 3B, 3C
		9.10	MODU mobilised to site for relief well drilling within 21 days.	1, 3C
		9.11	First well kill attempt completed within 71 days (Credible Scenario-01) and 77 days (Credible Scenario-02).	1, 3B, 3C
		9.12	Open communication line(s) to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
		9.13	Relief Well Peer review undertaken during well design which includes screening and identification of suitable MODU(s) with in-force Australian safety cases for relief well drilling.	1, 3C
		9.14	Monthly monitoring of the availability of MODUs through existing market intelligence including current Safety Case history, to meet specifications for relief well drilling. Titleholders of suitable MODUs notified.	3C
		9.15	At least two communication methods, one of which will include the capability to communicate with aviation.	1, 3A
		9.16	Prior to entering the reservoir, reconfirm that pre-identified/screened MODU(s) remain available for relief well drilling and engage titleholder.	1, 3C
10	Support vessels	10.1	Monthly monitoring of availability of larger vessels through existing Frame Agreements and market intelligence to meet specifications for source control.	3C

		10.2	Frame agreements for Infield Support Vessels (ISVs) require vessels maintain in-force safety case approvals covering ROV operations and provide support in the event of an emergency.	1, 3B, 3C
		10.3	MODU and vessel contracts include clause outlining requirement for support in the event if an emergency	1, 3C
11	Safety case	11.1	Woodside will prioritise MODU or vessel(s) for intervention work(s) that have an existing safety case.	1, 3C
		11.2	Woodside Planning, Logistics, and Safety Officers (on-roster/ call 24/7) to assist in expediting the safety case assessment process as far as practicable.	1, 3C
		11.3	Woodside will maintain minimum safe operating standards that can be provided to MODU and vessel operators for safety case guidance.	1, 3C

The resulting source control capability has been assessed against the WCCS. The range of techniques provide a feasible and viable approach to well intervention and relief well drilling operations to stop the well flowing.

- The health and safety, financial, capital and operations/maintenance costs of implementing the alternative, additional or improved control measures identified and not carried forward are considered clearly disproportionate to the insignificant environmental benefit gained and/or not reasonably practicable for this PAP.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.2.

5.3 Subsea Dispersant Injection

Subsea dispersant injection involves the deployment of a subsea dispersant manifold with associated equipment to inject chemical dispersant directly into the oil plume in the event of a loss of well containment from either the GDA05 or LDA01 wells. As it may take some time to mobilise subsea dispersant equipment, surface dispersants are generally used in the interim to treat oil that makes it to the surface provided appropriate surface concentrations thresholds (>50 g/m^2) are present.

The use of subsea dispersants has similar benefits to surface dispersant application including a potential reduction in the volume of hydrocarbons that reach the shoreline thereby reducing impacts to sensitive receptors. In addition to these benefits, subsea dispersant application may reduce volatile organic compound (VOC) levels during surface response operations, reducing risks and hazards to responders.

The *Subsea Dispersants Operational Plan* details the mobilisation and resource requirements for dispersant operations including the logistics, support and facility arrangements to manage the movement of personnel and resources.

5.3.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which a response need can be based:

- For Credible Scenario-01, the maximum volume of subsea hydrocarbons released is predicted to be approximately 5931 m^3/day for week 1, gradually decreasing to 4731 m^3/day by week 10 or until the well is killed.
- For Credible Scenario-02, the maximum volume of subsea hydrocarbons released is predicted to be approximately 944 m^3/day for week 1, gradually decreasing to 800 m^3/day by week 11 or until the well is killed.
- Ability to treat a large proportion of the daily hydrocarbon release volumes.
- A subsea dispersant injection system with sufficient coiled tubing for water depth.
- Arrangements for support organisations who provide specialist services, including subsea plume monitoring, or resources should be tested regularly.
- Plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.
- The duration of the spill may be up to 71 days (Credible Scenario-01) and 77 days (Credible Scenario-02) with response operations completing in month 3 (Credible Scenario-01 and Credible Scenario-02) based on the predicted time to complete shoreline clean-up operations.

In addition, a number of assumptions are required to estimate the response need for Subsea Dispersant Injection. These assumptions have been described in the table below.

Table 5-5: Response Planning Assumptions – Subsea Dispersant Injection

Response Planning Assumptions	
Safety considerations	Subsea dispersant operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site. Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • high winds, waves and/or sea states • high ambient temperatures.
Technique	**Application parameters [10]**
Subsea Dispersant Injection	The predicted performance range for SSDI is based on; • total rate of subsea released oil available for SSDI • subsea inspection (ROV) observing oil release and technique safe for deployment • dispersant to oil application at 1:60-1:100 (used to determine the volume of dispersant required) • predicted dispersant effectiveness of 50-60% of contacted subsea oil (based upon industry research).
SSDI operation	• 1 x SSDI operation includes: – 1 x suitable ISV (vessel specifications as per Source Control and Well Intervention Plan) – subsea dispersant delivery system – work class ROV with ancillaries and Hydraulic Power Unit (HPU) – dispersant pump – down hole line / coiled tubing – trained ROV operator(s) – trained subsea specialists.
Dispersant delivery (per operation)	• Lower – 60 m^3 per 24 hours • Upper – 75 m^3 per 24 hours

[10] Performance ranges outlined are indicative for response planning purposes. Where actual figures and concentrations exist based on deterministic modelling or laboratory results, these will be used for response and capability planning.

5.3.2 Environmental performance based on need

Table 5-6: Environmental Performance – Subsea Dispersant Injection

<table>
<tr><th colspan="2">Environmental Performance Outcome</th><td colspan="3">To reduce consequences to surface and shoreline receptors and increase the bioavailability of hydrocarbons for microbial breakdown.</td></tr>
<tr><th colspan="2">Control measure</th><th colspan="2">Performance Standard</th><th>Measurement Criteria (Section 5.12)</th></tr>
<tr><td rowspan="5">12</td><td rowspan="5">Subsea spraying</td><td>12.1</td><td>Contract in place to provide Subsea Dispersant equipment resources (via SFRT).</td><td rowspan="2">1, 3B, 3C, 4</td></tr>
<tr><td>12.2</td><td>Oceaneering support staff available all year round, via contract, to assist with the mobilisation, deployment, and operation of the SFRT equipment.</td></tr>
<tr><td>12.3</td><td>Subsea Dispersant vessel will have the following minimum specifications:
• compensated seabed crane up to 36 MT
• mobilised to site for deployment within 12 days.</td><td>1, 3A, 3C, 4</td></tr>
<tr><td>12.4</td><td>Per day dispersant log completed to record quantity of dispersants applied.</td><td>1, 3A, 3B</td></tr>
<tr><td>12.5</td><td>Contract in place with Wild Well Control Inc to provide SSDI and debris clearance equipment and trained personnel.</td><td>1, 3B, 3C, 4</td></tr>
<tr><td rowspan="4">13</td><td rowspan="4">Support vessels</td><td>13.1</td><td>At least two communication methods, one of which will include the capability to communicate with aviation.</td><td>1, 3C, 4</td></tr>
<tr><td>13.2</td><td>Monthly monitoring of the availability of ISVs through existing Frame Agreements and market intelligence to meet specifications for subsea dispersant injection.</td><td>3C, 4</td></tr>
<tr><td>13.3</td><td>Frame agreements for ISVs require vessels to maintain in-force safety case approvals covering ROV operations and provide support in the event of an emergency.</td><td>1, 3B, 3C</td></tr>
<tr><td>13.4</td><td>Monitoring of NOPSEMA's list of registered operators and cross reference against their locations and minimum specifications for SSDI vessels</td><td>1, 3A, 4</td></tr>
<tr><td rowspan="3">14</td><td rowspan="3">Dispersant</td><td>14.1</td><td>Year-round access to 5000m^3 of dispersant located globally which is ready to be mobilised within 24-48 hours under activation of OSRL Global Dispersant Stockpile (GDS) membership.</td><td rowspan="2">1, 3A, 3B, 3C, 3D, 4</td></tr>
<tr><td>14.2</td><td>Year-round access to additional dispersant stockpiles via memberships with OSRL and AMOSC.</td></tr>
<tr><td>14.3</td><td>OSCA approved dispersants prioritised for surface and subsea use</td><td>1, 3A, 3B, 3C, 4</td></tr>
</table>

The resulting subsea dispersant injection capability has been assessed against the WCCS. The maximum volume of subsea hydrocarbons released for Credible Scenario-01 is predicted to be approximately 5931 m^3/day for 71 days when the well is killed. For Credible Scenario-02 the maximum volume of subsea hydrocarbons released is approximately 944 m^3/day for 77 days when the well is killed.

Dispersant efficacy testing has not been undertaken for subsea conditions, but industry experience estimates a subsea amenability to dispersant of approximately 50-60% effectiveness.

The SSDI capability currently available provides the capacity to treat 1,800-4,500 m^3 of subsea hydrocarbons per day with the application of 60-75m^3/day of dispersant. The release rate for Credible Scenario-02 is within this range and, although above this range for Credible Scenario-01, the use of SSDI could reduce predicted quantities of hydrocarbon reaching the surface by 76%. It is therefore considered a primary response technique for the subsea loss of well containment scenarios and the capability is deemed sufficient.

Under optimal conditions, during the subsea release period the capability available meets the need identified and indicates that, the subsea dispersant capability has the following expected performance(s):

- Entrained hydrocarbon concentrations in the water column are predicted to increase at most subsurface receptor locations, with dispersant application from the trapping of treated entrained hydrocarbons at a lower depth (from subsea dispersant application) due to the greatly reduced droplet size and therefore reduced buoyancy.

- The application of subsea dispersant may reduce the maximum local concentrations and maximum accumulated volumes at receptors predicted to be contacted by floating hydrocarbons and may reduce the amount of hydrocarbons reaching the shoreline.
- The scope of the Frame Agreement Vessel Safety Case includes a range of subsea activities that would cover the requirement for SSDI operations such as subsea manifold installation, commissioning, cargo transfer (including bulk liquids), operating as a stable platform for activities including ROV operations, and accommodation support alongside or within the 500m safety zone of an existing facility which may be in production.
- An SSDI vessel can be activated and mobilised within 12 days. Detailed breakdown of this timing is included in Section 6.3. Whilst Woodside will make every endeavour to accelerate the activities to reduce this timeframe, Woodside believes that the timeframe outlined is appropriate and realistic to ensure these activities can be completed reliably.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.3.

5.4 Surface Dispersant Application

Surface dispersant application may reduce surface hydrocarbons and therefore prevent, or reduce the scale of, shoreline contact. Priority would be placed on treating high volume surface hydrocarbons closest to the release location as this is where high surface concentrations are predicted, and dispersant application is expected to achieve the greatest environmental benefit (refer to Annex A).

Weathering of the hydrocarbons would reduce dispersant efficacy. In the event of an ongoing loss of well containment, modelling predicts hydrocarbons reaching the surface may be heavily weathered or spread below effective response thresholds. Surface dispersant application is weather and sea–state dependent. Periods of downtime can be expected.

The *Surface Dispersant Operational Plan* details the mobilisation and resource requirements for dispersant operations including the logistics, support and facility arrangements to manage the movement of personnel and resources.

Deterministic modelling conducted for Credible Scenario-02 predicts that, for the duration of the spill, surface oil concentrations will not meet the 50 g/m^2 minimum concentration threshold required for surface dispersant application operations to be effective. Dispersant is also inappropriate for use on diesel spills. Therefore, the following section addresses a dispersant response for the Credible Scenario-01 loss of well containment scenario only.

5.4.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which response need is based for each scenario:

- Surface hydrocarbons at response threshold (>50 g/m^2 and <15,000 cSt) are predicted to be present in the open water within 9 km of the well as follows:

Area (km^2)	Volume (m^3)	Day
3	175	1
5	366	2
2	162	3
1	55	4
1	54	5
1	58	6
2	145	7
2	111	18
1	59	27
1	51	30
1	75	32

- Surface volume and area peak at 366 m^3 and 5 km^2 respectively on day 2.
- The duration of the Credible Scenario-01 spill may extend up to 71 days with response operations extending to month 3 based on the predicted time to complete shoreline clean-up operations.
- Arrangements for support organisations who provide specialist services (dispersant spray aircraft, logistics services for mobilising dispersant and Air Attack Supervisors) or resources (dispersants and transfer pumping systems) and should be tested regularly.
- Plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.
- Defined Zone of Application (ZoA) to reduce environmental consequences on subsea receptors
- In addition, a number of assumptions are required to estimate the response need for Surface Dispersant Application. These assumptions have been described in the table below.

Table 5-7: Response Planning Assumptions – Surface Dispersant Application

Response Planning Assumptions		
Safety considerations	Surface dispersant operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site. Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • high winds, waves and/or sea states • high ambient temperatures.	
Technique	**Predicted performance range[11]** (% of surface oil volume available predicted to be treated by response technique)	
Surface Dispersant Application (Combined vessel and aircraft)	Lower	9% (1:25 DOR x 78.85% effectiveness x 50% encounter rate)
	Upper	12% (1:20 DOR x 80.25% effectiveness x 75% encounter rate)
	The predicted performance range for SDA is based on: • remaining surface oil available for SDA following weathering, • operational monitoring observing surface oil at minimum BAOAC 4 (discontinuous true oil colour) or BAOAC 5 (continuous true oil colour), • safe for deployment, within range of vessels and aircraft, • dispersant to oil application at 1:20-1:25 (based on uniform surface oil 100g/m^2 and 50 litres/hectare application rate) allows for 3-4 km^2 per aircraft per day, • predicted dispersant effectiveness of 9-12 % for contacted surface oil, and • spraying encounter rate of approximately 50-75% (50-25% of dispersant sprayed does not contact surface oil)	
Dispersant to Oil Ratio (DOR)	• Lower – 1:20 (at 100 g/m^2) • Upper – 1:25 (at 100 g/m^2)	

Physical properties	**<u>Surface Threshold</u>**
	• Lower – 50g/m^2 (equates to 100g/m^2 with approx. 50% coverage and/or 200g/m^2 with approx. 25% coverage)
	    • BAOAC 4 – discontinuous true oil colour - lower threshold 50g/m^2
	• Optimum – 100g/m^2 (equates to >100g/m^2 with approx. 100% coverage and/or 200g/m^2 with approx. 50% coverage)
	    • BAOAC 5 – Continuous true oil colour – lower threshold 200 g/m^2
	<u>Viscosity</u>
	• Optimum – <5,000 cSt at sea surface temperature
	• Upper – 15,000 cSt at sea surface temperature	

Dispersant Effectiveness	Dispersant testing on NWS Condensate (analogue used for GWF3 Condensate) indicates that average dispersant efficiency (%) for oil age will be; • 80.25% (0 hrs) • 78.75% (24hrs) • 100% (72hrs) • 100% (>240 hrs) This data is based on a range of weathering results and five (5) National Plan OSCA approved an/or transitional dispersants that will be the selected dispersant used by Woodside.	

[11] Performance ranges outlined above are indicative for response planning purposes. Where actual figures and concentrations exist based on deterministic modelling or laboratory results, these will be used for response and capability planning.

5.4.2 Environmental performance based on need

Table 5-8: Environmental Performance - Surface Dispersant Application

Environmental Performance Outcome		To reduce consequences to surface and shoreline receptors and increase the bioavailability of hydrocarbons for microbial breakdown.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.12)**
15	Aerial spraying	15.1	1 aircraft with minimum payload of 1850 litre mobilised to site within 4 hours of activation. 1 additional aircraft mobilised to site within another 20 hours of activation. 4 additional aircraft mobilised to site within 48 hours of activation.	1, 3B, 3C, 4
		15.2	1 high capacity aircraft with minimum payload of 10 m^3 available to spray on day 2.	
		15.3	Fixed Wing Aerial Dispersant Contract (FWADC) to complete a minimum of 2 sorties per day and high capacity aircraft to complete a minimum of 2 sorties per day	1
		15.4	Per sortie spray log completed to record where dispersants were applied	1, 3A, 3B
16	Vessel spraying	16.1	2 offtake support vessels from integrated fleet will undertake dispersant trials within 48 hours of the release as per first strike plan.	1, 3A, 3B, 3C, 4
		16.2	2 offtake support vessels will be available for deployment to spray dispersant for the duration of the response.	3A, 3C, 4
		16.3	Up to 2 vessels spraying per day by day 2.	1, 3C
		16.4	Per day spray log completed to record where dispersants were applied	1, 3A, 3B
17	Dispersant	17.1	Year-round access to 5000m^3 of dispersant located globally which is ready to be mobilised on activation of GDS membership within 24-48 hours.	1, 3A, 3B, 3C, 3D, 4
		17.2	Year-round access to additional dispersant stockpiles via memberships with OSRL and AMOSC.	
		17.3	OSCA approved dispersants prioritised for surface and subsea use	1, 3A, 3B, 3C, 4
		17.4	Only apply surface dispersants within the Zone of Application and on BAOAC 4 and 5	
		17.5	Continuous monitoring of dispersed oil plume and visual monitoring of effectiveness	

The resulting surface dispersant response capability following ALARP evaluation has been assessed against the WCCS and surface release scenario.

- Surface concentration, viscosity and mass vary for each time step based on spreading and weathering algorithms from the deterministic modelling results. Woodside has reviewed the deterministic modelling data based to determine the response need and required capability for surface dispersant application as a response technique.
- For Credible Scenario-01, deterministic modelling predicts that volume and surface area at threshold concentration peak at 366 m^3 and 5 km^2 respectively on day 2 for treatment by vessel and aerial dispersant operations. Woodside's existing capability is sufficient to treat the expected surface hydrocarbons from day 2-3 and throughout the incident.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.4.

5.5 Containment and Recovery

Containment and recover is used to reduce damage to sensitive resources by the physical containment and mechanical removal of hydrocarbons from the marine environment. It has a lower capacity for removing surface oil than the application of dispersant but avoids potential additional impacts created by the resulting increase in entrained hydrocarbons in the water column.

Weathering and spreading of hydrocarbons will significantly reduce containment and recovery effectiveness. In the event of an ongoing loss of well containment, modelling predicts fresh hydrocarbons reaching the surface may be heavily weathered and present in small discrete patches. Containment and recovery is also weather and sea-state dependent. Periods of downtime can be expected.

The conditions in the vicinity of the PAP are expected to exceed wind speeds equivalent to Beaufort Sea-state 3 for approximately 90% of the year during the PAP (APASA modelling input data). Therefore, it is expected that open water containment and recovery operations would not, in general, be an effective response technique. However, containment and recovery may be available for deployment nearshore and/or when the weather window permits, and priority would be given to being prepared to deploy units if the required conditions are met.

The *Containment and Recovery Operational Plan* details the mobilisation and resource requirements for response operations including the logistics, support and facility arrangements to manage the movement of personnel and resources.

Deterministic modelling conducted for Credible Scenario-02 predicts that, for the duration of the spill, surface oil concentrations will not meet the 50 g/m^2 minimum concentration threshold required for effective containment and recovery operations to be effective. Containment and recovery is also inappropriate for use on diesel spills. Therefore, the following section addresses a dispersant response for the Credible Scenario-01 loss of well containment scenario only.

5.5.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which response need is based:

- Surface hydrocarbons at response threshold (>50 g/m^2) available for containment and recovery operations are predicted to be present in the open water within 9 km of the well as follows:

Area (km^2)	Volume (m^3)	Day
3	175	1
5	366	2
2	162	3
1	55	4
1	54	5
1	58	6
2	145	7
2	111	18
1	59	27
1	51	30
1	75	32

- Surface volume and area peak at 366 m^3 and 5 km^2 respectively on day 2.
- The duration of the Credible Scenario-01 spill may extend up to 71 days with offshore response operations extending to month 2 (at times when surface hydrocarbons are at recoverable threshold concentrations) and shoreline response operations extending up to month 3 based on the predicted time to complete shoreline clean-up operations.
- Arrangements for support organisations who provide specialist services (logistics services for mobilising equipment, trained Offshore Supervisors and waste disposal) and/or resources

(vessels, containment and recovery equipment, transfer pumping systems) should be tested regularly.

- Plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.

In addition, a number of assumptions are required to estimate the response need for Containment and Recovery. These assumptions have been described in the table below.

Table 5-9: Response Planning Assumptions – Containment and Recovery

<table>
<tr><th colspan="3">Response Planning Assumptions</th></tr>
<tr><th>Technique</th><th colspan="2">Predicted performance range
(% of surface oil volume available predicted to be recovered by response technique)</th></tr>
<tr><td rowspan="3">Containment and recovery</td><td>Lower</td><td>5%</td></tr>
<tr><td>Upper</td><td>10%</td></tr>
<tr><td colspan="2">The predicted performance range for containment and recovery is based on:
• remaining surface oil available for containment and recovery following weathering,
• Monitor and evaluate operations observing surface oil at minimum BAOAC 4 (discontinuous true oil colour) or BAOAC 5 (continuous true oil colour)
• safe for deployment, within range of vessels and aircraft,
• encounter rate of approximately 50-75% (50-25% of surface coverage is not surface oil)</td></tr>
<tr><th colspan="3">Response Capability details</th></tr>
<tr><td>Containment and recovery operation</td><td colspan="2">• 1 x containment and recovery operation includes:
– 2 x suitable vessels (vessel specifications as per Marine Operations Plan)
– 1 x boom system (minimum 800 mm overall height and approximately 200 m length) with all required ancillaries)
or
– 1 x suitable vessel (vessel specifications as per Marine Operations Plan)
– 1 x single ship system (minimum 800 mm overall height and approximately 200 m length) with all required ancillaries)
and
– 1 x skimmer (min 20 m^3 / hr) with all required ancillaries
– 1-2 x trained supervisor per operation
• 8-10 x support personnel per operation</td></tr>
<tr><td>Physical properties</td><td colspan="2"><u>Surface Threshold</u>
• Lower – 50 g/m^2 (equates to 100 g/m^2 with approx. 50% coverage and/or 200 g/m^2 with approx. 25% coverage)
– BAOAC 4 – Discontinuous true oil colour - lower threshold 50 g/m^2
• Optimum – 100 g/m^2 (equates to >100 g/m^2 with approx. 100% coverage and/or 200 g/m^2 with approx. 50% coverage)
– BAOAC 5 – Continuous true oil colour – lower threshold 200 g/m^2</td></tr>
</table>

Expected effectiveness	• 1 containment and recovery operation is expected to be able to contain and recover approx. 22.5 – 67.5 m^3 per day (10hr operation) includes one (1) change out of temporary waste storage equipment (if required) • Based on the following assumptions; – Boom system with 70 m opening = 0.07 km – Vessel moving at 0.7 kn = 1.3 km/h – Area covered per hour = 0.07 km x 1.3 km = 0.09 km^2 – Area covered per day = 0.09 km^2 x 10 hours = 0.9 km^2 / day – Recovery per day (low) = 0.9 km^2 x 50 g/m^2 x 50% coverage = 22.5 m^3 / 10-hour day – Recovery per day (high) = 0.9 km^2 x 100 g/m^2 x 75% = 67.5 m^3 / 10-hour day Increased surface oil concentration may result in increased recovery capacity providing other conditions and oil properties remain suitable for containment and recovery. For planning purposes, conservative concentrations outlined above have been used.

5.5.2 Environmental performance based on need

Table 5-10: Environmental Performance – Containment and Recovery

Environmental Performance Outcome		To reduce consequences to surface and shoreline receptors.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.12)**
18	Vessel-based recovery systems	18.1	Woodside maintains an integrated fleet of vessels, including vessels with at least 10t bollard pull. Additional vessels can be sourced through existing contracts/frame agreements	1, 3A, 3B, 3C, 4
		18.2	1 containment and recovery operations would be deployed by day 1.	
		18.3	4 additional containment and recovery operations using 3rd party provider resources would be deployed by day 10.	
		18.4	Each operation will have internal or added 100 m^3 of liquid waste storage onboard.	
		18.5	Decanting in accordance with National Plan guidelines to occur in daylight hours into the apex of the boom once hydrocarbons/water has settled in storage container.	1, 3A, 3C, 4
		18.6	Contract with waste management services for transport, removal, treatment and disposal of waste	
		18.7	Recovered hydrocarbons and wastes will be transferred to Dampier for reprocessing or disposal	
		18.8	Waste management services available and employed during response	
19	Response teams	19.1	Deployment of 4 containment and recovery teams would be available by day 4 and 6 containment and recovery teams available by day 5.	1, 2, 3A, 3B, 3C, 4
		19.2	Deployment team will be comprised of: • 1-2 trained specialists per operation • 8-10 personnel for support • Personnel sourced through resource pool	1, 2, 3B, 4
		19.3	Teams will segregate liquid and solid wastes at the earliest opportunity.	
		19.4	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s)	1, 3A, 3B
20	Response systems	20.1	Rapid sweep systems and active boom systems to be prioritised for mobilisation in the event of a response.	1, 3C
21	Management of Environmental	21.1	The boom will be monitored and maintained to ensure trapped fauna are released as early as possible, with containment and recovery activities occurring in daylight hours only.	1

	Impact of the response risks	21.2	If vessels are required for access, anchoring locations will be selected to minimise disturbance to benthic primary producer habitats. Where existing fixed anchoring points are not available, locations will be selected to minimise impact to nearshore benthic environments with a preference for areas of sandy seabed where they can be identified.	

Woodside has assessed the resulting containment and recovery capability against the WCCS.

- Surface concentration and mass vary for each time step based on spreading and weathering algorithms within the model. Woodside has reviewed the deterministic modelling data based on the response planning assumptions outlined above to determine the response need and required capability.
- For Credible Scenario-01, deterministic modelling predicts that volume and surface area at threshold concentration peak at 366 m^3 and 5 km^2 respectively on day 2 for treatment by containment and recovery operations. Woodside's existing capability would not be sufficient to recover all expected surface hydrocarbons however earliest shoreline impact for Credible Scenario-01 is predicted to be week 4 allowing adequate time to source additional resources from third party service providers if required.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.5.

5.6 Shoreline Protection and Deflection

The placement of containment, protection or deflection booms on and near a shoreline is a response technique to reduce the potential volume of hydrocarbons contacting or spreading along shorelines, which may reduce the scale of shoreline clean-up. Hydrocarbons contained by the booms would be collected where practicable.

Shorelines would be protected where accessible via vessel or shore. Where hydrocarbon contact has already occurred, there may still be value in deploying protection equipment to limit further accumulations and preventing remobilisation of stranded hydrocarbons.

Shoreline protection and deflection equipment would be mobilised to selected locations, where the following conditions were met:

- Sea-states and hydrocarbon characteristics permit safe deployment of protection and deflection measures.
- Oil trajectory has been identified as heading towards identified RPAs.

5.6.1 Response need based on predicted consequence parameters

GWF3 loss of well containment (Credible Scenario-01)

The following statements identify the key parameters upon which the response need can be based:

- The shortest timeframe that shoreline contact from floating oil above threshold is predicted to be 22.6 days at Pilbara Islands – Southern Group (5 m^3).
- Pre-emptive assessment and shoreline assessments (OM04 and OM05) will be mobilised prior to shoreline contact which is predicted to occur on day 22.6 at Pilbara Islands – Southern Group (5 m^3).
- The duration of the spill may be up to 71 days with response operations extending up to month 3 based on the predicted time to complete shoreline clean-up operations.

Lambert Deep loss of well containment (Credible Scenario-02)

The following statements identify the key parameters upon which a response need can be based:

- The shortest timeframe that shoreline contact from floating oil is predicted to be 17 days at Barrow Island (27 m^3).
- Pre-emptive assessment and shoreline assessments (OM04 and OM05) will be mobilised prior to shoreline contact which is predicted to occur on day 17 at Barrow Island (27 m^3).
- The duration of the spill may be up to 77 days with response operations extending up to month 3 based on the predicted time to complete shoreline clean-up operations.

Marine diesel spill caused by vessel collision (Credible Scenario-03)

- There is no shoreline impact predicted at response threshold of >100 g/m^2. The maximum shoreline concentration is 9.8 g/m^2.

All scenarios

- Predictive modelling (OM01), direct observation/surveillance (OM02) and, where appropriate, hydrocarbon detection in water (OM03), will be employed from the outset of a spill to track the oil, assess where and when appropriate response techniques can be deployed and to identify when the spill enters State Waters. When RPAs at threat of impact can be accurately deduced, this will trigger the undertaking of pre-emptive assessments of sensitive receptors at risk (OM04), to direct any protection and deflection operations. OM04 would be undertaken in liaison with WA DoT (if a Level 2/3 incident and within State Waters).
- Following pre-emptive assessments of sensitive receptors at risk, and in agreement of prioritisation with WA DoT (if a Level 2/3 incident and within State Waters), protection and deflection operations would commence until agreed termination criteria are reached.

- Arrangements for support organisations who provide specialist services (trained personnel, protection and deflection equipment) and/or resources should be tested regularly; and
- TRPs for RPAs along with other relevant plans, procedures and support documents need to be in place for Operational and Support functions. These should be reviewed and updated regularly.

In addition, a number of assumptions are required to estimate the response need for Shoreline Protection and Deflection. These assumptions have been described in the table below.

Table 5-11: Response Planning Assumptions – Shoreline Protection and Deflection

Response Planning Assumptions	
Safety considerations	Shoreline protection and deflection operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site. Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • safe for deployment and conditions within range of vessels • high ambient temperatures.
Shoreline Protection and Deflection	• 1 x Shoreline Protection and Deflection operation may include; – Quantity of shoreline sealing boom (as outlined in TRP) – Quantity of fence or curtain boom (as outlined in TRP) – 1-2 x trained supervisors – 8-10 x personnel / labour hire Specific details of each operation would be tailored to the TRP implemented (where available).

5.6.2 Environmental performance based on need

Table 5-12: Environmental Performance – Shoreline Protection and Deflection

Environmental Performance Outcome		To stop hydrocarbons encountering particularly sensitive areas		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.12)**
22	Response teams	22.1	In liaison with WA DoT (for Level 2/3 incidents), relevant Tactical Response Plans (TRPs) will be identified in the First Strike plan for activation 5 days prior to a predicted impact.	1, 3A, 3C, 4
		22.2	In liaison with WA DoT (for Level 2/3 incidents), mobilise teams to RPAs 5 days prior to predicted impact. Teams to contaminated RPAs comprised of: • 1-2 trained specialists per operation • 8-10 personnel/labour hire • Personnel sourced through resource pool.	1, 2, 3B, 3C, 4
		22.3	In liaison with WA DoT (for Level 2/3 incidents), 1 operation mobilised 5 days prior to predicted impact for each identified RPA. Expected to be 1 RPA within 17 days (operation as detailed above) for Credible Scenario-02 and 1 RPA within 22.6 days for Credible Scenario-01.	1, 3A, 3B, 4
		22.4	12 trained personnel available (2 supervisors plus 10 additional personnel) 5 days prior to predicted impact for each identified RPA. Sourced through resource pool.	1, 2, 3A, 3B, 3C, 4
		22.5	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
		22.6	The safety of shoreline response operations will be considered and appropriately managed. During shoreline operations: • All personnel in a response will receive an operational/safety briefing before commencing operations • Gas monitoring and site entry protocols will be used to assess safety of an operational area before allowing access to response personnel.	1, 3B, 4
23	Response equipment	23.1	Equipment mobilised from closest stockpile 5 days prior to predicted impact.	1, 3A, 3C, 4
		23.2	Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles 5 days prior to predicted impact.	1, 3C, 3D, 4
		23.3	Supplementary equipment mobilised from OSRL 5 days prior to predicted impact.	
		23.4	Woodside maintains integrated fleet of vessels. Additional vessels can be sourced through existing contracts/frame agreements	1, 3A, 3C, 4
24	Management of Environmental Impact of the response risks	24.1	If vessels are required for access, anchoring locations will be selected to minimise disturbance to benthic primary producer habitats. Where existing fixed anchoring points are not available, locations will be selected to minimise impact to nearshore benthic environments with a preference for areas of sandy seabed where they can be identified.	1
		24.2	Shallow draft vessels will be used to access remote shorelines to minimise the impacts associated with seabed disturbance on approach to the shorelines.	

The resulting shoreline protection and deflection capability has been assessed against the WCCS. The range of techniques provide an ongoing approach to shoreline protection and deflection at identified RPAs.

Under optimal conditions, during the subsea and surface releases the capability available exceeds the need identified. It indicates that the shoreline protection and deflection capability have the following expected performance:

- Existing capability allows for mobilisation and deployment of shoreline protection operations by day 2 (if required). Given that no shoreline contact is predicted at threshold (>100 g/m^2) until day 17 (Credible Scenario-02) and day 22.6 (Credible Scenario-01), the existing capability is considered sufficient to mobilise and deploy protection at RPAs prior to hydrocarbon contact, guided by the ongoing operational monitoring.
- TRPs have been developed for identified RPAs that are predicted to be impacted except in international locations.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.6.

5.7 Shoreline Clean-up

Shoreline clean-up may be undertaken using a broad range of techniques when floating hydrocarbons contact shorelines. The timing, location and extent of shoreline clean-up activities can vary from one scenario to another, depending on the hydrocarbon type, sensitivities and values contacted, shoreline type and access, degree of oiling, and area oiled.

Shoreline clean-up is typically undertaken as a three-phase process:

- Phase one (gross contamination removal) involving the collection of bulk oil, either floating against the shoreline or stranded on it.
- Phase two (moderate to heavy contamination removal) involving removal or in-situ treatment of shoreline substrates such as sand or pebble beaches.
- Phase three (final treatment or polishing) involving removal of the remaining residues of oil.

As phase one typically involves recovery of floating and pooled oil, and phase three removes minor volumes, they have not been considered in the assessment of response need for the scenarios identified.

The *Shoreline Cleanup Operational Plan* details the mobilisation and resource requirements for a shoreline clean-up operation including the logistics, support and facility arrangements to manage the movement of personnel and resources. It includes the process for the IMT to mobilise resources depending on the nature and scale of the spill. Woodside would activate and mobilise trained and competent personnel in shoreline assessment before or following shoreline contact at response thresholds.

Shoreline clean-up consists of different manual and mechanical recovery techniques to remove hydrocarbons and contaminated debris from a shoreline; this is to minimise ongoing environmental contamination and impact. The National Plan also provides guidance on shoreline clean-up techniques as outlined in National Plan Guidance *Response, assessment and termination of cleaning for oil contaminated foreshores* (AMSA 2015).

5.7.1 Response need based on predicted consequence parameters

GWF3 loss of well containment (Credible Scenario-01)

The following statements identify the key parameters upon which the response need can be based:

- The shortest timeframe that shoreline contact from floating oil above threshold is predicted to be 22.6 days at Pilbara Islands – Southern Group (5 m^3).
- Pre-emptive assessment and shoreline assessments (OM04 and OM05) will be mobilised prior to shoreline contact which is predicted to occur on day 22.6 at Pilbara Islands – Southern Group (5 m^3).
- The duration of the spill may be up to 71 days with response operations extending up to month 3 based on the predicted time to complete shoreline clean-up operations.

Lambert Deep loss of well containment (Credible Scenario-02)

The following statements identify the key parameters upon which a response need can be based:

- The shortest timeframe that shoreline contact from floating oil is predicted to be 17 days at Barrow Island (27 m^3).
- Pre-emptive assessment and shoreline assessments (OM04 and OM05) will be mobilised prior to shoreline contact which is predicted to occur on day 17 at Barrow Island (27 m^3).
- The duration of the spill may be up to 77 days with response operations extending up to month 3 based on the predicted time to complete shoreline clean-up operations.

Marine diesel spill caused by vessel collision (Credible Scenario-03)

- There is no shoreline impact predicted at response threshold of >100 g/m^2. The maximum shoreline threshold is 9.8 g/m^2.

All scenarios

- Predictive modelling (OM01), direct observation/surveillance (OM02) and, where appropriate, hydrocarbon detection in water (OM03), will be employed from the outset of a spill to track the oil, assess where and when appropriate response techniques can be deployed and when the spill enters State Waters. When RPAs at threat of impact can be accurately deduced, this will trigger the undertaking of pre-emptive assessments of sensitive receptors at risk (OM04) and, subsequently, shoreline assessments (OM05) to establish the extent and distribution of oiling and thus direct any shoreline clean-up operations. OM04 and OM05 would be undertaken in liaison with WA DoT (if a Level 2/3 incident and within State Waters).
- Following Shoreline Assessment, and agreement of prioritisation with WA DoT (if a Level 2/3 event), clean-up operations would commence until agreed termination criteria are reached.
- Prior to predicted impact, and in line with the relevant TRP and in agreement with WA DoT (if a Level 2/3 event), rubbish removal and segregation will be undertaken along the shoreline to minimise additional oiled waste volumes.
- Arrangements for support organisations who provide specialist services (trained personnel, labour hire, shoreline clean-up, and site management equipment) and/or resources and should be tested regularly.
- TRPs for RPAs along with other relevant plans, procedures and support documents should be in developed and in place for Operational and Support functions. These should be reviewed and updated regularly.

In addition, a number of assumptions are required to estimate the response need for shoreline clean-up. These assumptions have been described in the table below.

Table 5-13: Response Planning Assumptions – Shoreline Clean-up

Response planning assumptions: Shoreline clean-up	
Safety considerations	Shoreline clean-up operations cannot be implemented if the safety of response personnel cannot be guaranteed. This requires an initial and ongoing risk assessment of health and safety hazards and risks at the site. Personnel safety issues may include: • hydrocarbon gas and/or liquid exposure • waves and/or sea states, tidal cycle and intertidal zone limits • presence of wildlife • high ambient temperatures.
Manual shoreline clean-up operation (Phase 2)	1 x manual shoreline clean-up operation (Phase 2) may include: • 1–2 x trained supervisor • 8–10 x personnel/labour hire • Supporting equipment for manual clean-up including rakes, shovels, buckets, plastic bags etc.
Physical properties	<u>**Surface Threshold for Response Planning**</u> • Lower – 100 g/m^2 – 100% coverage of 'stain' – cannot be scratched off easily on coarse sediments or bedrock • Optimum – 250 g/m^2 – 25% coverage of 'coat' – can be scratched off with a fingernail on coarse sediments In the event of a real incident, operational monitoring will be undertaken from the outset of a spill whether or not these thresholds have been reached.
Efficiency **(m^3 oil recovered per person per day)**	Manual shoreline clean-up (Phase 2) – approximately 0.25–1 m^3 oil recovered per person per 10 hr day is based on moderate to high coverage of oil (100 g/m^2–1,000 g/m^2) with manual removal using shovels/rakes, etc. from studies of previous response operations and exercises.

Table 5-14: Shoreline Clean-up techniques and recommendations

Technique	Description	Shoreline type		Application
		Recommended	Not recommended	
Natural recovery	Allowing shoreline to self-clean; no intervention undertaken.	Remote and inaccessible shorelines for personnel, vehicles and machinery. Other clean-up techniques may cause more damage than allowing the shoreline to naturally recover. Natural recovery may be recommended for areas with mangroves and coral reefs due to their sensitivity to disturbance from other shoreline clean-up techniques. High-energy shorelines: where natural removal rates are high, and hydrocarbons will be removed over a short timeframe.	Low-energy shorelines: these areas tend to be where hydrocarbon accumulates and penetrates soil and substrates.	May be employed, if the operational NEBA identifies that other clean-up techniques will have a negligible or negative environmental impact on the shoreline. May also be used for buried or reworked hydrocarbons where other techniques may not recover these.
Manual recovery	Use of manpower to collect hydrocarbons from the shoreline. Use of this form of clean-up is based on type of shoreline.	Areas where shorelines may not be accessible by vehicles or machinery and personnel can recover hydrocarbons manually. Where hydrocarbons have formed semi-solid to solid masses that can be picked up manually. Areas where nesting and breeding fauna cannot or should not be disturbed.	Coral reef or other sensitive intertidal habitats, as the presence of a response may cause more environmental damage then allowing them to recover naturally. For some high-energy shorelines such as cliffs and sea walls, manual recovery may not be recommended as it may pose a safety threat to responders.	May be used for sandy shorelines. Buried hydrocarbons may be recovered using shovels into small carry waste bags, but where possible the shoreline should be left to naturally recover to prevent any further burying of hydrocarbons (from general clean-up activities).
Sorbents	Sorbent boom or pads used to recover fluid or sticky hydrocarbons. Can also be used after manual clean-up to remove any residues from crevices or from vegetation.	When hydrocarbons are free-floating close to shore or stranded onshore. As a secondary treatment method after hydrocarbon removal and in sensitive areas where access is restricted.	Access for deploying and retrieving sorbents should not be through soft or sensitive habitats or affect wildlife.	Used for rocky shorelines. Sorbent boom will allow for deployment from small shallow draught vessels, which will allow deployment close to shore where water is sheltered and to aid recovery. Sorbents will create more solid waste compared with manual clean-up, so will be limited to clean rocky shorelines.

Technique	Description	Shoreline type		Application
		Recommended	Not recommended	
Vacuum recovery, flushing, washing	The use of high volumes of low-pressure water, pumping and/or vacuuming to remove floating hydrocarbons accumulated at shorelines.	Suited to rocky or pebble shores where flushing can remobilise hydrocarbons (to be broken up) and aid natural recovery. Any accessible shoreline type from land or water. May be mounted on barges for water-based operations, on trucks driven to the recovery area, or hand-carried to remote sites. Flushing and vacuum may be useful for rocky substrate. Medium- to high-energy shorelines where natural removal rates are moderate to high. Where flushed hydrocarbons can be recovered to prevent further oiling of shorelines.	Areas of pooled light, fresh hydrocarbons may not be recoverable via vacuum due to fire and explosion risks. Shorelines with limited access. Flushing and washing not recommended for loose sediments. High-energy shorelines where access is restricted.	High volume low pressure (HVLP) flushing and washing into a sorbent boom could be used for rocky substrate, if protection booming has been unsuccessful in deflecting hydrocarbons from these areas.
Sediment reworking	Movement of sediment to surf to allow hydrocarbons to be removed from the sediment and move sand via heavy machinery.	When hydrocarbons have penetrated below the surface. Recommended for pebble/cobble shoreline types. Medium- to high-energy shorelines where natural removal rates are moderate to high.	Low-energy shorelines as the movement of substrate will not accelerate the natural cleaning process. Areas used by fauna which could potentially be affected by remobilised hydrocarbons.	Use of wave action to clean sediment: appropriate for sandy beaches where light machinery is accessible.
Vegetation cutting	Cutting vegetation to prevent oiling and reduce volume of waste and debris.	Vegetation cutting may be recommended to reduce the potential for wildlife being oiled. Where oiling is restricted to fringing vegetation.	Access in bird-nesting areas should be restricted during nesting seasons. Areas of slow-growing vegetation.	May be used on shorelines where vegetation can be safely cleared to reduce oiling.
Cleaning agents (National Plan registered Oil Spill Cleaning Agent – ‘OSCA’)	Application of chemicals such as dispersants to remove hydrocarbons.	May be used for manmade structures and where public safety may be a concern.	Natural substrates and in low-energy environments where sufficient mixing energy is not present.	Not recommended for shorelines. Could be used for manmade structures such as boat ramps.

5.7.2 Environmental performance based on need

Table 5-15: Environmental Performance – Shoreline Clean-up

Environmental Performance Outcome		To remove bulk and stranded hydrocarbons from shorelines and facilitate shoreline amenity habitat recovery.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.12)**
25	Shoreline responders	25.1	In liaison with WA DoT (for Level 2/3 incidents), deployment of 1 shoreline clean-up team to each contaminated RPA comprised of: • 1-2 trained specialists per operation • 8-10 personnel/labour hire • Personnel sourced through resource pool 5 days prior to predicted impact upon request from the IMT.	1, 2, 3A, 3B, 3C, 4
		25.2	Relevant TRPs will be identified in the first strike plan for activation 5 days prior to operational monitoring predicting impacts.	1, 3A, 3C, 4
		25.3	Relevant TRPs available for shoreline contacted 5 days prior to operational monitoring predicting impacts.	1, 3A, 3C, 4
		25.4	Clean-up operations for shorelines in line with results and recommendations from SCAT outputs.	1, 3A, 3B
		25.5	All shorelines zoned and marked before clean-up operations commence to prevent secondary contamination and minimise the mixing of clean and oiled sediment and shoreline substrates.	
		25.6	In liaison with WA DoT (for Level 2/3 incidents), mobilise and deploy 1 shoreline clean-up operation to each site where operational monitoring predicts an accumulation 5 days prior to impact.	1, 2, 3A, 3C, 4
		25.7	The safety of shoreline response operations will be considered and appropriately managed. During shoreline clean-up operations: • All personnel in a response will receive an operational/safety briefing before commencing operations • Gas monitoring and site entry protocols will be used to assess safety of an operational area before allowing access to response personnel	1, 3B, 4
		25.8	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
26	Waste Management	26.1	Contract with waste management services for transport, removal, treatment and disposal of waste.	1, 3A, 3B, 3C, 4
		26.2	Access to 180 m^3 waste storage capacity by week 4.	
		26.3	Waste management services available and employed during response.	
27	Shoreline clean-up equipment	27.1	Contract in place with 3rd party providers to access equipment.	1, 3A, 3C, 4
		27.2	Equipment mobilised from closest stockpile 5 days prior to predicted impact.	
		27.3	Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles 5 days prior to predicted impact.	1, 3C, 3D, 4
		27.4	Supplementary equipment mobilised from OSRL 5 days prior to predicted impact.	
28	Management of Environmental Impact of the	28.1	If vessels are required for access, anchoring locations will be selected to minimise disturbance to benthic primary producer habitats. Where existing fixed anchoring points are not available, locations will be selected to minimise impact to	1

	response risks		nearshore benthic environments with a preference for areas of sandy seabed where they can be identified.	
		28.2	Shallow draft vessels will be used to access remote shorelines to minimise the impacts associated with seabed disturbance on approach to the shorelines.	
		28.3	Vehicular access will be restricted on dunes, turtle nesting beaches an in mangroves.	
		28.4	Shoreline access route (foot, car, vessel and helicopter) with the least environmental impact identified will be selected by a specialist in SCAT operations.	
		28.5	Removal of vegetation will be limited to moderately or heavily oiled vegetation.	
		28.6	Oversight by trained personnel who are aware of the risks.	
		28.7	Trained unit leaders brief personnel prior to operations of the environmental risks of presence of personnel on the shoreline.	

The resulting shoreline clean-up capability has been assessed against the WCCS. The range of techniques provide an ongoing approach to shoreline clean-up at identified RPAs. Woodside's capability can cover all required shoreline clean-up operations for the PAP and thus meets the need identified for this activity. The shoreline clean-up capability has the following expected performance (if required during a response):

- Existing capability allows for mobilisation and deployment of shoreline clean-up operations by day 2 (if required). Given that no shoreline contact is predicted at threshold (>100 g/m^2) until day 17 (Credible Scenario-02) and day 22.6 (Credible Scenario-01), the existing capability is considered sufficient to mobilise and deploy protection at RPAs prior to hydrocarbon contact, guided by the ongoing operational monitoring.
- Woodside has the capacity to mobilise and deploy up to 105-140 shoreline clean-up teams (approx. 1,260-1,680 responders in total) by week 3 using existing labour hire contracts with Woodside, AMOSC, Core Group, AMSA, WA DoT and OSRL team leads.
- Assessment of response capability indicates that for a worst-case scenario the actual teams required would meet the available capability and the response would be completed by the end of month 3.
- Woodside has considered deployment of additional personnel to undertake shoreline clean-up operations but is satisfied that the identified level of resource is balanced between cost, time and effectiveness. The most significant constraint on expanding the scale of response operations is accommodation and transport of personnel in the Exmouth to Port Hedland region and management of response generated waste. From previous assessment of accommodation in this region, Woodside estimates that current accommodation can cater for a range of 500-700 personnel per day for an ongoing operation.
- TRPs have been developed for identified RPAs that are predicted to be impacted except in international locations.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.7.

5.8 Oiled wildlife response

Woodside would implement a response in accordance with the *Oiled Wildlife Operational Plan*. This plan includes the process for the IMT to mobilise resources depending on the nature and scale of the spill. Oiled wildlife operations would be implemented with advice and assistance from the Oiled Wildlife Advisor from the Department of Biodivseristy, Conservation and Attractions (DBCA).

Oiled wildlife response is undertaken in accordance with the Western Australian Oiled Wildlife Response Plan to ensure it is conducted in accordance with legislative requirements under the *Animal Welfare Act 2002*.

If there is a net environmental benefit, oiled wildlife operations will be conducted 24 hours per day to reduce the time for rehabilitation and release of oiled wildlife. Hazing and pre-emptive capture techniques to keep non-oiled animals away from contaminated habitat in instances where it is deemed appropriate will be conducted in accordance with the Western Australian Oiled Wildlife Response Plan, specifically vessels used in hazing/pre-emptive capture will approach wildlife at slow speeds to ensure animals are not directed towards the oil and deterrence/hazing and pre-emptive capture will only be conducted if Woodside has licensed authority from DBCA and approval from the Incident Controller.

Shoreline access will be considered as part of the operational NEBA. Vehicular access would be restricted on dunes, turtle nesting beaches and in mangroves. Woodside retains specialist personnel to support and manage oiled wildlife operations, including trained and competent responders in Exmouth and Dampier. Additional personnel would be sourced through Woodside’s arrangements to support an oiled wildlife response as required.

5.8.1 Response need based on predicted consequence parameters

The following statements identify the key parameters upon which a response need can be based:

- The shortest timeframe that shoreline contact from floating oil is predicted to be 17 days at Barrow Island (27 m^3) for Credible Scenario-02 and 22.6 days at Pilbara Islands – Southern Group (5 m^3) for Credible Scenario-01. There is no shoreline impact predicted at response threshold of >100 g/m^2 for Credible Scenario-03.
- The offshore location of the release site is expected to initially result in low numbers of at-risk or impacted wildlife.
- As the surface oil approaches shorelines, potential for oiled wildlife impacts are likely to increase.
- It is estimated that an oiled wildlife response would be between Level 2 and 3, as defined in the WA OWRP (Table 5-18).

Table 5-16: Key at-risk species potentially in Response Protection Areas and open ocean

Species	Montebello Islands and State Marine Park	Barrow Island	Lowendal Islands	Pilbara Islands – Southern Islands Group	Muiron Islands MMA & WHA	Dampier Archipelago	Pilbara Islands – Northern Islands Group	Open ocean
Marine turtles	✓	✓	✓	✓	✓	✓	✓	✓
Whale sharks	✓	✓	✓		✓			✓
Seabirds and/or migratory shorebirds	✓	✓	✓	✓	✓	✓	✓	✓
Cetaceans – migratory whales	✓	✓	✓		✓	✓		✓
Cetaceans – dolphins and porpoises	✓	✓	✓	✓	✓	✓	✓	✓
Dugongs	✓	✓	✓	✓	✓		✓	✓
Sharks and rays	✓	✓	✓	✓	✓	✓	✓	✓

The oiled wildlife response technique targets key wildlife populations at risk within Commonwealth open waters and the nearshore waters as described in Section 4 of the EP. Responding to oiled wildlife consists of eight key stages, as described in Table 5-17 below.

Table 5-17: Oiled wildlife response stages

Stage	Description
Stage 1: Wildlife first strike response	Gather situational awareness including potential wildlife assets at risk.
Stage 2: Mobilisation of wildlife resources	Resources include personnel, equipment and facilities.
Stage 3: Wildlife reconnaissance	Reconnaissance to identify potentially affected animals.
Stage 4: IAP wildlife sub-plan development	The IAP includes the appropriate response options for oiled wildlife, including wildlife priorities for protection from oiling; deterrence measures (see below); and recovery and treatment of oiled wildlife; resourcing of equipment and personnel. It includes consideration of deterrence practices such as ‘hazing’ to prevent wildlife from entering areas potentially contaminated by spilled hydrocarbons, as well as dispersing, displacing or relocating wildlife to minimise/prevent contact and provide time for clean-up.
Stage 5: Wildlife rescue and staging	This includes the different roles of finding oiled wildlife, capturing wildlife, and holding and/or transportation of wildlife to oiled wildlife facilities.
Stage 6: Establishment of an oiled wildlife facility	Treatment facilities would be required for the first-aid, cleaning and rehabilitation of affected animals. A vessel-based ‘on-water’ facility would likely need to be established to enable stabilisation of oiled wildlife before transport to a suitable treatment facility. Suitable staging sites in the Dampier and Exmouth have been identified in the draft Regional OWROP, should a land-based site be required.
Stage 7: Wildlife rehabilitation	Considerations include a suitable rehabilitation centre and personnel, wildlife housing, record keeping and success tracking.
Stage 8: Oiled wildlife response termination	Once a decision has been made to terminate operations, the Incident Controller will stand down individual participating and supporting agencies.

Reconnaissance and primary response would be done during operational monitoring and surveillance activities. Where marine wildlife are observed on water or transiting near or within the spill area, observations would be recorded through surveillance records. The shoreline assessments would be done in accordance with OM05, which would be used as a further tool to identify wildlife and habitats contacted by hydrocarbons.

Staging sites would be established as forward bases for shoreline- or vessel-based field teams. Once recovered to a staging site, wildlife would be transported to the designated oiled wildlife facility or a temporary holding centre (before being transported to the oiled wildlife facility). Temporary holding centres are required when there is significant distance between a staging site and the oiled wildlife facility, to enable stabilisation of oiled animals. The oiled wildlife facility is the primary location where animals would be housed and treated. Sites proposed for staging a regional oiled wildlife response in Dampier and Exmouth have been identified.

To deploy a response that is appropriate to the nature and scale of the event, as well as scalable over time, Woodside would implement an oiled wildlife response in consultation with DBAC and use the capability outlined in the WA OWRP, with additional capability if required (e.g. volunteers) accessible through Woodside's *People & Global Capability Surge Labour Requirement Plan*.

The WA OWRP provides indicative oiled wildlife response levels (Table 5-18) and the resources likely to be needed at each increasing level of response.

Table 5-18: Indicative oiled wildlife response level (adapted from the WA OWRP, 2014)

Oiled wildlife response Level	Indicative personnel numbers	Indicative duration	Indicative number of birds (non-threatened species)	Indicative number of birds (threatened species)	Turtles (hatchlings, juveniles, adults)	Cetaceans	Pinnipeds	Dugongs
Level 1	6	<3 days	1–2/day <5 total	No complex birds	None	None	None	None
Level 2	26	4–14 days	1–5/day <20 total	No complex birds	<20 hatchlings No juv/adults	None	None	None
Level 3	59	4–14 days	5–10/day <50 total	1–5/day <10 total	<5 juv/adults <50 hatchlings	None	<5	None
Level 4	77	>14 days	5–10/day <200 total	5–10/day	<20 juv/adults <500 hatchlings	<5, or known habitats affected	5–50	Habitat affected only
Level 5	116	>14 days	10–100/ day >200 total	10–50/day	>20 juv/adults >500 hatchlings	>5 dolphins	>50	Dugongs oiled
Level 6	122	>14 days	>100/day	10–50/day	>20 juv/adults >500 hatchlings	>5 dolphins	>50	Dugongs oiled

5.8.2 Environmental performance based on need

Table 5-19: Environmental Performance – Oiled Wildlife Response

Environmental Performance Outcome		Oiled Wildlife Response is conducted in accordance with the Western Australian Oiled Wildlife Response Plan (WAOWRP) to ensure it is conducted in accordance with legislative requirements to house, release or euthanise wildlife under the Animal Welfare Act 2002.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.12)**
29	Wildlife response equipment	29.1	Contracted capability to treat 100 individual wildlife for immediate mobilisation to Response Protection Areas (RPAs).	1, 3A, 3B, 3C, 4
		29.2	Contracted capability to treat up to an additional 250 individual wildlife within a 5 day period.	
		29.3	National plan access to additional resources under the guidance of the WA DoT (up to a Level 5 oiled wildlife response as specified in the OWRP), with the ability to treat about 600 individual wildlife by the time hydrocarbons contact the shoreline.	1, 3C, 4
		29.4	Vessels used in hazing/pre-emptive capture will approach wildlife at slow speeds to ensure animals are not directed towards the hydrocarbons.	1, 3A, 3B, 4
		29.5	Facilities for the rehabilitation of oiled wildlife are operational 24/7 as per WAOWRP.	1, 3A, 4
30	Wildlife responders	30.1	2 wildlife divisional commanders to lead the oiled wildlife operations who have completed an Oiled Wildlife Response Management course.	1, 2, 3B
		30.2	Wildlife responders to be accessed through resource pool and additional agreements with specialist providers.	1, 2, 3A, 3B, 3C, 4
		30.3	Oiled wildlife operations (including hazing) would be implemented with advice and assistance from the Oiled Wildlife Advisor from the DBCA, and in accordance with the processes and methodologies described in the WA OWRP and the relevant regional plan.	1
		30.4	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B

The resulting wildlife response capability has been assessed against the WCCS. The range of techniques provide an ongoing approach to response at identified RPAs.

Under optimal conditions, during the subsea or surface release, the capability available meets the need identified. It indicates that, the wildlife response capability has the following expected performance:

- Mobilisation and deployment of 1 wildlife collection team to each impacted RPA as directed by operational monitoring.
- Mobilisation and deployment of up to 2 central wildlife treatment and rehabilitation locations at Exmouth and Dampier in accordance with WA OWRP, if required.
- The waste storage capacity is sufficient to meet the need (circa 1 m^3 waste generated per wildlife unit cleaned).

Woodside would establish a wildlife collection point at the RPA for identified oiled wildlife collection and sorting. From these locations, recovered wildlife would be transported to a central treatment location at Dampier or Exmouth.

5.9 Waste Management

Waste management is considered a support technique to shoreline clean-up and wildlife response. Waste generated and collected during the response that will require handling, management and disposal may consist of:

- Liquids (hydrocarbons and contaminated liquids) collected during shoreline clean-up and wildlife response, and/or
- Solids/semi-solids (oily solids, garbage, contaminated materials) and debris (e.g. seaweed, sand, woods, and plastics) collected during shoreline clean-up and wildlife response.

Expected waste volumes during an event are likely to vary depending on oil type, volume released, response techniques employed and how weathering of hydrocarbons. Waste management, handling and capacity should be scalable to ensure continuous response operations can be maintained.

All waste management activities will follow the *Environment Protection (Controlled Waste) Regulations 2004* and the waste will be managed to minimise final disposal volumes. Waste treatment techniques will consider contaminated solids treatment to allow disposal to landfill and solids with high concentrations of hydrocarbon will be treated and recycled where possible or used in clean fill if suitable.

The waste products would be transported from response locations to the nearest suitable staging area/waste transfer station for treatment, disposal or recycling. Waste will be transferred with appropriately licensed vehicles. Containers will be available for temporary waste storage and will be:

- Labelled with the waste type
- Provided with appropriate lids to prevent waste being blown overboard
- Bunded if storing liquid wastes.
- Processes will be in place for transfers of bulk liquid wastes and include:
  - Inspection of transfer hose undertaken prior to transfer
  - Watchman equipped with radio visually monitors loading hose during transfer
  - Tank gauges monitored throughout operation to prevent overflow.

The *Oil Spill Preparedness Waste Management Support Plan* details the procedures, capability and capacity in place between Woodside and its primary waste services contractor (Veolia Waste Management) to manage waste volumes generated from response activities.

5.9.1 Response need based on predicted consequence parameters

Table 5-20: Response Planning Assumptions – Waste Management

	Response planning assumptions: Waste management
Waste loading per m^3 oil recovered (multiplier)	Containment & Recovery – approx. 10x multiplier for oily waste generated by containment and recovery operations
	Shoreline clean-up (manual) – approx. 5-10x multiplier for oily solid and liquid wastes generated by manual clean-up.
	Oiled wildlife response – approx. $1m^3$ of oily liquid waste generated for each wildlife unit cleaned.

5.9.2 Environmental performance based on need

Table 5-21: Environmental performance – waste management

Environmental Performance Outcome		To minimise further impacts, waste will be managed, tracked and disposed of in accordance with laws and regulations.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.12)**
31	Waste Management	31.1	Contract with waste management services for transport, removal, treatment and disposal of waste.	1, 3A, 3B, 3C, 4
		31.2	Access to at least 675 m^3 of solid and liquid waste storage available within 4 days upon activation of 3rd party contract, if required.	
		31.3	Access to 384 m^3 waste storage capacity by day 2 (Credible Scenario-01).	
		31.4	Recovered hydrocarbons and wastes will be transferred to licensed treatment facility for reprocessing or disposal.	
		31.5	Teams will segregate liquid and solid wastes at the earliest opportunity.	
		31.6	Waste management provider support staff available year-round to assist in the event of an incident with waste management as detailed in contract.	
		31.7	Open communication line to be maintained between IMT and waste management services to ensure the reliable flow of accurate information between parties.	1, 3A, 3B
		31.8	Waste management to be conducted in accordance with Australian laws and regulations.	1, 3A, 3B, 3C, 4
		31.9	Waste management services available and employed during response.	

The resulting waste management capability has been assessed against the WCCS. The range of techniques provide an ongoing approach to waste management at identified RPAs.

It indicates that the waste management capability has the following expected performance:

- The largest shoreline waste volumes predicted for Credible Scenario-01 are 50 m^3 during week 4 and up to 730 m^3 during month 2 with a maximum of 840 m^3 of waste expected across all shoreline clean-up operations during the response. The capability available exceeds the need identified.
- The largest shoreline waste volumes predicted for Credible Scenario-02 are 450 m^3 in week 3 and 1880 m^3 during month 3 with a maximum of 2470 m^3 of waste expected across all shoreline clean-up operations during the response. The capability available exceeds the need identified.
- Offshore operations may generate up to an additional peak of 1066 m^3 oily waste for one week (week 1) of operations for Credible Scenario-01. The capability available exceeds the need from day 3.
- Veolia has the capacity to treat up to 120,000 m^3 overall waste volumes. The waste management requirements are within Woodside’s and its service providers existing capacity.
- Woodside has assessed the existing capability available and considered potential alternative, additional and improved control measures. Where control measures have been selected and implemented, they are included in Section 6.9.

Document to be read in conjunction with GWF3 and Lambert Deep Drilling and Subsea Installation Environment Plan.

5.10 Scientific monitoring

A scientific monitoring program (SMP) would be activated following a Level two or three unplanned hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors. This would consider receptors at risk (ecological and socio-economic) for the entire predicted Environment that Maybe Affected (EMBA) and in particular, any identified Pre-emptive Baseline Areas (PBAs) for the credible spill scenario(s) or other identified unplanned hydrocarbon releases associated with the operational activities (refer to Table 2-1: PAP credible spill scenarios).

The outputs of the stochastic hydrocarbon spill modelling were used to assess the environmental risk of the hydrocarbon affected area as delineated by the ecological impact EMBA and social-cultural EMBA based on exceedance of environmental and social-cultural hydrocarbon threshold concentrations (refer to Table 2-2, Section 2.3.1.1 and see Section 4 and 6 of the EP for further information on applicable thresholds and the EMBAs). The Petroleum Activities Program worst-case credible spill Credible Scenario-01 and Credible Scenario-02 define the EMBAs and are the basis of the SMP approach presented in this section

It should be noted that the resulting SMP receptor locations differ from the Response Protection Areas (RPAs) presented and discussed in Section 3 of this document due to the applicability of different hydrocarbon threshold levels. The SMP would be informed by the data collected via the operational monitoring program (OMP) studies, however, it differs from the OMP in being a long-term program independent of, and not directing, the operational oil spill response or monitoring of impacts from response activities (refer to Section 5.1) for operational monitoring overview).

Key objectives of the Woodside oil spill SMP are:

- Assess the extent, severity and persistence of the environmental impacts from the spill event; and
- Monitor subsequent recovery of impacted key species, habitats and ecosystems.

The SMP comprises ten targeted environmental monitoring programs to assess the condition of a range of physico-chemical (water and sediment) and biological (species and habitats) receptors including Environment Protection and Biodiversity Conservation Act (EPBC Act 1999) listed species, environmental values associated with protected areas and socio-economic values, such as fisheries. The ten SMPs are as follows:

- SM01 - Assessment of the presence, quantity and character of hydrocarbons in marine waters (linked to OM01 to OM03)
- SM02 - Assessment of the presence, quantity and character of hydrocarbons in marine sediments (linked to OM01 and OM05)
- SM03 – Assessment of impacts and recovery of subtidal and intertidal benthos
- SM04 - Assessment of impacts and recovery of mangroves/saltmarsh habitat
- SM05 - Assessment of impacts and recovery of seabird and shorebird populations
- SM06 - Assessment of impacts and recovery of nesting marine turtle populations
- SM07 - Assessment of impacts to pinniped colonies including haul-out site populations
- SM08 - Desktop assessment of impacts to other non-avian marine megafauna
- SM09 - Assessment of impacts and recovery of marine fish (linked to SM03)
- SM10 - Assessment of physiological impacts to important fish and shellfish species (fish health and seafood quality/safety) and recovery.

These SMPs have been designed to cover all key tropical and temperate habitats and species within Australian waters and broader, if required. A planning area for scientific monitoring is also identified to acknowledge potential hydrocarbon contact below the environmental threshold concentrations and beyond the EMBA. This planning area has been set with reference to the entrained low exposure value of 10 ppb detailed in the NOPSEMA Bulletin #1 Oil Spill Modelling (2019), as shown in Figure 5-1:

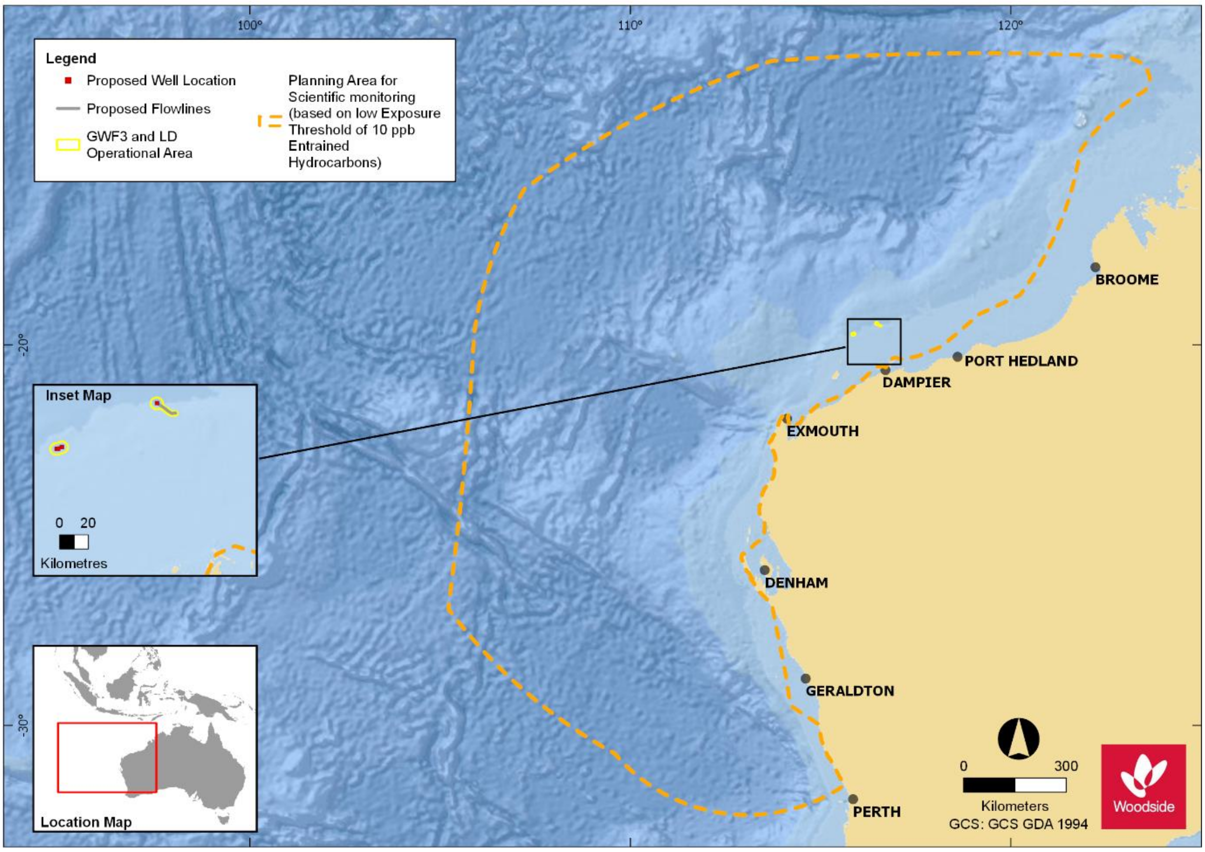


Figure 5-1:The planning area for scientific monitoring based on the area potentially contacted by the low (below ecological impact) entrained hydrocarbon threshold of 10 ppb in the event of the worst-case credible spill scenario (Credible Scenario-01 and Credible Scenario-02).

Please note that Figure 5-1 represents the overall combined extent of the oil spill model outputs based on a total of 100 replicate simulations over an annual period for Credible Scenario-01 and Credible Scenario-02 and therefore represents the largest spatial boundaries of 100 Credible Scenario-01 and Credible Scenario-02 hydrocarbon spill combinations, not the spatial extent of a single Credible Scenario-01 and Credible Scenario-02 hydrocarbon spill.

5.10.1 Scientific Monitoring Deployment Considerations

Table 5-22: Scientific monitoring deployment considerations

Scientific Monitoring Deployment Considerations	
Existing baseline studies for sensitive receptor locations predicted to be affected by a spill	PBAs of the following two categories: • PBAs within the predicted <10-day hydrocarbon contact time prediction: The approach is to conduct a desktop review of available and appropriate baseline data for key receptors for locations (if any) that are potentially impacted within 10 days of a spill and look to conduct baseline data collection to address data gaps and demonstrate spill response preparedness. Planning for baseline data acquisition is typically commenced pre-PAP and execution of studies undertaken with consideration of weather, receptor type, seasonality and temporal assessment requirements. • PBAs >10 days' time to predicted hydrocarbon contact in the event of an unplanned hydrocarbon release (from the facility operational activities). SMP activation (as per the GWF3 and Lambert Deep Drilling and Subsea Installation FSP) directs the SMP team to follow the steps outlined in the SMP Operational Plan. The steps include: checking the availability and type of existing baseline data, with particular reference to any PBAs identified as >10 days to hydrocarbon contact. Such information is used to identify response phase PBAs and plan for the activation of SMPs for pre-emptive (i.e. pre-hydrocarbon contact) baseline assessment.
Pre-emptive Baseline in the event of a spill	Activation of SMPs in order to collect baseline data at sensitive receptor locations with predicted hydrocarbon contact time >10 days (as documented in ANNEX C).
Survey platform suitability and availability	In the event of the SMP activation, suitable survey platforms are available and can support the range of equipment and data collection methodologies to be implemented in nearshore and offshore marine environments.
Trained personnel to implement SMPs suitable and available.	Access to trained personnel and the sampling equipment contracted for scientific monitoring via a dedicated scientific monitoring program standby contract.
Met-ocean conditions	The following met-ocean conditions have been identified to implement SMPs: • Waves <one m for nearshore systems • Waves <1.5 m for offshore systems • Winds <20 knots • Daylight operations only SMP implementation will be planned and managed according to HSE risk reviews and the met-ocean conditions on a day to day basis by SMP operations.

5.10.2 Response Planning Assumptions

Table 5-23: Scientific monitoring response planning assumptions

Response Planning Assumptions	
PBAs	PBAs identified through the application of defined hydrocarbon impact thresholds during the Quantitative Spill Risk Assessment process and a consideration of the minimum time to contact at receptor locations fall into two categories: • PBAs for which baseline data are planned for and data collection may commence pre-PAP (≤ 10 days minimum time to contact), where identified as a gap. • PBAs (> 10 days minimum time to contact) for which baseline data may be collected in the event of an unplanned hydrocarbon release. Response phase PBAs are prioritised for SMP activities due to vulnerability (i.e. time to contact and environmental sensitivity) to potential impacts from hydrocarbon contact and an identified need to acquire baseline data.

	Time to hydrocarbon contact of >10 days has been identified as a minimum timeframe within which it is feasible to plan and mobilise applicable SMPs and commence collection of baseline (pre-hydrocarbon contact) data, in the event of an unplanned hydrocarbon release from GWF3 and Lambert Deep Drilling and Subsea Installation. PBAs for GWF3 and Lambert Deep Drilling and Subsea Installation identified and listed in ANNEX D, Table D-1. The PBAs together with the situational awareness (from the operational monitoring) are the basis for the response phase SMP planning and implementation.
Pre-Spill	A review of existing baseline data for receptor locations with potential to be contacted by floating or entrained hydrocarbons at environmental thresholds within ≤10 days has identified the following: • Rankin Bank [12] • Glomar Shoal • Montebello Islands • Barrow Island • Lowendal Islands[13] • Pilbara Southern Island Group • Montebello State Marine Park For example, adequate baseline data are available for Rankin Bank and Glomar Shoal as last surveyed (benthic communities and fish assemblages) in November 2018 (Currey-Randall et al., 2019). Australian Marine Parks (AMPs) potentially affected includes: • Montebello AMP All the Australian Marine Parks (AMPs) are located in offshore waters where hydrocarbon exposure is possible on surface waters and in the water column.
In the Event of a Spill	Locations with >10 days to hydrocarbon contact, as well as the wider area, will be investigated and identified by the SMP team (in the Environment Unit of the Incident Control Centre (ICC)) as the spill event unfolds and as the situational awareness provided by the OMPs permits delineation of the spill affected area (for example, updates to the spill trajectory tracking). The full list is presented in ANNEX D, based on the PAP worst-case credible spill scenario(s) (Table 2-1). To address the initial focus in a response phase SMP planning situation, receptor locations predicted to be contacted between >10 days and 20 days have been identified as follows: • Ningaloo Coast, North[14] • Muiron Islands[15] • Ningaloo AMP • Gascoyne AMP • Argo-Rowley Terrace AMP In the event key receptors within geographic locations that are potentially impacted after 10 days following a spill event or commencement of the spill and where adequate and

[12] Floating oil will not accumulate on submerged features and at open ocean locations, therefore, no surface contact will occur and only entrained hydrocarbon contact is predicted at Rankin Bank ≤10 days.
[13] ≤10 days time to contact is specifically applicable to Barrow Island and Montebello Islands; however, the Lowendal Islands are being included as a precautionary approach, given the spill modelling does not encompass the complex hydrographic processes for these islands groups.
[14] Ningaloo Coast includes the WHA and State Marine Park
[15] Muiron islands includes the WHA and Marine Management Area

	appropriate baseline data are not available, there will be a response phase effort to collect baseline data for the following purposes: i. Priority will be given to the collection of baseline data for receptors predicted to be within the spill affected area prior to hydrocarbon contact. The process is initiated with the investigation of available baseline and time to hydrocarbon contact (>10 days which is sufficient time to mobilise SMP teams and acquire data before hydrocarbon contact). With reference to the GWF3 and Lambert Deep Drilling and Subsea Installation PAP, priority would be focused on Ningaloo Coast and Muiron Islands. ii. Highly sensitive and/or valued habitats and communities in coastal waters will be prioritised for pre-emptive baseline surveys over open water areas of AMPs e.g. Ningaloo AMP. iii. Collect baseline data for receptors predicted to be outside the spill affected area so reference datasets for comparative analysis with impacted receptor types can be assessed post-spill.
Baseline Data	A summary of the spill affected area and receptor locations as defined by the EMBAs for the PAP worst case credible spill Credible Scenario-01 and Credible Scenario-02, is presented in the GWF3 and Lambert Deep Drilling and Subsea Installation EP (refer to Section 6 in the EP). The key receptors at risk by location and corresponding SMPs based on the EMBAs for the PAP are presented in ANNEX D, as per the PAP credible spill scenarios one and two. This matrix maps the receptors at risk with their location and the applicable SMPs that may be triggered in the event of a Level two or three hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors. Receptor locations and applicable SMPs are colour coded to highlight possible time to contact based on receptor locations identified as PBAs. The status of baseline studies relevant to the PAP are tracked by Woodside through the maintenance of a Corporate Environment Environmental Baseline Database (managed by the Woodside Environmental Science team), as well as accessing external databases such as the Department of Water and Environmental Regulation (WA) Index of Marine Surveys for Assessment (IMSA)[16] (refer to ANNEX C: Oil Spill Scientific Monitoring Program).

5.10.3 Summary – scientific monitoring

The resulting scientific monitoring capability has been assessed against the PAP worst case credible spill scenarios. The range of strategies provide an ongoing approach to monitoring operations to assess and evaluate the scale and extent of impacts. All known reasonably practicable control measures have been adopted with the cost and organisational complexity of these options determined to be moderate and the overall delivery effectiveness determined to be medium. The SMP's main objectives can be met, with no additional, alternative or improved control measures providing further benefit.

5.10.4 Response planning: need, capability and gap – scientific monitoring

The receptor locations identified in ANNEX D provide the basis of the SMPs likely to be selected and activated. Once the Woodside SMP Delivery team and Standby SMP contractor have been stood up and the exact nature and scale of the spill becomes known, the SMPs to be activated will be confirmed as per the process set out in the SMP Operational Plan.

Scope of SMP Operations in the event of a hydrocarbon spill:

Receptor locations of interest for the SMP during the response phase are:

- Ningaloo Coast, North
- Muiron Islands
- Ningaloo AMP

[16] https://biocollect.ala.org.au/imsa#max%3D20%26sort%3DdateCreatedSort

- Gascoyne AMP
- Argo-Rowley Terrace AMP

Documented baseline studies are available for certain sensitive receptor locations including the Ningaloo Coast and Muiron Islands (ANNEX D, Table D-2). The SMP approach in the response phase would still deploy SMP teams to maximise the opportunity to collect pre-emptive baseline data at sensitive receptor locations, i.e., the sections of the Ningaloo Coast not immediately contacted to hydrocarbons. As the exact locations where hydrocarbon contact occurs may be unpredictable, SM01 would be mobilised as a priority to be able to detect hydrocarbons and track the leading edge of the spill to verify where hydrocarbon contact occurs which will assist with where SMP resources are a priority need to obtain pre-emptive baseline data.

The option analysis in Section 6.10 considers ways to reduce the gap by considering alternate, additional, and/or improved control measures on each selected response strategy.

5.10.5 Environmental performance based on need

Table 5-24: Environment Performance – Scientific Monitoring

Environmental Performance Outcome		Woodside can demonstrate preparedness to stand up the SMP to quantitatively assess and report on the extent, severity, persistence and recovery of sensitive receptors impacted from the spill event.		
Control measure		**Performance Standard**		**Measurement Criteria**
32	• Woodside has an established and dedicated SMP team comprising the Environmental Science Team and additional Environment Advisers within the Health Safety Environment and Quality (HSEQ) Function.	32.1	SMP team comprises a pool of competent Environment Advisers (stand up personnel) who receive training regarding the SMP, SMP activation and implementation of the SMP on an annual basis.	• Training materials. • Training attendance registers. Process that maps minimum qualification and experience with key SMP role competency and a tracker to manage availability of competent people for the SMP team including redundancy and rostering.
33	• Woodside has contracted SMP service provider to provide scientific personnel to resource a base capability of one team per SMP (SM01-SM10, see ANNEX C Table C-2) as detailed in Woodside's SMP standby contractor Implementation Plan, to implement the oil spill scientific monitoring programs. The availability of relevant personnel is reported to Woodside on a monthly basis via a simple report on the base-loading availability of people for each of the SMPs comprising field work for data collection (SMP resourcing report register).	**33.1**	Woodside maintains the capability to mobilise personnel required to conduct scientific monitoring programs SM01 – SM10 (except desktop based SM08): • Personnel are sourced through the existing standby contract with SMP standby contractor, as detailed within the SMP	• Hydrocarbon Spill Preparedness Team Internal Control Environment tracks the quarterly review of the Oil Spill Contracts Master. • SMP resource report of personnel availability

	• In the event of a spill and the SMP is activated, the base-loading availability of scientific personnel will be provided by SMP standby contractor for the individual SMPs and where gaps in resources are identified, SMP standby contractor/Woodside will seek additional personnel (if needed) from other sources including Woodside's Environmental Services Panel.		Implementation Plan. • Scientific Monitoring Program Implementation Plan describes the process for standing up and implementing the scientific monitoring programs. SMP team stand up personnel receive training regarding the stand up, activation and implementation of the SMP on an annual basis.	provided by SMP contractor on monthly basis (SMP resourcing report register. • Training materials. • Training attendance registers. • Competency criteria for SMP roles. SMP annual arrangement testing and reporting.
34	• Roles and responsibilities for SMP implementation are captured in Table C-1 (ANNEX C) and the SMP team (as per the organisational structure of the ICC) is outlined in SMP Operational Plan. Woodside has a defined Crisis and Incident Management structure including Source Control, Operations, Planning and Logistics functions to manage a loss of well containment response. • SMP Team structure, interface with SMP standby contractor and linkage to the ICC is presented in Figure C-1, ANNEX C. • Woodside has a defined Command, Control and Coordination structure for Incident and Emergency Management that is based on the AIIMS framework utilised in Australia. • Woodside utilises an online Incident Management System (IMS) to coordinate and track key incident management functions. This includes specialist modelling programs, geographic information systems (GIS), as well as communication flows within the Command, Control and Coordination structure. • SMP activated via the FSP. • Step by step process to activation of individual SMPs provided in the SMP Operational Plan. • All decisions made regarding SMP logged in the online IMS (SMP team members trained in using Woodside's online Incident Management System). • SMP component input to the ICC IAP as per the identified ICC timed sessions and the SMP IAP logged on the online IMS. • Woodside Environmental Science Team provides awareness training on the	**34.1**	• Woodside has established an SMP organisational structure and processes to stand up and deliver the SMP.	• SMP Oil Spill Scientific Monitoring Operational Plan. • SMP Implementation Plan. • SMP annual arrangement testing and reporting.

	activation and stand-up of the Scientific Monitoring Programme (SMP) for the Environment Advisers in Woodside who are listed on the SMP team on an annual basis. • Woodside Environmental Science Team provides awareness training on the activation and stand-up of the Scientific Monitoring Programme (SMP) for the SMP Standby provider. • Woodside Environmental Science Team co-ordinates an annual SMP arrangement testing exercise performed by the SMP standby contractor SMP team participates in since 2016 (refer to the SMP Document Register).			
35	• Chartered and mutual aid vessels. • Suitable vessels would be secured from the Woodside support vessels, regional fleet of vessels operated by Woodside and other operators and the regional charter market. • Vessel suitability will be guided by the need to be equipped to operate grab samplers, drop camera systems and water sampling equipment (the individual vessel requirements are outlined in the relevant SMP methodologies (refer to Table C-2, ANNEX C). • Nearshore mainland waters could use the same approach as for open water. Smaller vessels may be used where available and appropriate. Suitable vehicles and machinery for onshore access to nearshore SMP locations would be provided by Woodside's transport services contract and sourced from the wider market. • Dedicated survey equipment requirements for scientific monitoring range from remote towed video and drop camera systems to capture seabed images of benthic communities to intertidal/onshore surveying tools such as quadrats, theodolites and spades/trowels, cameras and binoculars (specific survey equipment requirements are outlined in the relevant SMP methodologies (refer to Table C-2, ANNEX C)). Equipment would be sourced through the existing SMP standby contract with Standby SMP contractor for SMP resources and if additional surge capacity is required this would be available through the other Woodside Environmental Services Panel Contractors and specialist contractors. Standby SMP contractor can also address equipment redundancy through	**35.1**	Woodside maintains standby SMP capability to mobilise equipment required to conduct scientific monitoring programs SM01 – SM10 (except desktop based SM08): • Equipment is sourced through the existing standby contract with Standby SMP standby contractor, as detailed within the SMP Implementation Plan.	• Hydrocarbon Spill Preparedness TeamInternal Control Environment tracks the quarterly review of the Oil Spill Contracts Master. • SMP standby monthly resource reports of equipment availability provided by SMP contractor (SMP resourcing report register). • SMP annual arrangement testing and reporting.

	either individual or multiple suppliers. MoUs are in place with marine sampling equipment suppliers and analytical laboratories (SMP resourcing report register). • Availability of SMP equipment for offshore/onshore scientific monitoring team mobilisation is within one week to ten days of the commencement of a hydrocarbon release. This meets the SMP mobilisation lead time that will support meeting the response objective of 'acquire, where practicable, the environmental baseline data prior to hydrocarbon contact required to support the post-response SMP.			
36	Woodside's SMP approach addresses the pre-PAP acquisition of baseline data for PBAs with ≤10 days if required following a baseline gap analysis process. Woodside maintains knowledge of Environmental Baseline data through: • Documentation annual reviews of the Woodside Baseline Environmental Studies Database, and specific activity baseline gap analyses. • Accessing external databases such as the Department of Water and Environmental Regulation (WA) Index of Marine Surveys for Assessment (IMSA)[17] (refer to ANNEX C: Oil Spill Scientific Monitoring Program).	**36.1**	• Annual reviews of environmental baseline data. • PAP specific Pre-emptive Baseline Area baseline gap analysis.	• Annual review/update of Woodside Baseline Environmental Studies Database. • Desktop review to assess the environmental baseline study gaps completed prior to EP submission. • Accessing baseline knowledge via the SMP annual arrangement testing.

Environmental Performance Outcome	SMP plan to acquire response phase monitoring targeting pre-emptive data achieved.	
Control measure	**Performance Standard**	**Measurement Criteria**

[17] https://biocollect.ala.org.au/imsa#max%3D20%26sort%3DdateCreatedSort

37	Woodside's SMP approach addresses: • Scientific data acquisition for PBAs >10 days to hydrocarbon contact and activated in the response phase and • Transition into post-response SMP monitoring.	37.1	**PBA baseline data acquisition in the response phase** If baseline data gaps are identified for PBAs that has predicted hydrocarbon contact (contact time >10 days), there will be a response phase effort to collect baseline data with priority in implementing SMPs given to receptors where pre-emptive baseline data can be acquired or improved. SMP team (within the Environment Unit of the ICC) contribute SMP component of the ICC Planning Function in development of the IAP.	• Response SMP plan. • Woodside's online Incident Management System Records. • SMP component of the Incident Action Plan.
		37.2	**Post Spill contact** For the receptors contacted by the spill in where baseline data are available, SMPs programs to assess and monitor receptor condition will be implemented post spill (i.e. after the response phase):	• SMP planning document. • SMP Decision Log. • IAPs.
Environmental Performance Outcome		Implementation of the SMP (response and post-response phases).		
Control measure		**Performance Standard**		**Measurement Criteria**
38	• Scientific monitoring will address quantitative assessment of environmental impacts of a level two or three spill or any release event with the potential to contact sensitive environmental receptors. The SMP comprises ten targeted environmental monitoring programs. • SMP supporting documentation: (1) Oil Spill Scientific Monitoring Operational Plan; (2) SMP Implementation Plan and (3) SMP Process and Methodologies Guideline. • The Oil Spill Scientific Monitoring Operational Plan details the process of SMP selection, input to the IAP to trigger operational logistic support services. Methodology documents for each of the ten SMPs are accessible detailing	38.1	**Implementation of SM01** SM01 will be implemented to assess the presence, quantity and character of hydrocarbons in marine waters during the spill event in nearshore areas.	Evidence SM01 has been triggered: • Documentation as per requirements of the SMP Operational Plan. • Woodside's online Incident Management System Records. • SMP component of the IAP. • SMP data records from field.

	equipment, data collection techniques and the specifications required for the survey platform support. • The SMP standby contractor holds a Woodside SMP implementation plan detailing activation processes, linkage with the Woodside SMP team and the general principles for the planning and mobilisation of SMPs to deliver the individual SMPs activated. Monthly resourcing report are issued by the SMP standby contractor (SMP resourcing report register). All SMP documents and their status are tracked via SMP document register.	38.2	**Implementation of SM02-SM10** SM02-SM10 will be implemented in accordance with the objectives and activation triggers as per Table C-2 of ANNEX C.	Evidence SMPs have been triggered: • Documentation as per requirements of the SMP Operational Plan. • Woodside's online Incident Management System Records. • SMP component of the IAP. • SMP Data records from field.
		38.3	**Termination of SMP plans** The Scientific Monitoring Program will be terminated in accordance with termination triggers for the SMP's detailed in Table C-2 of ANNEX C, and the Termination Criteria Decision-tree for Oil Spill Environmental Monitoring (Figure C-3 of ANNEX C):	Evidence of Termination Criteria triggered: • Documentation and approval by relevant stakeholders to end SMPs for specific receptor types.

5.11 Incident Management System

The Incident Management System is both a control measure and a measurement criterion. As a control measure the IMS function is to prompt, facilitate and record the completion of three key response planning processes detailed below. As a measurement criterion, the IMS records the evidence of the timeliness of all response actions included in the environmental performance standards and the plans used of the PAP.

As the IMS does not directly remove hydrocarbons spilt into the marine environment there is no direct relationship to the response planning need.

5.11.1 Incident action planning

The ICC will be required to collect and interpret information from the scene of the incident to determine support requirements to the site-based IMT, develop an IAP and assist the IMT with the execution of that plan. The site-based IC may request the ICC to complete notifications internally within Woodside, to stakeholders and government agencies as required. Depending on the type and scale of the incident either the ICC Duty Manager (DM) or IC will be responsible for ensuring the development of the IAP. Incident Action Planning is an ongoing process that involves continual review to ensure techniques to control the incident are appropriate to the situation at the time.

5.11.2 Operational NEBA process

In the event of a response Woodside will confirm that the response techniques adopted at the time of EP/OPEP acceptance remain appropriate to reduce the consequences of the spill. This process verifies that there is a continuing net environmental benefit associated with continuing the response technique through the operational NEBA process. This process manages the environmental risks and impacts of response techniques during the spill response, an operational NEBA will be undertaken throughout the response, for each operational period.

The operational NEBA will consider the risks and benefits of conducting and response activity. For example, if vessels are required for access to nearshore or onshore areas, anchoring locations will be selected to minimise disturbance to benthic habitats. Vessel cleanliness would be commensurate with the receiving environment. The operational NEBA will consider the risks and benefits of conducting other response techniques.

The operational NEBA process is also used to terminate a response. Using data from operational and scientific monitoring activities the response to a hydrocarbon spill will be terminated in accordance with the termination process outlined in the OPEA. In effect the operational NEBA will determine whether there is net environmental benefit to continue response operations.

5.11.3 Stakeholder engagement process

Woodside will ensure stakeholders are engaged during the spill response in accordance with internal standards. This process requires that Woodside will:

- Undertake all required notifications (including government notifications) for stakeholders in the region (identified in the FSP). This includes notification to mariners to communicate navigational hazards introduced through response equipment and personnel.
- Identify and engage with relevant stakeholders and continually assess and review.

5.11.4 Environmental performance based on need

Table 5-25: Environmental Performance – Incident Management System

<table>
<tr><th colspan="2">Environmental Performance Outcome</th><td colspan="3">To support the effectiveness of all other control measures and monitor/record the performance levels achieved.</td></tr>
<tr><th colspan="2">Control measure</th><th colspan="2">Performance Standard</th><th>Measurement Criteria (Section 5.12)</th></tr>
<tr><td rowspan="3">39</td><td rowspan="3">Operational SIMA</td><td>39.1</td><td>Confirm that the response strategies adopted at the time of acceptance remain appropriate to reduce the consequences of the spill within 24 hours.</td><td rowspan="6">1, 3A</td></tr>
<tr><td>39.2</td><td>Record the evidence and justification for any deviation from the planned response activities.</td></tr>
<tr><td>39.3</td><td>Record the information and data from operational and scientific monitoring activities used to inform the SIMA.</td></tr>
<tr><td rowspan="3">40</td><td rowspan="3">Stakeholder engagement</td><td>40.1</td><td>Prompt and record all notifications (including government notifications) for stakeholders in the region are made.</td></tr>
<tr><td>40.2</td><td>In the event of a response, identification of relevant stakeholders will be re-assessed throughout the response period.</td></tr>
<tr><td>40.3</td><td>Undertake communications in accordance with:
• Woodside Crisis Management Functional Support Team Guideline – Reputation
• External Communication Operating Standard External Stakeholder Engagement Operating Standard</td></tr>
<tr><td rowspan="8">41</td><td rowspan="8">Personnel required to support any response</td><td>41.1</td><td>Action planning is an ongoing process that involves continual review to ensure strategies to control the incident are appropriate to the situation at the time.</td><td>1, 3B</td></tr>
<tr><td>41.2</td><td>A duty roster of trained and competent people will be maintained to ensure that minimum manning requirements are met all year round.</td><td>3C</td></tr>
<tr><td>41.3</td><td>Immediately activate the IMT with personnel filling one or more of the following roles:
• Operations Duty Manager
• D&C Duty Manager
• Operations Coordinator
• Deputy Operations Coordinator
• Planning Coordinator
• Logistics (materials, aviation, marine and support positions)
• Management Support
• Health and Safety Advisor
• Environment Duty Manage
• People Coordinator
• Public Information Coordinator
• Intelligence Coordinator
• Finance Coordinator.</td><td rowspan="4">1, 2, 3B, 3C, 4</td></tr>
<tr><td>41.4</td><td>Collect and interpret information from the scene of the incident to determine support requirements to the site-based IMT, develop an IAP and assist with the execution of that plan.</td></tr>
<tr><td>41.5</td><td>S&EM advisors will be integrated into ICC to monitor performance of all functional roles.</td></tr>
<tr><td>41.6</td><td>Continually communicate the status of the spill and support Woodside to determine the most appropriate response by delivering on the responsibilities of their role.</td></tr>
<tr><td>41.7</td><td>Follow the OPEA, Operational Plans, FSPs, support plans and the IAPs developed.</td><td>1, 2, 3A, 4</td></tr>
<tr><td>41.8</td><td>Contribute to Woodside’s response in accordance with the aims and objectives set by the Duty Manager.</td><td>1, 2, 3B, 3C, 4</td></tr>
</table>

5.12 Measurement criteria for all response techniques

Woodside ensures compliance with environmental performance outcomes and standards through four primary mechanisms. The performance tables aforementioned identify which of these four mechanisms monitors the readiness and records the effectiveness and performance of the control measures adopted.

1. The Incident Management System

The Incident Management System (IMS) supports the implementation of the Emergency & Crisis Management Procedure. The IMS provides a near real-time, single source of information for monitoring and recording an incident and measuring the performance of those control measures.

The Emergency & Crisis Management Procedure defines the management framework, including roles and responsibilities, to be applied to any size incident (including hydrocarbon spills). The organisational structure required to manage an incident is developed in a modular fashion and is based on the specific requirements of each incident. The structure can be scaled up or down.

The IAP process formally documents and communicated the:

- incident objectives;
- status of assets;
- operational period objectives;
- response techniques (defined during response planning); and
- the effectiveness of response techniques.

The information captured in the IMS (including information from personal logs and assigned tasks/close outs) confirms the response techniques implemented remain appropriate to reduce the consequences of the spill. The system also records all information and data that can be used to support the site-based IMT, development and the execution of the IAP.

2. The Security & Emergency Management Competency Dashboard

The Security & Emergency Management (S&EM) competency dashboard records the number of trained and competent responders that are available across Woodside, and some external providers, to participate in a response.

This number varies depending on expiry of competency certificates, staff attrition, internal rotations, leave and other absences. As such the Dashboard is designed to identify the minimum manning requirements and to identify sufficient redundancy to cater for the variances listed above.

Figure 5-2 shows the minimum manning numbers for the different hydrocarbon spill response roles and the number of qualified persons against those roles.

Woodside's pool of trained responders is composed of but not limited to personnel from the following organisations:

- Woodside internal
- AMOSC core group
- AMOSC
- OSRL
- Marine Spill Response Corporation (MSRC)
- AMSA
- Woodside contracted workforce

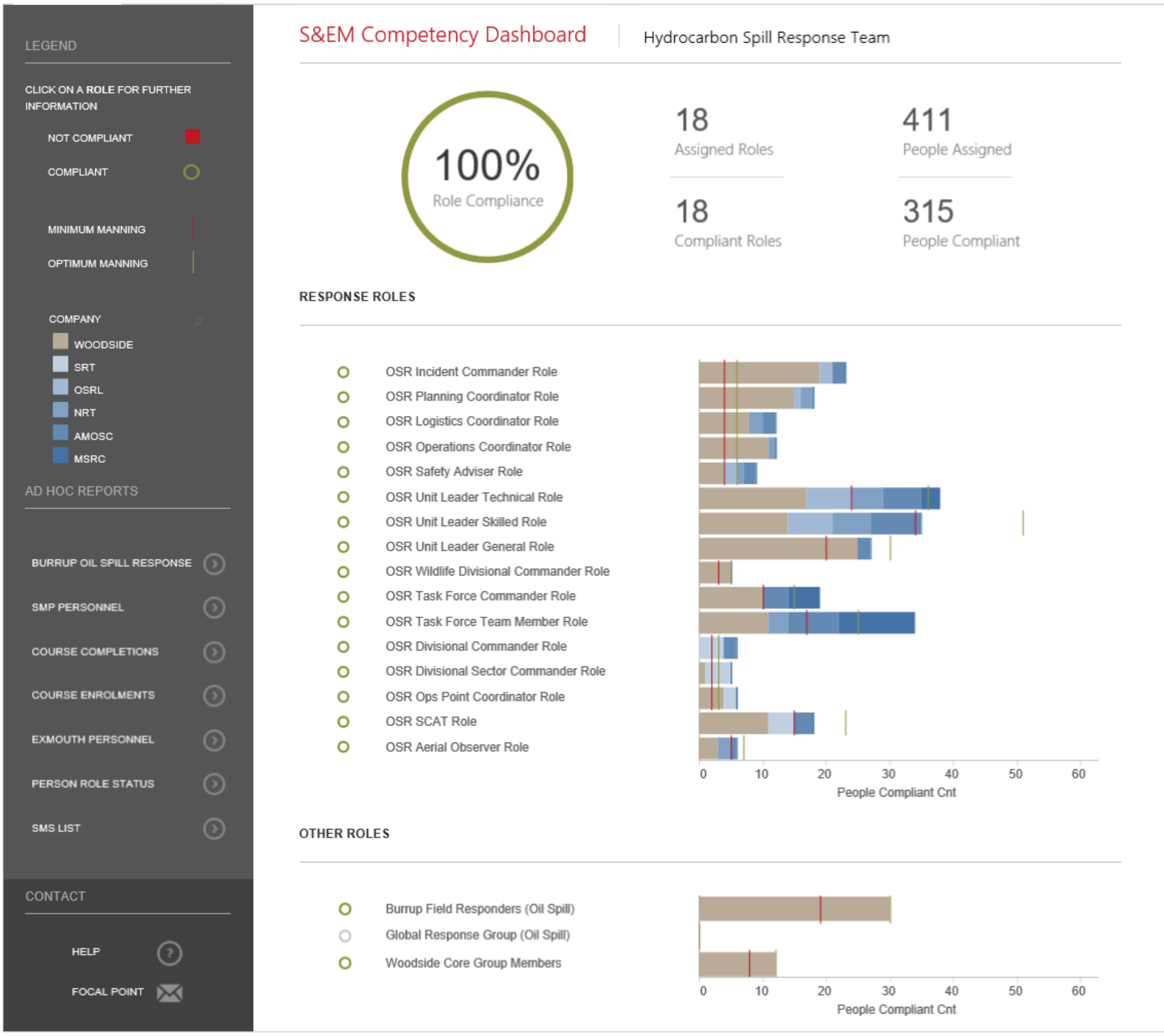


Figure 5-2: Example screen shot of the Hydrocarbon Spill Preparedness competency dashboard

The Dashboard is one of Woodside's key means of monitoring its readiness to respond. It also shows that Woodside can meet the requirements of the environmental performance standard that relate to filling certain response roles.

Figure 5-3 shows deeper dive into the Operations Point Coordinator role and the training modules required to show competence.

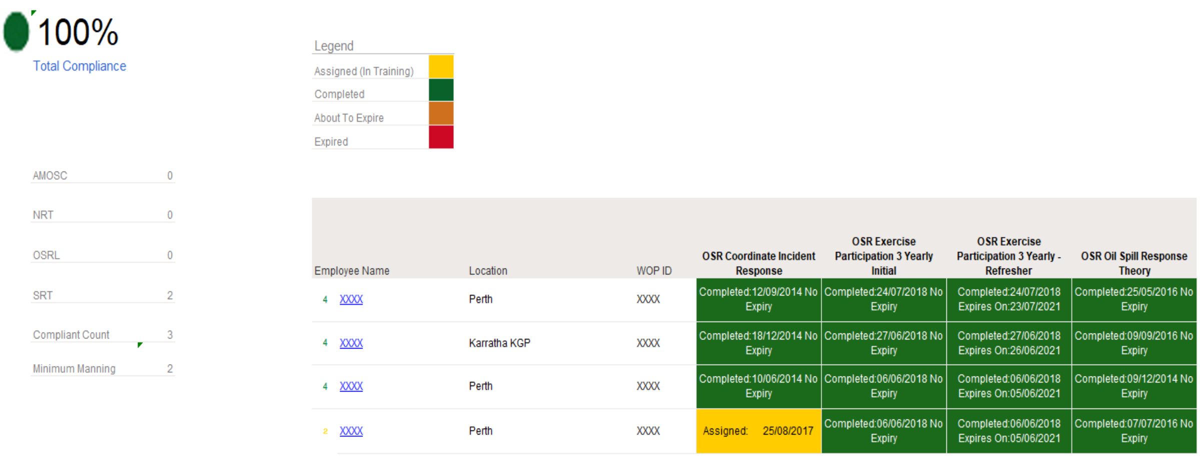


Figure 5-3: Example screen shot for the Operations Point Coordinator role

3. The Hydrocarbon Spill Preparedness ICE Assurance Process

The Hydrocarbon Spill Response Team has developed a Hydrocarbon Spill Preparedness and Response Internal Control Environment (ICE) process to align and feed into the Woodside Management System Assurance process for hydrocarbon spill. The process tracks compliance over four key control areas:

a) **Plans** – Ensures all plans (including: OPEA, FSPs, operational plans, support plans and TRPs) are current and in line with regulatory and internal requirements.

b) **Competency** – Ensures the competency dashboard is up to date and there are the minimum competency numbers across ICC, CMT and hydrocarbon spill response roles. The hydrocarbon spill training plan and exercise schedule, including testing of arrangements is also tracked. The Testing of Arrangements (TOA) register tracks the testing of all hydrocarbon spill response arrangements, key contracts and agreements in place with internal and external parties to ensure compliance.

c) **Capability** – Tracks and monitors capability that could be required in a hydrocarbon incident, including but not limited to: integrated fleet[18] vessel schedule, dispersant availability, rig/vessels monitoring, equipment stockpiles, tracking buoy locations and the CICC duty roster.

d) **Compliance & Assurance** – Ensures all regulator inspection outcomes are actioned and closed out, the global legislation register is up to date and that the key assurance components are tracked and managed. Assurance activities (including Audits) conducted on memberships with key Oil Spill Response Organisations (OSROs) including AMOSC and OSRL are also tracked and recorded in the ICE.

The ICE assurance process records how each commitment listed in the performance tables above is managed to ensure ongoing compliance monitoring. The level of compliance can be reviewed in real time and is reported on a monthly basis through the S&EM Function.

The completion of the assurance checks (over and above the ICE process) is also applied via the Woodside Integrated Risk & Compliance System (WiRCS) and subject to the requirements of Woodside's Provide Assurance Procedure.

[18] The Integrated fleet consists of vessels from multiple operators that have been contracted to Woodside to undertake a number of duties including hydrocarbon spill response

4. The Hydrocarbon Spill Preparedness and Response Procedure

This procedure sets out how to plan and prepare for a liquid hydrocarbon spill to the marine environment. (Note, this procedure does not apply to scenarios relating to gas releases in the marine environment).

This procedure details the:

- Requirement for an OPEP to be developed, maintained, reviewed, and approved by appropriate regulators (where applicable) including:
  - Defining how spill scenarios are developed on an activity specific basis;
  - Developing and maintaining all hydrocarbon spill related plans;
  - Ensuring the ongoing maintenance of training and competency for personnel;
  - Developing the testing of spill response arrangements; and
  - Maintaining access to identified equipment and personnel.
- Planning for hydrocarbon spill response preparedness
- Accountabilities for hydrocarbon spill response preparedness
- Spill training requirements
- Requirements for spill exercising / testing of spill response arrangements
- Spill equipment and services requirements.

The procedure also details the roles and responsibilities of the dedicated Woodside Hydrocarbon Spill Preparedness team. This team is responsible for:

- Assuring that Woodside hydrocarbon spill responders meet competency requirements.
- Establishing the competency requirements, annual training schedule and a training register of trained personnel.
- Establishing and maintaining the total numbers of trained personnel required to provide an effective response to any hydrocarbon spill incident.
- Ensuring equipment and services contracts are maintained
- Establishing OPEPs
- Establishing OPEAs
- Priority response receptor determination
- ALARP determination
- Ensuring compliance and assurance is undertaken in accordance with external and internal requirements.

6 ALARP EVALUATION

This Section should be read in conjunction with Section 5 which is the capability planned for this activity.

6.1 Monitor and Evaluate – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.1.1 Monitor and Evaluate – Control Measure Options Analysis

6.1.1.1 Alternative Control Measures

Alternative Control Measures considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Aerostat (or similar inflatable observation platform) for localised aerial surveillance.	Lead time to Aerostat surveillance is disproportionate to the environmental benefit. The system also provides a very limited field of visibility around the vessel it is deployed from.	Long lead time to access (>10 days). Each system would require an operator to interpret data and direct vessels accordingly. Requires multiple systems for shoreline use.	Purchase cost per system approx. A$300,000.	This option is not adopted as the minimal environmental benefit gained is disproportionate to the cost and complexity of its implementation.	No

6.1.1.2 Additional Control Measures

Additional Control Measures considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Additional personnel trained to use systems.	Current arrangement provides an environmental benefit in the availability of trained personnel facilitating access to monitoring data used to inform all other response techniques. No improvement required.	No improvement can be made, all personnel in technical roles e.g. intelligence unit are trained and competent on the software systems. Personnel are trained and exercised regularly. Use of the software and systems forms part of regular work assignments and projects.	Cost for training in-house staff would be approx. A$25,000.	This option is not adopted as the current capability meets the need.	No
Additional satellite tracking buoys to enable greater area coverage.	Increased capability does not provide an environmental benefit compared to the disproportionate cost in having an additional contract in place.	Tracking buoy on location at manned facility, additional needs are met from Woodside owned stocks in King Bay Support Base (KBSB) and Exmouth or can be provided by service provider.	Cost for an additional satellite tracking buoy would be A$200 per day or A$6000 to purchase.	This option is not adopted as the current capability meets the need, but additional units are available if required.	No
Additional trained aerial observers.	Woodside has access to a pool of trained, competent observers at strategic locations to ensure timely and sustainable response. Additional observers are available through current contracts with AMOSC and OSRL.	Aviation standards and guidelines ensure all aircraft crews are competent for their roles. Woodside maintains a pool of trained and competent aerial observers with various home base locations to be called upon at the time of an incident. Regular audits of oil spill response organisations ensure training and competency is maintained.	Cost for additional trained aerial observers would be A$2000 per person per day.	This option is not adopted as the current capability meets the need, but additional observers are available via response contractors if required.	No

6.1.1.3 Improved Control Measures

Additional Control Measures considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster turnaround time from modelling contractor.	Improved control measure does not provide an environmental benefit compared to the disproportionate cost in having an additional contract in place.	External contractor on ICC roster to be called as soon as required. However initial information needs to be gathered by ICC team to request an accurate model. External contractor has person on call to respond from their own location.	Modelling service with a faster activation time would be achieved via membership of an alternative modelling service at an annual cost of A$50,000 for 24hr access plus an initial A$5000 per modelling run.	This option is not adopted as the minimal environmental benefit gained is disproportionate to the cost and complexity of its implementation.	No
Night time aerial surveillance.	The risk of undertaking the aerial observations at night is disproportionate to the limited environmental benefit. The images would be of low quality and as such the variable is not adopted.	Flights will only occur when deemed safe by the pilot. The risk of night operations is disproportionate to the benefit	No improvement can be made without risk to personnel health and safety and breaching Woodside's Golden Rules.	This option is not adopted as the safety considerations outweigh any environmental benefit gained.	No

Additional Control Measures considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
		gained, as images from sensors (IR, UV, etc). will be low quality. Flight time limitations will be adhered to.			
Faster mobilisation time (for water quality monitoring).	Due to the restriction on accessing the spill location on Day one there is no environmental benefit in having vessels available from day one. The cost of having dedicated equipment and personnel is disproportionate to the environmental benefit. The availability of vessels and personnel meets the response need. Shortening the timeframes for vessel availability would require dedicated response vessels on standby in KBSB. The cost and organisational complexity of employing two dedicated response vessels (approximately $15M/year per vessel) is considered disproportionate to the potential environmental benefit to be realised by adopting this delivery options.	Operations are not feasible on day 1 as the hydrocarbon will take time to surface, and volatility has potential to cause health concerns within the first 24 hours of the response.	Cost for purchase of equipment approx. A$200,000. Ongoing costs per annum for cost of hire and pre-positioning for life of asset/activity would be larger than the purchase cost. Dedicated equipment and personnel, living locally and on short notice to mobilise. The cost would be approx. A$1 m per annum, which is disproportionate to the incremental benefit this would provide, assets are already available on day 1. 2 integrated fleet vessels are available from day 1, however these could be tasked with other operations.	This option is not adopted as the area could not be accessed earlier due to safety considerations. Additionally, the cost and complexity of implementation outweighs the benefits.	No

6.1.2 Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.2 Source Control – ALARP Assessment

Woodside has based its response planning on the worst-case credible scenarios (as described in Section 2.2). This includes the following selection of primary source control and well intervention techniques which would be conducted concurrently:

- ROV intervention
- debris clearance and/or removal
- capping stack (only viable for a loss of well containment of a lower magnitude than the worst case credible scenario where the plume radius is ~25 m)
- relief well drilling.

6.2.1 ROV Intervention

Following confirmation of an emergency event, Woodside would mobilise inspection class ROVs to assess the status of the wellhead. The ROV available on the MODU can be deployed for this purpose within 48 hours. Work class ROVs for well intervention are also available through the existing frame agreements and are available for deployment within seven days (Table 6-1). It is not expected that any additional regulatory approvals would be required as inspection, maintenance and repair is within the scope of activities for the GWF3 and Lambert Deep Operations Safety Case as well as the scope of activities for contracted Frame Agreement vessels.

As Woodside holds Frame Agreements for vessels along with contracts for ROV providers and pilots, inspection activities using ROVs are expected to commence within seven days.

A hydraulic accumulator contained as part of the SFRT can be mobilised and deployed with well intervention attempted within 11 days.

Table 6-1: ROV timings

	Estimate ROV inspection duration for GDA05 (days)	Estimate ROV inspection duration for LDA01 (days)
Source and mobilise vessel with work class ROV	2 days	2 days
Liaise with Regulator regarding risks and impacts*	4 days	4 days
Undertake ROV Inspection	1 day	1 day
TOTAL	**7 days***	**7 days***

** Based on timings from the Report into the Montara Commission of Enquiry, submission and discussion of revised documentation for limited activities inside the Petroleum Safety Zone (water deluge operations) to manage personnel risks and impacts was up to 20 days.*

6.2.1.1 Safety Case considerations

Woodside has assessed against the NOPSEMA safety case guidance (NOPSEMA N-09000-GN1661), confirming that vessels conducting subsea intervention operations are not classified as an “associated offshore place” but as a facility and therefore require the appropriate Safety Case arrangements to be in place. In the event of an emergency, Woodside has access to suitable vessels (ISVs) for well intervention through existing frame agreements. The frame agreements for ISV vessels require the vessels to maintain in-force safety case approval covering a range of subsea activities. This would cover the requirement for intervention operations such as subsea manifold installation, maintenance and repair, commissioning, cargo transfer (including bulk liquids) and ROV operations. With frame agreements in place, the credible Safety Case Scenario from those presented in Figure 6-4 and Figure 6-5 for implementing this response would be “no safety case revision required”. Timeframes for well intervention are detailed in Figure 6-2 and Figure 6-3 and would be implemented concurrently to the actions required by the "no Safety Case" revision scenario detailed in Figure 6-4 and Figure 6-5, therefore, the Safety Case scenario will have no impact on the delivery of the strategy.

6.2.2 Debris clearance and/or removal

The Woodside Source Control Response Procedure details the mobilisation and resource requirements for implementing this strategy. Debris clearance may be required as a prerequisite to deployment of the capping stack. The AMOSC SFRT would be mobilised from Fremantle. The mobilisation of the SFRT would take place in parallel with mobilisation of the capping stack to ensure initial ROV surveys and debris clearance have commenced before the arrival of the capping stack. The SFRT comprises ROV-deployed cutters and tools that are used to remove damaged or redundant items from the wellhead and allow improved access to the well. The SFRT can be mobilised and deployed with well intervention attempted within 11 days.

6.2.2.1 Safety Case considerations

Woodside has assessed against the NOPSEMA safety case guidance (NOPSEMA N-09000-GN1661) and can confirm that vessels conducting debris clearance and removal operations are not classified as an "associated offshore place" but as a facility and therefore require the appropriate Safety Case arrangements in place. In the event of an emergency, Woodside has access to suitable ISVs for these operations through existing frame agreements. The frame agreements for ISVs require the vessels to maintain in-force safety case approval covering a range of subsea activities. This would cover the requirement for debris clearance and removal operations such as subsea manifold installation, commissioning, cargo transfer (including bulk liquids) and ROV operations. With frame agreements in place, the credible Safety Case Scenario, from those presented in Figure 6-4 and Figure 6-5 for implementing this response would be "no safety case revision required". Timeframes for debris clearance and removal equipment deployment are detailed in Figure 6-2 and Figure 6-3 and would be implemented concurrently to the actions required by the "No Safety Case" revision scenario detailed in Figure 6-4 and Figure 6-5, therefore, the Safety Case scenario will have no impact on the delivery of the strategy.

6.2.3 Capping stack

The Woodside Source Control Response Procedure details the mobilisation and resource requirements for implementing this strategy. A capping stack is designed to be installed on a subsea well and provides a temporary means of sealing the well, until a permanent well kill can be performed through either a relief well or well re-entry.

Woodside has developed a project specific capping stack deployment plan and also commissioned an independent, subsea site-specific plume and gas dispersion study for the GWF3 and Lambert Deep wells (WWCI, 2020). The study indicates that shallow water in combination with high absolute open hole flow rates in the event of a worst-case blowout prohibit the safe deployment of a capping stack for both the GWF3 and Lambert Deep Drilling and Subsea Installation projects.

Various alternative options for safe and effective deployment of a capping stack in these conditions (plume of 90 m radius) were assessed but due to their complex nature or inability to implement under those conditions, these have been deemed as not ALARP (see Section 6.2.7).

Though all capping stack deployment technologies are unproven for high rate gas wells, in the event of a loss of well containment at less than the WCCS (plume radius is ~25 m), the use of a subsea deployment method such as a heavy lift vessel, which is more commonly used in industry, is a more reliable and, in turn, ALARP approach. If environmental conditions permit (wind speed, wave height, current and plume radius is ~25 m), deployment of a capping stack with a heavy lift vessel with a 120 T crane capacity, as recommended in the WWCI study, could be feasible.

Woodside assumes that sourcing conventional capping stack deployment vessels would be per the Source Control Response Procedure. This plan has pre-identified vessel specifications for the capping stack deployment and Woodside monitors the availability and location of these vessels on a monthly basis. Woodside maintain several frame agreements with various vessel service providers and maintains the ability to call off services with a capping stack and debris clearance agreement. The location of suitable vessels for capping stack deployment are monitored monthly. The supply arrangements and reliability to achieve the required mobilisation time will be revalidated prior to spud. Consideration to mobilise the capping stack from the supplier on a suitable vessel but then hand over to another vessel to conduct the capping activity will also be made to meet response time frames.

A capping stack will be mobilised to site within 16 days. Woodside will monitor the conditions around the wellsite and deployment for well intervention attempt will be undertaken once plume size is acceptable (~25 m radius) and safety and metocean conditions are suitable.

6.2.3.1 Safety Case considerations

Woodside has assessed against the NOPSEMA safety case guidance (NOPSEMA N-09000-GN1661) and can confirm that vessels conducting capping stack are not classified as an “associated offshore place” but as a facility and therefore require the appropriate Safety Case arrangements in place.

The 16-day timeframe to mobilise the vessel is based on the following assumptions:

- existing frame agreement vessel, located outside the region with approved Australian Safety Case
- a safety case revision and scope of validation is required
- vessel has an active heave compensated crane, rated to at least 120 T and at least 90 m in length and a deck capacity to hold at least 110 T of capping stack.

Timeframes for capping stack deployment detailed in Figure 6-2 and Figure 6-3 would be implemented concurrently with the actions required for the Safety Case revision development scenarios detailed in Figure 6-4 and Figure 6-5 and Table 6-4. To reduce uncertainty in regulatory approval timeframe, Woodside is collaborating with The Drilling Industry Steering Committee (DISC) and a contracted ISV Vessel Operator to develop a generic Safety Case Revision that contemplates a capping stack deployment. This Safety Case Revision will be used to reduce uncertainty in permissioning timeframes in the event a capping stack deployment is required. Woodside will execute the capping stack response in the fastest possible timeframe, provided the required safety and metocean conditions allow. Woodside has considered a broad range of alternate, additional, and improved options as outlined later in Section 6.2.5.

6.2.4 Relief Well drilling

The options analysis detailed in this section considers options to source, contract and mobilise a MODU and ensure necessary regulatory approvals are in place to meet timelines for relief well drilling. The screening for relief well drilling MODUs is based on the following and the process used for GWF3 and Lambert Deep is illustrated in Figure 6-1:

- Primary – review internal Woodside drilling programs and MODU availability to source an appropriate rig operating within Australia with an approved Safety Case.
- Alternate – source and contract a MODU through APPEA MOU that is operating within Australia with an approved Safety Case.
- Contingency – Source and contract a MODU outside Australia with an approved Australian Safety Case.

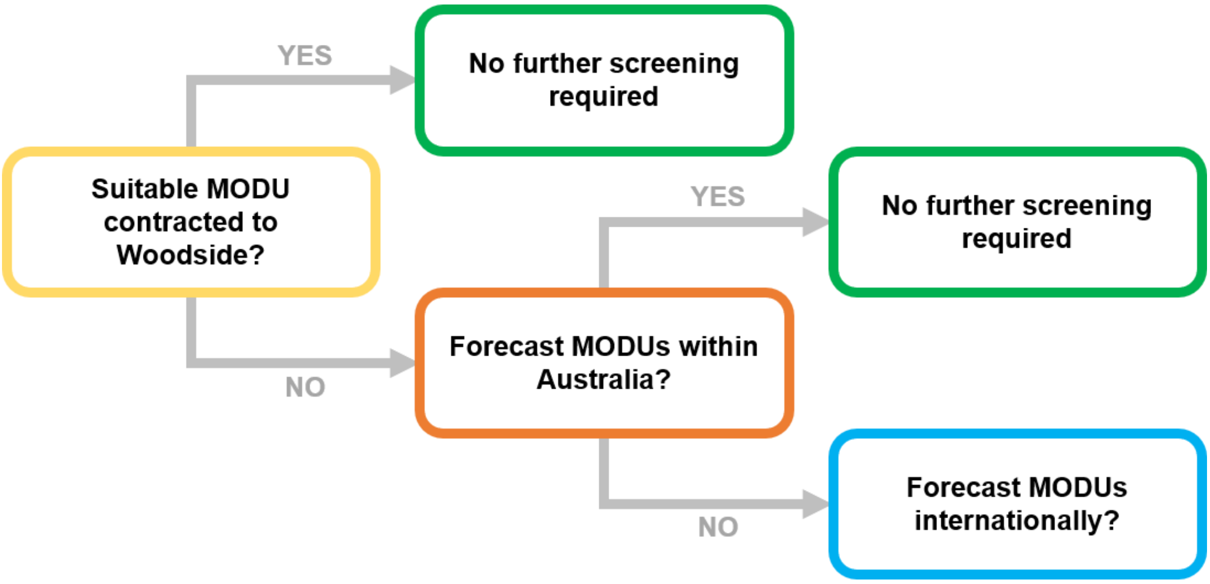


Figure 6-1: GWF3 and Lambert Deep process for sourcing relief well MODU

Woodside has not assessed the timeframe for obtaining a relief well MODU through international supply for this project as the certainty of supply has been confirmed through local supply. Screening of a relief well MODU from international waters is undertaken only if required, i.e. there is low confidence in local (Australian) availability. The screening of relief well MODUs is undertaken and presented at a well design stage peer assessment. The capability, location and Australian Safety Case status is assessed for each Woodside contracted MODU. In the event the Woodside contracted MODUs are unsuitable, screening is extended to all MODUs operating in Australian Waters. The suitability and location of pre-identified relief well MODUs is tested again prior to the operation. Though the APPEA MoU will serve as the instrument to facilitate the transfer of drilling units and well site services between operators in the event of an emergency, Woodside will engage each of the identified titleholders in advance to maintain confidence in MODU suitability and availability.

Based on the detail provided, the Primary and Alternate approaches are expected to be achieved within the 21-day period.

The internal and external availability of moored MODUs, plus rig activities of registered operators and rigs with approved safety cases, are tracked by Woodside on a monthly basis, with a two-year look ahead, to ensure that the best available option can be sourced and utilised in the event of the worst-case credible scenario.

If the above forecast indicates a gap in availability of a suitable MODU for relief well drilling within Australia, screening would be extended to MODUs with a valid safety case outside Australia. If an international MODU with an Australian safety case is not identified, an internal review will be undertaken, NOPSEMA notified and the issue tabled at the APPEA Drilling Industry Safety Committee. A review of the significance of the change in risk will be undertaken in accordance with Woodside's environment management of change requirements and relevant regulatory triggers. The aforementioned lookahead timeframe would allow two years' warning of any potential gap. Woodside will execute relief well drilling in the fastest possible timeframe.

The detail of these arrangements demonstrates that the risks have been reduced to ALARP and Acceptable levels through the control measures and performance standards outlined in Section 5.2.

6.2.4.1 Relief Well drilling timings

The duration of a blowout (from initiation to a successful kill) is assessed as 71 days for GDA05 and 77 days for LDA01. Relief wells for other wells within the field are expected to be similar duration.

The two wells analysed were selected for the following reasons:

- GDA05 is an indicative well design for the three planned GDA wells to be drilled in the campaign as part of the PAP. This well was also analysed for the well-kill modelling work due to it being the worst-case blowout rates for the GDA wells.
- LDA01 was selected as this is a standalone development well in another permit area but part of the same PAP.

Details on the steps and time required to drill a relief well is shown in Table 6-2 below. Moored MODUs are suitable for the GWF3 and Lambert Deep PAPs and have been used as the basis for the analysis within this document.

To validate the effectiveness of the relief MODU supply arrangements through the APPEA MoU, the 21-day mobilisation period was tested in April 2019 in an exercise facilitated by an external party. This exercise included suspension of the assisting operator's activities, contracting the MODU, vessel safety case revision and transit to location. The testing of mobilisation arrangements has been incorporated into Woodside's Hydrocarbon Spill Arrangements Testing Schedule.

Table 6-2: Relief well drilling timings

	Estimate Relief Well duration for GDA05 Well (days) – moored	**Estimate Relief Well duration for LDA01 Well (days) – moored**
Source and contract MODU comprising the following stages:	**21 days total:**	**21 days total:**
Activate MOU. Secure and suspend well. Complete relief well design. Secure relief well materials.	*8 days*	*8 days*
Transit to location based on mobilisation from Northwest shelf region.	*2 days*	*2 days*
Backload and loadout bulks and equipment, complete internal assurance of relief well design.	*2 days*	*2 days*
Contingency for unforeseen event (e.g. longer transit from another area, problems in securing well, cyclone event)	*9 days*	*9 days*
Pre-spud survey	**Already included**	**Already included**
Mooring Spread Installation *NB Occurs in parallel with the 21 days to mobilise the rig, so the timing included here is the difference*	**16 days**	**15.6 days**
Drilling, casing and look ahead estimate *NB timing variation between the two wells is due to the wells casing program differences. Intersection point assumed to be into the production liner of the blowing out well for both wells analysed.*	**20.0 days**	**25.6 days**
Intersection & well kill comprising the following stages:	**14.0 days total:**	**14.0 days total:**
Drill out shoe, conduct formation integrity test and drill towards intersection point	*1.5 days*	*1.5 days*
Execute well-specific ranging plan to intersect blowout wellbore in minimum timeframe, with highest possible accuracy.	*9.5 days*	*9.5 days*
Pump kill weight drilling fluid per the relief well plan. Confirm the well is static with no further flow.	*0.5 days*	*0.5 days*

Contingency for unforeseen technical issues (e.g.: more ranging runs required to make intersect, additional mud circulations required to execute kill	*2.5 days*	*2.5 days*
	71.0 days	**77 days (76.2)**

The following conditions and assumptions are applicable:

- A dynamically positioned MODU is not feasible for the water depths at GDA-05 and LDA-01.
- A pre-lay mooring spread is required to moor the rig over subsea infrastructure. Estimated duration to procure and install the pre-lay moorings is five (5) weeks, which would occur in parallel to MODU mobilisation. The breakdown of this timeframe is as follows:

Table 6-3: Mooring Spread installation timings

Activity	Duration (days)
Design mooring spread and commence sourcing equipment	7
Source equipment and mobilise to supply base (carried out concurrently while sourcing rig)	21
Install pre-lay spread	7
Connect to pre-laid moorings and prepare to spud	1.6
Total	**36.6**

Woodside has considered a broad range of alternate, additional, and improved options as outlined in Section 6.2.5.

Intersect and kill duration is estimated at 14 days. This is a moderately conservative estimate. During the intersect process, the relief well will be incrementally drilled and logged to accurately approach and locate the existing well bore. This will result in the highest probability of intersecting the well on the first attempt and thus will reduce the overall time to kill the well. During the Montara incident, it took five attempts to achieve a successful intersect.

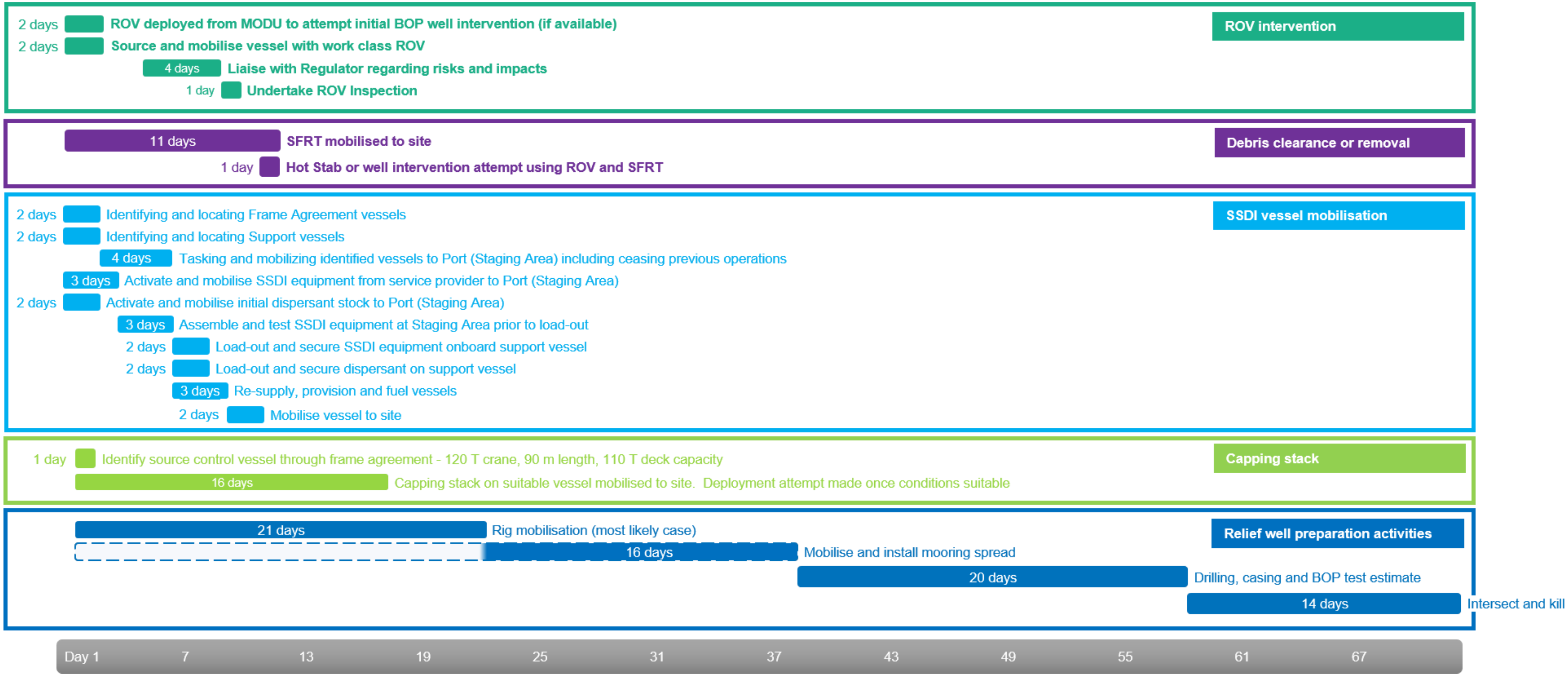


Figure 6-2: Source control and well intervention response strategy deployment timeframes for GWF3 (GDA05 well)

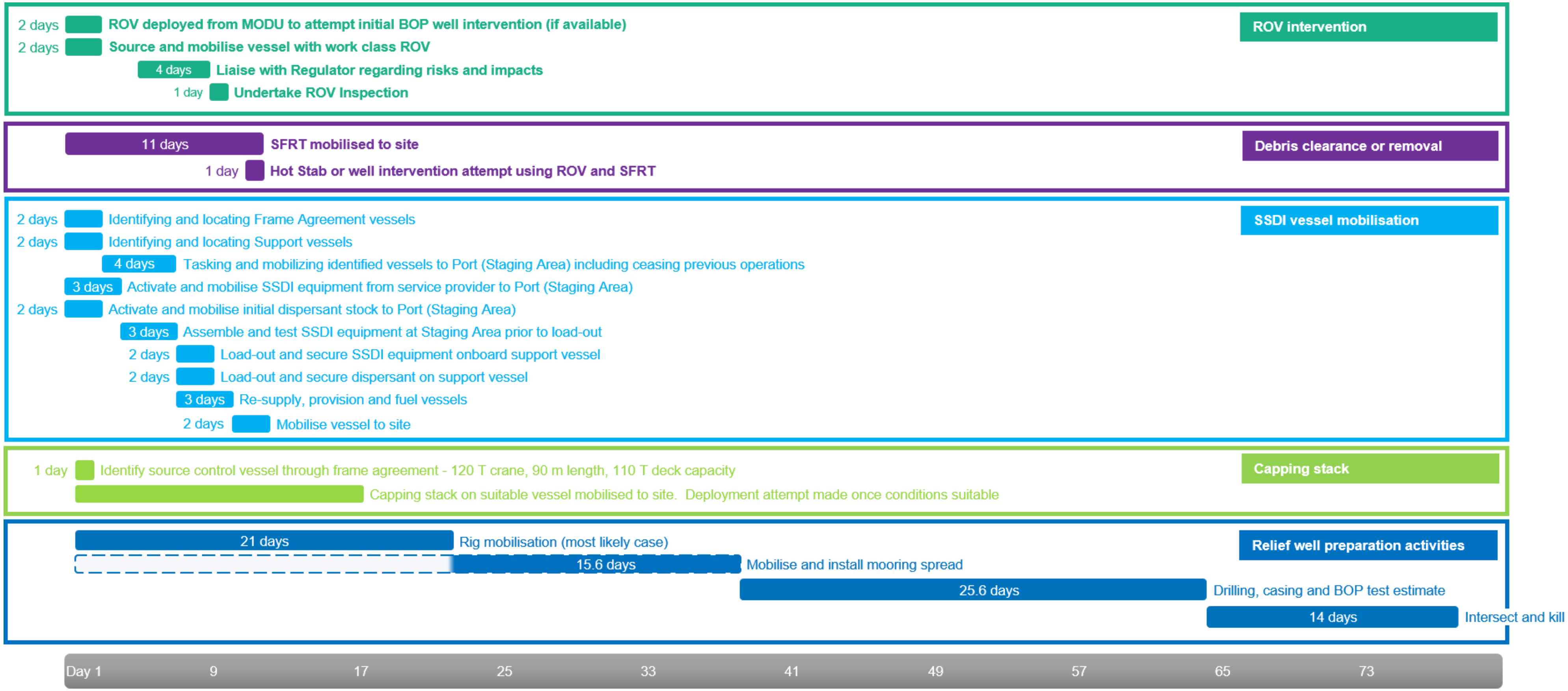


Figure 6-3: Source control and well intervention response strategy deployment timeframes for Lambert Deep (LDA01 well)

6.2.4.2 Safety Case considerations

Woodside recognises that it will not be the Operator or holder of the Safety Case for the MODU and/or vessels involved in relief well activities. In the event that a revision to the Operator's Safety Case is required for relief well drilling, Woodside has identified measures to ensure timely response and optimise preparedness as far as practicable that can be undertaken to expedite a straightforward Safety Case revision for a MODU/ vessel to commence drilling a relief well. Performance standards associated with these measures have been included in Section 5.2.

These include;

- Access to Safety and Risk discipline personnel with specialist knowledge.
- Monitoring internal and external rigs and vessel availability in the region and extended area through contracted arrangements on a monthly basis, with a two-year lookahead.
- Prioritisation of rigs/vessels with current or historical contracting arrangements. Woodside maintains records of previous contracting arrangements and companies. All current contracts for vessels and rigs are required to support Woodside in the event of an emergency.
- Leverage mutual aid arrangements such as the APPEA MOU for vessel and rig support.
- Woodside Planning and Logistics, and Safety Officers (on-Roster/Call 24/7) which can articulate need for, and deliver Woodside support, in key delivery tasks including sitting with potential outside operators.
- Ongoing strategic industry engagement and collaboration with NOPSEMA to work toward time reductions in regulatory approvals for emergency events.

Woodside has identified three safety case revision development and submission scenarios for a MODU and plotted these alongside the relief well preparation activities in Figure 6-4 and Figure 6-5. The assumptions for each of the cases are detailed in subsequent Table 6-4.

The MODUs screened for contingency relief well drilling all operate under an Accepted base Safety Case. A relief well Safety Case Revision would leverage the previously accepted Safety Case Revision for the GWF3 and Lambert Deep Drilling and Subsea Installation, including the associated site-specific well hazards. As such, there is less new detail for the regulator to review and should present a short review timeframe with no impact expected to the commencement of relief well drilling activities.

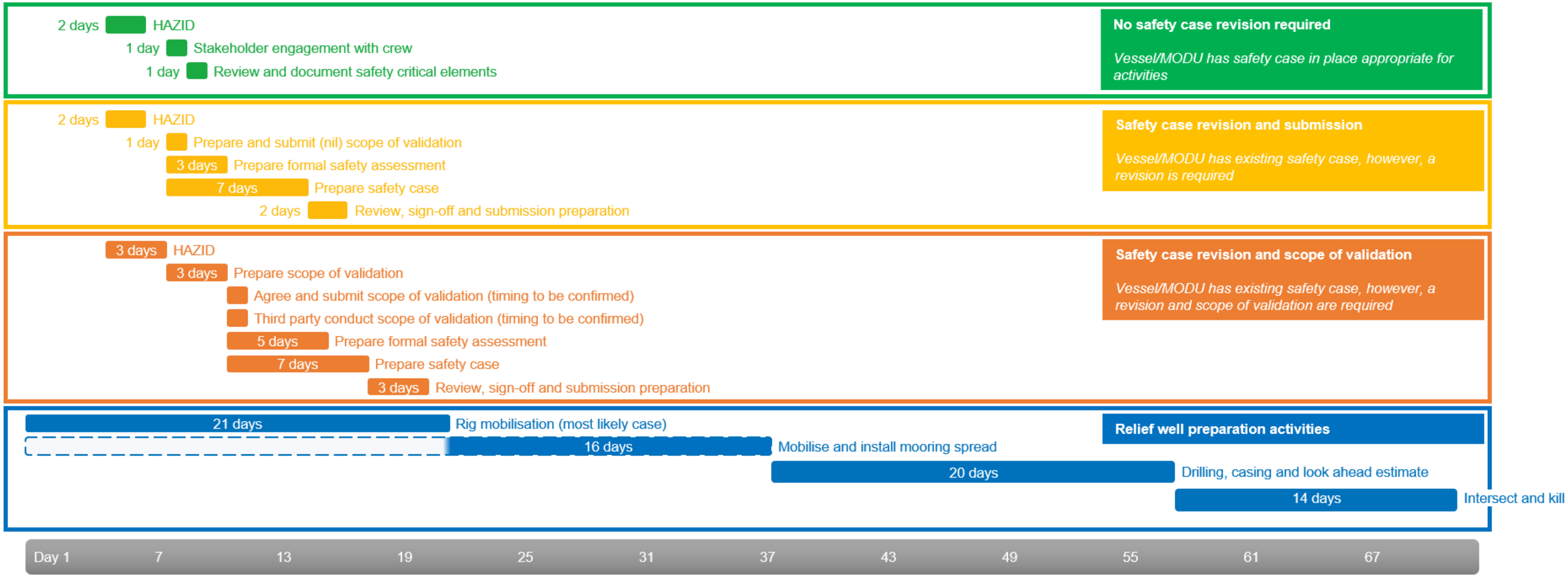


Figure 6-4: Timeline showing safety case revision timings alongside other relief well preparation activity timings for GWF3 (GDA05 well)

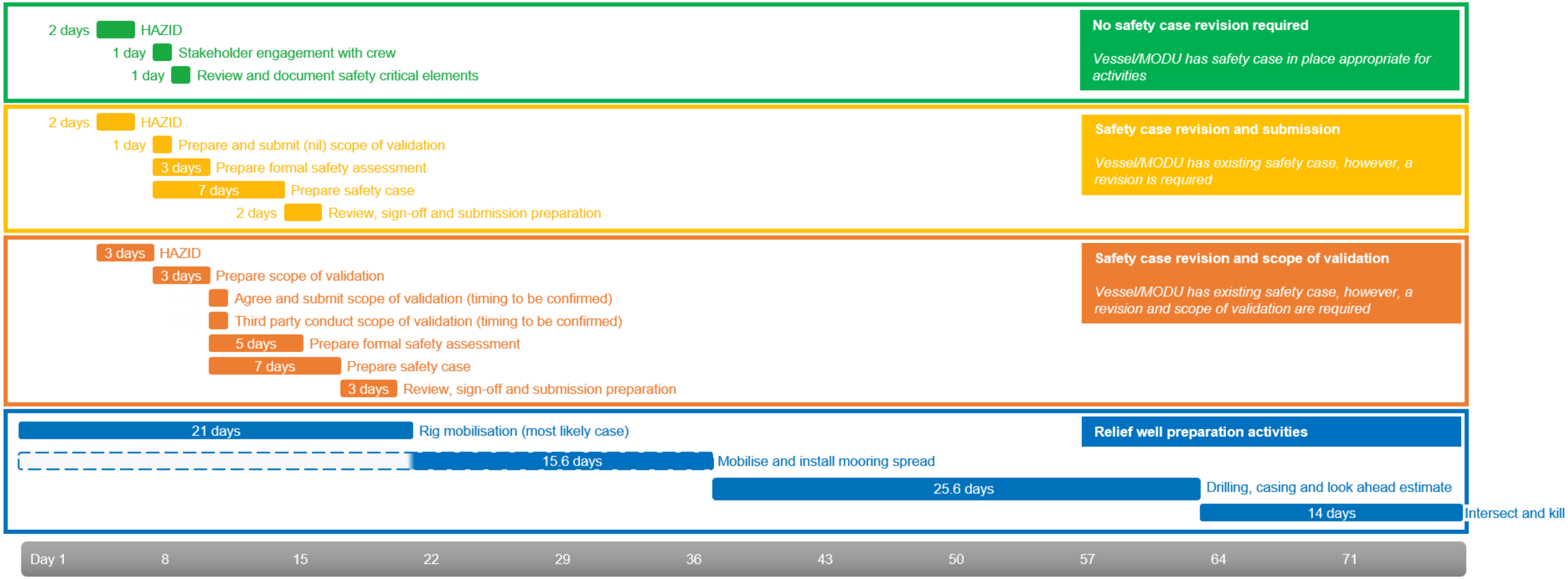


Figure 6-5: Timeline showing safety case revision timings alongside other relief well preparation activity timings for Lambert Deep (LDA01 well)

Table 6-4: Safety case revision conditions and assumptions

Case	No safety case revision required	Safety case revision and submission	Safety case revision and scope of validation
Description	Vessel/MODU has a safety case in place appropriate for activities.	Vessel/MODU has an existing safety case, however, a revision is required.	Vessel/MODU has an existing safety case, however, a revision is required plus scope of validation.
Conditions/ assumptions	• Assumes that existing vessel/MODU safety case covers working under the same conditions or the loss of containment is not severe enough to result in any risk on the sea surface.	• Safety case timing assumes vessel/MODU selected and crew and available for workshops and safety case studies.	• Safety case timing assumes vessel/ MODU selected and crew and available for workshops and safety case studies.
		• Assumes nil scope of validation. This assumes that the vessel for SSDI allows for working in a hydrocarbon environment and control measures are already in place in the existing safety case. For MODU, it assumes that the relief well equipment is already part of the MODU facility and MODU safety case.	• Validation will be required for new facilities only. The time needed for the validator to complete the review (from the last document received) and prepare validation statement is undetermined. This is not accounted for here as the safety case submission is not dependent on the validation statement, however the safety case acceptance is.
		• Assumes safety case preparation is undertaken 24/7.	• Assumes safety case preparation is undertaken 24/7.

6.2.5 Source Control – Control Measure Options Analysis

The assessments described in Sections 6.2.1, 6.2.2, 6.2.3 and 6.2.4 outline the primary and alternate approaches that Woodside would implement for source control. In Sections 6.2.6 and 6.2.7, Woodside has outlined the options considered against the activation/mobilisation (alternative, additional and improved options) and deployment (additional and improved options) processes as described in Section 2.1.1. This assessment provides an evaluation of:

- predicted cost associated with adopting the option
- predicted change/environmental benefit
- predicted effectiveness/feasibility of the option.

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical.

- Alternative options, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control.
- Additional control measures are evaluated in terms of their ability to reduce an impact or risk when added to the existing suite of control measures.
- Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility.

Options where there is not a clear justification for their inclusion or exclusion may be subject to a detailed assessment.

6.2.5.1 Activation/Mobilisation Options considered

Alternative

- Standby MODU shared for all Woodside activities
- Standby MODU shared across APPEA MOU Titleholders

Additional

- Implement and maintain minimum standards for Safety Case development

Improved

- Monitor internal drilling programs for rig availability
- Monitor external activity for rig availability
- Monitor status of Registered Operators/ Approved Safety cases for rigs

6.2.5.2 Deployment Options considered

Additional

- Offset capping alternative to conventional capping stack deployment
- Dual vessel capping stack deployment
- Subsea Containment System alternative to capping stack deployment
- Pre-drilling top-holes
- Purchase and maintain mooring system
- Contract in place with WWCI and Oceaneering

Improved

- Maintaining relief well drilling supplies (mud, casing, etc).

6.2.6 Activation/Mobilisation – Control Measure Options Analysis

This section details the assessment of alternative, additional or improved control measures that were considered to ensure the selected level of performance in Section 5.2 reduces the risk to ALARP. The Alternative, Additional and Improved control measures that have been assessed and selected are highlighted in green and the relevant performance of the selected control is cross referenced. Items highlighted in red have been considered and rejected on the basis that they are not feasible or the costs are clearly grossly disproportionate compared to the environmental benefit.

6.2.6.1 Alternative control measures

Alternative Control Measures Considered
Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control

Option considered	Feasibility	Environmental benefits/impacts	Approximate cost	Assessment conclusions	Implemented
Standby MODU shared for all Woodside activities	A standby MODU shared across all Woodside activities is likely to provide a moderate environmental benefit as it may reduce the 21-day sourcing, contracting and mobilisation time by up to 10 days (to 11 days). This would reduce the volume and duration of release and may reduce impacts on receptors and sensitivities.	This option is not considered feasible for all Woodside activities as there are a large range of well depths, complexities, geologies and geophysical properties across all Woodside's operations. The large geographic area of Woodside activities also means that the MODU is unlikely to be in the correct location at the right time when required.	Even with costs shared across Woodside operations, the costs (approximately A$219 m per annum, A$1.95 b over the five years) of maintaining a shared MODU are considered disproportionate to the environmental benefit potentially achieved by reducing mobilisation times by up to 10 days.	The costs and complexity of having a MODU and maintaining this arrangement for the duration of the Petroleum Activities Program are disproportionate to the environmental benefit gained above finding a MODU through the MOU agreement for all spill scenarios.	No
Standby MODU shared across APPEA MOU Titleholders	A standby MODU shared across all titleholders who are signatories to the APPEA MOU is likely to provide a minor environmental benefit as it may reduce the 21-day sourcing, contracting and mobilisation time by up to seven days (to 14 days). This would reduce the volume and duration of release and may reduce impacts on receptors and sensitivities.	This option is not considered feasible for a number of Titleholders due to the remote distances in Australia as well as a substantial range of well depths, types, complexities, geologies and geophysical properties across a range of Titleholders	As the environmental benefit is only considered minor and the reduction in timing would only be for the mobilisation period (reduction from 21 days to 14 days) the costs are considered disproportionate to the minor benefit gained.	The costs and complexity of having a MODU and maintaining a shared arrangement for the duration of the Petroleum Activities Program are disproportionate to the environmental benefit gained above finding a MODU through the MOU agreement for all spill scenarios.	No

6.2.6.2 Additional control measures

Additional Control Measures Considered
Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures

Option considered	Feasibility	Environmental benefits/impacts	Approximate cost	Assessment conclusions	Implemented
Implement and maintain minimum standards for Safety Case development	Woodside's contingency planning consideration would be to source a rig from outside Australia with an existing Safety Case. This would require development and approval of a safety case revision for the rig and activities prior to commencing well kill operations.	This option is considered feasible and would require Woodside to develop minimum standards for safe operations for relevant Safety Case input along with maintaining key resources to support review of Safety Cases. Woodside would not be the operator for relief well drilling and would therefore not develop or submit the Safety Case revision. Woodside's role as Titleholder would be to provide minimum standard for safe operations that MODU operators would be required to meet and/or exceed.	Woodside has outlined control measures and performance standards regarding template Safety Case documentation and maintenance of resources and capability for expedited Safety Case review.	This option has been selected based on its feasibility, low cost and the potential environmental benefits it would provide.	Yes

6.2.6.3 Improved control measures

Improved control measures Considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Feasibility**	**Environmental benefits/impacts**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Monitor internal drilling programs for rig availability	Woodside may be conducting other campaigns that overlap with the Petroleum Activities Program, potentially providing availability of a relief well drilling rig within Woodside. The environmental benefit of monitoring other drilling programs internally is that Woodside would be in a position to understand which other rigs might be rapidly available for relief well operations if required, potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.	Woodside monitors vessel and MODU availability through market intelligence services for location. Woodside will continually monitor other drilling and exploration activities within Australia and as available throughout the region to track rigs and explore rig availability during well intervention operations.	Associated cost of implementation is minimal to the environmental benefit gained. Woodside has outlined control measures and performance standards.	This option is a low-cost control measure with potential to reduce the volume of hydrocarbon released to the environment.	Yes
Monitor external activity for rig availability	The environmental benefit achieved by monitoring drilling programs and rig movements across industry provides the potential for increased availability of suitable rigs for relief well drilling. Additional discussions with other Petroleum Titleholders may be undertaken to potentially gain faster access to a rig and reduce the time taken to kill the well and therefore volume of hydrocarbons released.	Woodside will source a relief well drilling rig in accordance with the APPEA MOU on rig sharing in the unlikely event this is required. Commercial and operational provisions do not allow Woodside to discuss current and potential drilling programs in detail with other Petroleum Titleholders.	Associated cost of implementation is moderate to the environmental benefit gained. Woodside will continually engage with other Titleholders and Operators regarding activities within Australia and as available throughout the region to track rigs and explore rig availability during well intervention operations.	This option is a low-cost control measure with potential to reduce the volume of hydrocarbon released to the environment.	Yes
Monitor status of Registered Operators / Approved Safety cases for rigs	Woodside can monitor the status of Registered Operators for rigs operating within Australia (and therefore safety case status) on a monthly basis. This allows for a prioritised selection of rigs in the event of a response with priority given to those with an existing safety case.	The environmental benefit of monitoring other drilling programs internally is that Woodside would be in a position to understand which other rigs might be rapidly available for relief well operations if required, potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.	The cost is minimal.	This option is a low-cost control measure with potential to reduce the volume of hydrocarbon released to the environment.	Yes

6.2.7 Deployment – Control Measure Options Analysis

6.2.7.1 Additional Control Measures

Additional Control Measures considered
Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures

Option considered	Environmental consideration	Feasibility	Approximate cost	Assessment conclusions	Implemented
Offset capping alternative to conventional capping stack deployment	While the use of an offset capping system could reduce the quantity of hydrocarbon entering the marine environment, the feasibility issues surrounding an offset capping deployment in the water depths at the GDA05 well (125 m) and LDA01 well (130 m), together with mobilisation lead times for both a cap and required vessels/ support equipment, would minimise any environmental benefit gained.	Technical feasibility: • The base case considerations for OIE requires a coordinated response by 4 to 7 vessels working simultaneously outside of the 500m exclusion zone. In the event of a worst-case shallow water gas discharge, the 10% LEL modelled radius extends beyond the area of activity required for the OIE deployment thereby introducing health and safety risk to any vessels required for the initial deployment of the carrier and subsequent operations with ROV during capping operations. Though manageable for single vessels, it is prohibitive for operations requiring SIMOPs with numerous vessels working at 180 degrees from one another. • Water depth is also a key consideration as buoyancy modules have not been proven for use in these depths or with the expected worst-case gas blowout rates. Other factors: • Due to the OIE's size and scale, fabrication of equipment, e.g. mooring anchors, outside of the contractor's scope of supply is likely to require engagement of international suppliers, further increasing complexity and uncertainty in associated time frames. • Screening indicates that mobilising some components of the OIE, based in Italy, can only be done so by sea and is likely to erode any time savings realised through killing the well via a relief well. • The March 2019 OSRL exercise in Europe tested deployment of the OIE and highlighted that it will require a 600+MT crane vessel for deployment to ensure there is useable hook height for the crane to conduct the lift of the carrier. Vessels with such capability and a current Australian vessel safety case are not locally or readily available.	Due to risks, uncertainty and complexity of this option, and the inability to realise any environmental gains, any cost would be disproportionate to the benefits gained.	Woodside has confidence in availability of suitable relief well MODUs across the required drilling time frame thus the OIE would provide no advantage. Implementation of OIE has been assessed as a complex and unfeasible SIMOPs operation, precluded by a combination of the site-specific metocean and worst-case discharge conditions at the GWF3 and Lambert Deep location. Implementation of a novel technology such as OIE culminates in low certainty of success while at the same time increasing associated health and safety risks. As such the primary source control response and ALARP position remains drilling a relief well.	No
Dual vessel capping stack deployment	While the use of dual vessel to deploy the capping system could reduce the quantity of hydrocarbon entering the marine environment, this is an unproven technology. Additionally, the feasibility issues surrounding a dual vessel capping deployment in the water depths at GDA05 well (125 m) and LDA01 well (130 m), together with mobilisation lead times for both a cap and required vessels and support equipment, would minimise any environmental benefit.	A dual vessel deployment is somewhat feasible provided a large enough deck barge can be located. Deck barges of 120 m are not, however, very common and will present a logistical challenge to identify and relocate to the region. Further, the longer length barges may need mooring assist to remain centred over the well. The capping stack would be handed off from a crane vessel to the anchor handler vessel (AHV) work wire outside of the exclusion zone. The AHV would then manoeuvre the barge into the plume to get the capping stack over the well. In this method, the barge would be in the plume, but the AHV and all personnel would be able to maintain a safe position outside of the gas zone. The capping stack would actually be lowered on the AHV work wire so a crane would not be required on the barge.	Due to there being minimal environmental benefits gained by the prolonged lead times needed to execute this technique, plus a potential increase in safety issues, any cost would be disproportionate to the benefits gained.	Given there is minimal environmental benefit and an increase in safety issues surrounding SIMOPS and deployment in shallow waters, this option would not provide an environmental or safety benefit.	No
Subsea Containment System alternative to capping stack deployment	While the use of a subsea containment system could reduce the quantity of hydrocarbon entering the marine environment, this is an unproven technology. Additionally, the system is unlikely to be feasibly deployed and activated for at least 90 days following a blowout due to equipment requirements and logistics. No environmental benefit is therefore predicted given the release duration is 71 days (GWF3)/ 77 days (Lambert Deep) before drilling of a relief well under the adopted control measure.	The timing for mobilisation, deployment and activation of the subsea containment system is likely to be >90 days which is longer than the expected 71 days (GWF3)/ 77 days (Lambert Deep) relief well drilling operations based on the location, size and scale of the equipment required, including seabed piles that can only be transported by vessel.	Woodside has investigated the logistics of reducing this timeframe by pre-positioning equipment but the costs of purchasing dedicated equipment by Woodside for this Petroleum Activities Program is not considered reasonably practical and are considered disproportionate to the environmental benefit gained.	This option would not provide an environmental benefit.	No

Pre-drilling top-holes	This option represents additional environmental impacts associated with discharge of additional drill cuttings and fluids along with benthic habitat disturbance. It is also not expected to result in a significant decrease in relief well timings	This option is not considered feasible due to the uncertainties related to the location and trajectory of the intervention well, which may vary according to the actual conditions at the time the loss of containment event occurs. Additionally, there is only expected to be a minor reduction in timing for this option of 1-2 days based on the drilling schedule. Duration to drill and kill may be reduced by 1-2 days, but top-hole may have to be relocated, due to location being unsafe or unsuitable and further works will be required each year to maintain the top holes.	Utilising an existing MODU and pre-drilling top-hole for relief well commencement would significantly increase costs associated the Petroleum Activities Program. Estimated cost over the program's life is approx. A$555,000 per day over the PAP based on 2-4 days of top-hole drilling (plus standby time) for the well as the worst-case scenario.	This option would not provide an environmental benefit due to the additional environmental impacts coupled with a lack of improved relief well timings.	No
Purchase and maintain mooring system	Purchasing and maintaining a mooring system could provide a moderate environmental benefit as it may reduce equipment sourcing time. However, due to the continued need for specialists to install the equipment plus sourcing a suitable vessel, the timeframe reduction would be minimal.	Woodside is not a specialist in installing and maintaining moorings so would require specialists to come in to install the moorings and would also require specialist vessels to be sourced to undertake the work.	The cost of purchasing, storing and maintaining pre-lay mooring systems with anchors, chains, buoys and ancillary equipment is considered disproportionate to the environmental benefit gained.	This option would not provide an environmental benefit as timeframe reductions would be minimal.	No
Contract in place with WWCI and Oceaneering	Woodside has an agreement in place with WWCI and Oceaneering to provide trained personnel in the event of an incident. This will ensure that competent personnel are available in the shortest possible timeframe.	Having contracts in place to access trained, competent personnel in the event of an incident would reduce mobilisation times. This option is considered reasonably practicable.	Minimal cost implications – Woodside has standing contract in place to provide assistance across all activities.	This control measure is adopted as the costs and complexity are not considered disproportionate to any environmental benefit that might be realised.	Yes

6.2.7.2 Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Maintaining relief well drilling supplies	There is not predicted to be any reduction in relief well timing or spill duration from Woodside maintaining stocks of drilling supplies (mud, casing, cement, etc.)	It would be feasible to source some relief well drilling supplies such as casing but the actual composition of the cement and mud required will need to be specific to the well. This option is also not deemed necessary as the lead time for sourcing and mobilising these supplies is included in the 21 days for sourcing and mobilising a rig.	The capital cost of Woodside purchasing relevant drilling supplies is expected to be approximately A$600,000 with additional costs for storage and ongoing costs for replenishment. These costs are considered disproportionate to the environmental benefit gained.	This option would not provide an environmental benefit.	No

6.2.8 Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - Implement and maintain minimum standards for Safety Case development
  - Contract in place with WWCI and Oceaneering to supply trained, competent personnel
- Improved
  - Monitor internal drilling programs for MODU availability
  - Monitor external activity for MODU availability
  - Monitor status of Registered Operators / Approved Safety cases for MODUs

6.3 Subsea Dispersant Injection – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.3.1 Subsea Dispersant Injection timing

The scope of existing safety cases for Frame Agreement vessels includes all relevant activities for SSDI operations. Depending on the location and availability of vessels, Woodside expects the SSDI capability can be mobilised to site for deployment within 12 days. This may be able to be achieved faster if vessels are closer to appropriate staging areas and not already involved in other operations. The following steps are included within the indicative timeframe and many of these are expected to be concurrent activities, as shown in Figure 6-2 and Figure 6-3.

1. Identifying and locating Frame Agreement vessels (1-2 days)
2. Identifying and locating support vessels (1-2 days)
3. Tasking and mobilising identified vessels to port (staging area) including ceasing previous operations (2-4 days)
4. Activate and mobilise SSDI equipment from service provider to port (staging area) (2-3 days)
5. Activate and mobilise initial dispersant stock to port (staging area) (1-2 days)
6. Assemble and test SSDI equipment at staging area prior to load-out (2-3 days)
7. Re-supply, provision and fuel vessels (1-2 days)
8. Load-out and secure SSDI equipment onboard ISV (1-2 days)
9. Load-out and secure dispersant on support vessel (1-2 days)
10. Contingency for unforeseen events (1 day)

6.3.2 Response Planning: GWF3 and Lambert Deep loss of well containment scenarios (Credible Scenario-01 and Credible Scenario-02)

Following a loss of well containment it may take 2-5 days to complete a risk assessment, discuss and agree appropriate control measures with NOPSEMA (Safety, Environment and Well Integrity divisions), and monitor the operating environment within the Petroleum Safety Zone around a well or facilities. Subsea dispersant injection is unlikely to be deployed until approximately day 12, subject to subsea ROV survey of the site and agreement of risk assessment and recommended control measures to ensure personnel safety.

Dispersant efficacy testing has not been undertaken for subsea conditions, but industry experience estimates a subsea amenability to dispersant of approximately 50-60% effectiveness. Based on response planning assumptions outlined in Section 5.3, the subsea dispersant injection system (as part of the SFRT package) is able to deliver approx. 60-75 m³ per day on a continuous 24 hour/7 day basis.

For the purpose of capability demonstration below, Woodside has shown that once the SSDI system arrives and is able to be deployed safely, sufficient capability exists to commence and continue SSDI until the well is killed (approximately day 71 for Credible Scenario-01 and day 77 for Credible Scenario-02).

Table 6-5: Response Planning – Subsea Dispersant Injection

	Subsea Dispersant Injection (SSDI)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3
	Oil Release	5,931	5,931	5,931	5,931	5,931	5,931	5,931	40,285	39,417			
R1	Oil Release Rate (GWF3 Credible Scenario-01) - m³	5,931	5,931	5,931	5,931	5,931	5,931	5,931	40,285	39,417	38,451	144,774	73,019
R2	Oil Release Rate (Lambert Deep Credible Scenario-02) - m³	942	942	942	942	942	942	942	6,608	6,468	6,328	23,956	17,038
A	**Capability available - m³**												
A1	Predicted oil volume treated by SSDI (lower)	0	0	0	0	0	0	0	3,600	12,600	12,600	50,400	50,400
A2	Predicted oil volume treated by SSDI (upper)	0	0	0	0	4,500	4,500	4,500	31,500	31,500	31,500	126,000	126,000
A3	Dispersant application volume (lower)	0	0	0	0	0	0	0	120	420	420	1,680	1,680
A4	Dispersant application volume (upper)	0	0	0	0	75	75	75	525	525	525	2,100	2,100
B	**Subsea release oil remaining - m³**												
B1*	Predicted oil volume not treated (GWF3 Credible Scenario-01) (lower)	5,931	5,931	5,931	5,931	5,931	5,931	5,931	36,685	26,817	25,851	94,374	22,619
B2*	Predicted oil volume not treated (GWF3 Credible Scenario-01) (upper)	5,931	5,931	5,931	5,931	1,431	1,431	1,431	8,785	7,917	6,951	18,774	-52,981
B3*	Predicted oil volume not treated (Lambert Deep Credible Scenario-02) (lower)	942	942	942	942	942	942	942	3,008	-6,132	-6,272	-26,444	-33,362
B4*	Predicted oil volume not treated (Lambert Deep Credible Scenario-02) (upper)	942	942	942	942	-3,558	-3,558	-3,558	-24,892	-25,032	-25,172	-102,044	-108,962

A1 and A2 – the upper and lower volumes in m³ that subsea dispersant injection may be able to treat (based on response planning assumptions in Section 5.3 and volumes in A3 and A4). These are based on a 1:50 ratio for A1 and a 1:100 ratio for A2

A3 and A4 - the upper and lower volumes in m³ of the associated dispersant injection volumes for A1 and A2,

B1 and B2, and B3 and B4 – the upper and lower volumes in m³ of the subsea oil that is not treated on each day, following predicted treatment outlined in A1 and A2 (oil released - predicted oil volume treated (R1-A1)). Negative numbers indicate an exceedance of available capability versus need.

6.3.3 Subsea Dispersant Injection – Control Measure Options Analysis

6.3.3.1 Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Dedicated, contracted ISV for SSDI mobilisation and deployment (based in Australia)	Reducing the mobilisation and deployment time of the SSDI through vessel standby/pre-positioning is unlikely to result in a significant change in environmental benefit. Under current arrangements the SSDI system can be on location from approx. day 12 depending on ISV availability where a dedicated, contracted vessel may enable the SSDI system on location from day 10. Once deployed the SSDI will be utilised to increase entrainment of released oil and to ensure safe operations for surface deployment of SFRT and other surface response techniques.	A modified construction vessel or vessels with suitable remote operated underwater vehicles (ROVs) is required to load, transport and deploy the SSDI system. The critical element in deployment of the SSDI is the availability of an appropriate ISV. Achieving a shorter mobilisation would require the vessel's work schedule to be permanently restricted so as to permit a quicker return to Dampier, reducing the utilisation of the vessel, or the permanent retention of a dedicated ISV. Neither option is considered reasonably practicable. Acceleration is limited by availability of the SSDI system mobilisation and this control measure is not expected to reduce the estimated extent and magnitude of impact from a well release on receptor locations compared with the proposed mobilisation plan using pre-identified or vessels available through frame agreements.	A dedicated vessel on standby in Dampier, ready to load is estimated to cost A$20 m per annum. This is considered disproportionate for the PAP.	This response strategy is not considered as a primary response and this control measure is not adopted as the cost, complexity and feasibility is considered disproportionate to the minor environmental benefit that might be gained	No
Shared, contracted ISV for SSDI mobilisation and deployment (shared between Titleholders)	Reducing the mobilisation and deployment time of the SSDI through vessel standby/pre-positioning is unlikely to result in a significant change in environmental benefit. Under current arrangements the SSDI system can be on location from approx. day 12 depending on ISV availability where a dedicated, contracted vessel may enable the SSDI system on location from day 10. Once deployed the SSDI will be utilised to increase entrainment of released oil and to ensure safe operations for surface deployment of SFRT and other surface response techniques.	A modified Construction vessel or vessels with suitable remote operated underwater vehicles (ROVs) is required to load, transport and deploy the SSDI system. The critical element in deployment of the SSDI is the availability of an appropriate ISV. Achieving a shorter mobilisation would require the vessel's work schedule to be permanently restricted so as to permit a quicker return to Dampier, reducing the utilisation of the vessel, or the permanent retention of a dedicated ISV. Neither option is considered reasonably practicable. This option is not considered feasible for a number of Titleholders due to the remote distances in Australia as well as a substantial range of well depths, types, complexities, geologies and geophysical properties across a range of Titleholders. Additionally, acceleration is limited by availability of the SSDI system mobilisation and this control measure is not expected to reduce the estimated extent and magnitude of impact from a well release on receptor locations compared with the proposed mobilisation plan using pre-identified or vessels available through frame agreements.	A dedicated vessel on standby in Dampier, ready to load is estimated to cost A$20 m per annum. As a shared cost across a range of titleholders, this may be approximately A$2 m each. This is considered disproportionate for the PAP.	This response strategy is not considered as a primary response and this control measure is not adopted as the cost, complexity and feasibility is considered disproportionate to the minor environmental benefit that might be gained by 1-2 days of additional subsea dispersant injection.	No

6.3.3.2 Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Pre-identifying / contracting vessels through Frame Agreements for SSDI loading and operations	Ensuring the mobilisation and deployment time of the SSDI through vessel availability / contracting strategy is likely to result in a moderate environmental benefit as using these arrangements, the SSDI will be on location from approximately Day 12.	Achieving a shorter mobilisation would require the vessel being on standby with limited duties to permit a faster return to Dampier and this is not considered reasonably practical. Woodside has established frame agreements with vessel providers and will track availability of similar vessels. These options are both considered reasonably practicable.	Associated cost of implementation is minimal to the environmental benefit gained.	This control measure is adopted as the costs and complexity are not considered disproportionate to any environmental benefit that might be realised.	Yes

6.3.3.3 Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
No reasonably practical improved control measures identified.					

6.3.4 Selected Control Measures

Following review of alternative, additional and improved control measures, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - Pre-identifying / contracting vessels through Frame Agreements for SSDI loading and operations
- Improved
  - None selected

6.4 Surface Dispersant Application – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.4.1 Existing capability – Surface Dispersant Application

Woodside's existing level of capability is based on internal and third-party resources that are available 24 hours per day, 7 days per week. The capability presented below are displayed as ranges from lower to upper to incorporate operational factors such as weather, daylight, crew/vessel/aircraft location and duties prior to deployment, survey or classification society inspection requirements for vessels, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, refuelling/re-stocking provisioning, and other similar logistics and operational limitations that are beyond Woodside's direct control.

Table 6-6: Existing Capability - Surface Dispersant Application

E	Existing Capability												
E1	Existing level of surface dispersant application capability available – Aerial Dispersant Application (m^3)												
Existing capability - Surface Dispersant Application		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3
	By Volume – m^3												
E1.1	Predicted oil contacted by surface dispersant application (lower) - m^3	0	113	463	938	1,050	1,213	1,213	8,488	8,488	8,488	36,375	36,375
E1.2	Predicted oil dispersed by surface dispersant application (lower) - m^3	0	52	213	431	483	558	558	3,904	3,904	3,904	16,733	16,733
E1.3	Predicted oil contacted by surface dispersant application (upper) - m^3	0	885	1,260	2,385	2,385	2,385	2,385	16,695	16,695	16,695	71,550	71,550
E1.4	Predicted oil dispersed by surface dispersant application (upper) - m^3	0	730	1,040	1,968	1,968	1,968	1,968	13,773	13,773	13,773	59,029	59,029
E1.5	Dispersant delivery available (lower) - m^3	0	9	37	75	84	97	97	679	679	679	2,910	2,910
E1.6	Dispersant delivery available (upper) - m^3	0	59	84	159	159	159	159	1,113	1,113	1,113	4,770	4,770
	By Surface Area– km^2												
E1.7	Predicted surface area treated by surface dispersant application (lower) – km^2	0	2	7	15	17	19	19	136	136	136	582	582
E1.8	Predicted surface area treated by surface dispersant application (upper) – km^2	0	12	17	32	32	32	32	223	223	223	954	954
E2	Existing level of surface dispersant application capability available – Vessel Dispersant Application (m^3)												
	By Volume - m^3												
E2.1	Predicted oil contacted by surface dispersant application (lower) - m^3	50	50	50	50	100	100	100	700	700	700	3,000	3,000
E2.2	Predicted oil dispersed by surface dispersant application (lower) - m^3	23	23	23	23	46	46	46	322	322	322	1,380	1,380
E2.3	Predicted oil contacted by surface dispersant application (upper) - m^3	80	160	320	320	320	480	480	2,240	2,240	2,240	6,000	6,000
E2.4	Predicted oil dispersed by surface dispersant application (upper) - m^3	66	132	264	264	264	396	396	1,848	1,848	1,848	4,950	4,950
E2.5	Dispersant delivery available (lower) - m^3	8	8	8	8	16	16	16	112	112	112	480	480
E2.6	Dispersant delivery available (upper) - m^3	8	16	32	32	32	48	48	224	224	224	600	600
	By Surface Area – km^2												
E2.7	Predicted surface area treated by surface dispersant application (lower) – km^2	2	2	2	2	3	3	3	22	22	22	96	96
E2.8	Predicted surface area treated by surface dispersant application (upper) – km^2	2	3	6	6	6	10	10	45	45	45	120	120

6.4.2 Response Planning: GWF3 loss of well containment (Credible Scenario-01)

Modelling results at defined response thresholds (>50 g/m² and <15,000 cSt), where surface dispersants are likely to be effective, indicate that the surface release for Credible Scenario-01 is expected to be available for surface dispersant operations for up to 32 days (based on predicted dispersant effectiveness). From approximately day 32, modelling predicts there are no longer sufficient surface hydrocarbons to treat with surface dispersant application due to spreading, weathering and entrainment. Modelling predicts there is unlikely to be any surface concentrations at BAOAC 5 (greater than 200g/m²) and that the surface hydrocarbons will remain below 15,000 cSt for the duration of the spill.

To remove the majority of the surface hydrocarbons before shoreline contact would require the treatment of the majority of the initial surface release (366 m³ available surface oil on day 2). This would require 4-22 m³ of dispersant delivery on day 2 from 2 aircraft. The surface area of hydrocarbons within threshold values peaks at 5 km² on day 2 and would require 2 aircraft covering approximately 2-3 km² per aircraft.

Current capability will meet the required response need from day 2-3 onwards for the maximum available surface area (5 km²) and volume (366 m³). Woodside has considered both pre-positioning additional resources, and including additional capability on vessels, that would allow for the treatment of some additional surface hydrocarbons on day 1, thereby potentially limiting the migration of surface hydrocarbons above threshold concentration. These options are considered below but have not been selected for implementation as the spreading and weathering of the oil will remove a significantly higher proportion of hydrocarbons than surface dispersant application. As this spreading and weathering occurs, there will be limitations on available surface area that can be treated as aircraft operations from Dampier will have a predicted upper limit of 6 aircraft undertaking approximately 18-24 sorties per day based on aviation operation limitations (daylight operations, transit time to surface hydrocarbons, ground support, turnaround/refuelling times).

For the purpose of capability demonstration below, Woodside has shown that sufficient capability exists to commence and continue surface dispersant application until surface hydrocarbons no longer meet threshold parameters (approximately day 2-3).

Table 6-7: GWF3 loss of well containment (Credible Scenario-01) – Release volumes

GWF3 loss of well containment (Credible Scenario-01)		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		Week 2	Week 3	Week 4		Month 2	Month 3
	Oil on sea surface														
A	Total volume of oil released (surface) – m³	5931	5931	5931	5931	5931	5931	5931		40,285	39,417	38,451		144,774	73,019
B	Total volume of surface oil remaining after weathering (per day) – m³	175	366	162	55	54	58	145		0	111	59		51	75

A - This volume represents the total volume of hydrocarbons released from the identified for Credible Scenario-01. The total volume for this spill is released over approximately 71 days at a rate of 5931 m³ per day.

B - The GWF3 Condensate contains a low proportion (~0.8% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The unweathered mixture has a dynamic viscosity of 1.61 cP. The pour point of the whole oil (< -30 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf. The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 65.9% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 22.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 10.8% should evaporate over several days (265 °C < BP < 380 °C). Selective evaporation of the lower boiling-point components will lead to a shift in the physical properties of the remaining mixture, including an increase in the viscosity and pour point. Soluble aromatic hydrocarbons contribute approximately 16.3% by mass of the whole oil, with a large proportion (65.9%) in the C4-C10 range of hydrocarbons.

Table 6-8: GWF3 loss of well containment (Credible Scenario-01) – Treatable hydrocarbons

GWF3 loss of well containment (Credible Scenario-01)		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		Week 2	Week 3	Week 4		Month 2	Month 3
C	Treatable hydrocarbons following weathering														
C1	Total volume of surface oil >50g/m² – m³	175	366	162	55	54	58	145		0	111	59		51	75
C2	Total surface area >50g/m²– km²	3	5	2	1	1	1	2		0	2	1		1	1
	Dispersible hydrocarbons														
C3	Surface oil volume >50g/m² and viscosity <15,000 cSt – m³	175	366	162	55	54	58	145		0	111	59		51	75
C4	Surface area >50g/m² and viscosity <15,000 cSt – km²	3	5	2	1	1	1	2		0	2	1		1	1

C1 – indicates the total remaining volume of hydrocarbons in cubic metres (m³) on the sea surface above 50 g/m². Based on the information outlined in Section 2.3.2.1 regarding surface concentration thresholds, this is the total volume of oil that can be treated by containment and recovery and surface dispersant spraying operations.

C2 – indicates the total surface area in square kilometres (km²) of hydrocarbons above 50 g/m². This is the total surface area of BAOAC 4 and above that can be treated by containment and recovery and surface dispersant spraying operations.

C3 – indicates the total remaining volume of hydrocarbons in cubic metres (m³) on the sea surface above 50 g/m² and below 15,000 cSt. This is the total volume of oil that can potentially be treated by surface dispersant spraying operations.

C4 – indicates the total surface area in square kilometres (km²) of hydrocarbons above 50 g/m² and below 15,000 cSt. This is the total surface area of BAOAC 4 and above that can potentially be treated by surface dispersant spraying operations.

6.4.2.1 Response Planning Need: GWF3 loss of well containment (Credible Scenario-01) – Summary

Offshore response operations will always be guided by Operational Monitoring to target the thickest part of the slick, typically BAOAC 5 – continuous true oil colour with a surface oil concentration >200 g/m² and BAOAC 4 – discontinuous true oil colour with a surface oil concentration between 50 and 200 g/m².

For a surface release, the thickest oil is typically in the leading edge of the slick, driven by wind and currents. As the spill continues to weather and spread over a number of days and weeks, the surface concentration and surface area of continuous oil colour spreads and reduces to discontinuous true oil colour and finally sheen as shown below.

The response need is calculated from the surface area and volume of treatable hydrocarbons following weathering as outlined in Table 6-8 above. In order to target response operations, Woodside would deploy surface dispersant spraying at the leading edge. This approach would result in the greatest volume and surface area treated by surface dispersant operations but may also limit the geographic area and effectiveness of containment and recovery as these operations cannot be conducted under or near the surface dispersant spraying operations due to personnel safety reasons. In evaluating the response need for offshore operations, surface dispersant application is prioritised for BAOAC 5 and BAOAC 4.

Table 6-9: GWF3 loss of well containment (Credible Scenario-01) – Response Planning Need

GWF3 loss of well containment (Credible Scenario-01)		Day	Day	Day	Day	Day	Day	Day		Week	Week	Week		Month	Month
		1	2	3	4	5	6	7		2	3	4		2	3
D	**Response Planning Need**														
D1	**Bonn Agreement Oil Appearance Code (BAOAC) 5 – Continuous True oil colour**														
	Surface area of BAOAC 5 (>200 g/m²) – km²	0	0	0	0	0	0	0		0	0	0		0	0
	Surface area of BAOAC 5 (>200 g/m²) and <15,000 cSt – km²	0	0	0	0	0	0	0		0	0	0		0	0
	Volume of surface oil BAOAC 5 (>200 g/m²) - m³	0	0	0	0	0	0	0		0	0	0		0	0
	Volume of surface oil BAOAC 5 (>200 g/m²) and <15,000 cSt - m³	0	0	0	0	0	0	0		0	0	0		0	0
D2	**Bonn Agreement Oil Appearance Code (BAOAC) 4 – Discontinuous True oil colour**														
	Surface area of BAOAC 4 (50-200 g/m²) – km²	3	5	2	1	1	1	2		0	2	1		1	1
	Surface area of BAOAC 4 (50-200 g/m²) and <15,000 cSt – km²	3	5	2	1	1	1	2		0	2	1		1	1
	Volume of surface oil BAOAC 4 (50-200 g/m²) - m³	175	366	162	55	54	58	145		0	111	59		51	75
	Volume of surface oil BAOAC 4 (50-200 g/m²) and <15,000 cSt - m³	175	366	162	55	54	58	145		0	111	59		51	75
D3	**Bonn Agreement Oil Appearance Code (BAOAC) 3, 2 and 1 – Sheen**														
	Surface area of BAOAC 3, 2 and 1 (<50 g/m²) – km²	25	33	52	12	6	14	28		0	90	77		240	0
	Volume of surface oil BAOAC 3, 2 and 1 (<50 g/m²) - m³	149	385	683	41	50	107	263		0	441	411		1,244	0

6.4.2.2 Surface dispersant operations – GWF3 loss of well containment (Credible Scenario-01): Surface area and surface volume

Surface Dispersant operations using vessels and aircraft would target the identified heavy (BAOAC 4 and 5) patches of oil as this technique is able to treat larger volumes and surface areas than containment and recovery and is subject to a window of opportunity (prior to spreading below 50 g/m² and/or viscosity increasing above 15,000 cSt).

The surface area of thickest oil (BAOAC 4 and <15,000 cSt) available for surface dispersant application peaks at approximately 5 km² on day 2 where surface concentration and viscosity thresholds are met. By this time, Woodside would have use of 1 FWADC aircraft and at least 1 larger aircraft from OSRL, each able to undertake at least two sorties each per day operating from airfields in Dampier. These could cover a total area of approximately 4-6 km² and contact 96-537 m³ surface hydrocarbon, plus 1-2 vessels conducting dispersant spraying covering approximately 0.5-1 km² per response operation and treating 40-160 m³ of surface oil on day 2.

This capability is sufficient to treat the surface area of BAOAC 4 at full spraying rate (50 l/hectare) and the dispersant application volume would treat the available surface volume (366 m³).

6.4.3 Surface Dispersant Application – Control measure options analysis

6.4.3.1 Alternative Control Measures

Alternative Control Measures Considered
Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control

Option considered	Environmental consideration	Feasibility	Approximate cost	Assessment conclusions	Implemented
Dedicated Response Vessel in region (exclusive to Woodside)	The environmental benefits associated with surface dispersant application are described above. The additional environmental benefit obtained from immediate access to this equipment, permitting deployment as soon as conditions became favourable, would result in a negligible environmental benefit (25-40m^3 of oil contacted resulting in approximately 12-26m^3 of oil treated) based on one operation.	Chartering and equipping additional vessels on standby has been considered. The option is reasonably practicable but the sacrifice (charter costs and organisational complexity) is significant, particularly when compared with the anticipated availability of vessel and FWADC resources which have a similar dispersant delivery capacity and are available from day 2 to treat the spill. The effectiveness of this control (weather dependency, availability and survivability) is rated as very low.	The cost (A$15 m per annum for the PAP) and organisational complexity of employing a dedicated response vessel is considered disproportionate to the minor environmental benefit to be realised by implementing this control.	This option is not adopted as the existing capability meets the need.	No
Dedicated Response Vessel in region (shared resource)	The environmental benefit would be similar to that described above for Woodside integrated fleet vessels.	Additional resources and capability can be contracted should the need arise, and dispersant build-up is capable of satisfying additional demand.	The cost and complexity of implementing and maintain this alternative control measure is considered high given the predicted effectiveness. Even with consideration of shared costs, the minor benefit of this control measure does not justify the cost.	This option is not adopted as the existing capability meets the need.	No

6.4.3.2 Additional Control Measures

Additional Control Measures Considered
Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures

Option considered	Environmental consideration	Feasibility	Approximate cost	Assessment conclusions	Implemented
Lease/purchase additional spray systems and/or dispersant stocks (based at Exmouth/Dampier)	Purchase of additional system(s) and/or dispersant stocks would not provide a significant environmental benefit compared to the current capability in place.	Time to set up and mobilise a marine charter vessel is ~10 days, at which point existing surface dispersant systems are available for loading onto vessels. Adding additional spray systems would allow for extra surface dispersant application capacity but is unlikely to reduce deployment times for this strategy.	For the WCCS, additional vessel dispersant spray systems and large quantities of dispersant are already available through AMOSC, AMSA and OSRL therefore the cost is considered disproportionate to the minor benefit gained.	This option is not adopted as the current capability meets the need.	No
Train additional Woodside personnel in Dampier to coordinate vessel dispersant application	Limited environmental benefit to be gained by training additional personnel.	Current capability meets need. Woodside has a pool of trained, competent offshore responders / team leaders at strategic locations to ensure timely and sustainable response. Additional personnel are available through current contracts with AMOSC and OSRL and agreements with AMSA. Marine standards & guidelines ensure vessel masters are competent for their roles. Regular audits of oil spill response organisations ensure training and competency is maintained.	Minor additional cost regarding training and maintenance of competency.	This option is not adopted as the current capability meets the need.	No

6.4.3.3 Improved Control Measures

Improved Control Measures considered
Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility

Option considered	Environmental consideration	Feasibility	Cost	Assessment conclusions	Implemented
Locate vessel spraying equipment on additional in-field support vessel(s)	This option may achieve minor incremental improvements in surface oil and residual oil volumes similar to those described for integrated fleet vessels. However, given the likely vessel re-supply times involved to/from the offshore spill location, this option is unlikely to realise material environmental benefits additional the capability selected.	Woodside currently has dispersant spray systems pre-located on vessels used in-field during cargo transfer activities. Consideration of equipping additional vessels with similar equipment was made but is not being carried through to implementation.	The option is reasonably practicable and the cost (charter and operational/maintenance costs) is expected to be moderate, particularly when compared with the ability to rapidly commence spraying operations, subject to safety considerations but Woodside considers the existing control measures to be sufficient for the need.	This option is not adopted as the current capability meets the need.	No

6.4.4 Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.5 Containment and Recovery – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

The total marine resources identified to mobilise and support the response activities, are presented below**.** Sufficient containment and recovery units are available in the region to equip the available Woodside and mutual aid vessels should conditions favour this option. In the event of a large or continuous release, additional equipment would be available from other petroleum titleholders or internationally from OSRL and the Global Response Network (GRN) to equip a fleet of chartered vessels with similar lead time to the vessel themselves.

When the existing capability is implemented, the containment and recovery response would be targeted to contain and recover high volume surface hydrocarbons typically BAOAC 4 and 5 at the leading edge of the slick as observed by operational monitoring activities. This targeted approach is intended to reduce the volume of surface and accumulated hydrocarbons reaching sensitive receptors and shorelines and providing a localised, minor environmental benefit. If required, additional vessels of opportunity may be chartered on the spot market to scale up the operation. Even at maximum efficiency, containment and recovery would not prevent entrained and dissolved hydrocarbon plumes, but recovery could reduce the extent and impact of surface hydrocarbons and, therefore, stranded shoreline hydrocarbons. The available equipment and personnel could be mobilised to meet the estimated vessel profile and would not constrain an earlier build up if more vessels were available.

6.5.1 Existing Capability – Containment and Recovery

Woodside's exiting level of capability is based on internal and third-party resources that are available 24 hours per day, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, refuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

Table 6-10: Existing Capability – Containment and Recovery

E	Existing Capability												
Existing Capability - Containment and Recovery		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3
E3	Existing level of C&R capability available (m^3 recovered per day)												
	By Volume – m^3												
E3.1	Predicted oil recovered by containment and recovery (lower) – m^3	0	23	23	92	92	138	161	1,127	1,127	1,127	4,830	4,830
E3.2	Predicted oil recovered by containment and recovery (upper) – m^3	90	90	270	360	450	540	720	5,040	5,040	5,040	21,600	21,600
	By Surface Area – km^2												
E3.3	Predicted surface area treated by containment and recovery (lower) – km^2	0	1	1	4	4	5	6	49	49	49	210	210
E3.4	Predicted surface area treated by containment and recovery (upper) – km^2	1	1	3	4	5	6	6	112	112	112	480	480

For E3 – Containment and Recovery, the range of figures shows the predicted recovery rates of surface oil at 50 g/m² for the lower figures and 200 g/m² for the upper figures using conventional booming systems in a J or U configuration with an encounter rate of 25-50% surface oil meaning 75%-50% of the area within the booming system has surface oil that is not within threshold concentrations <50 g/m²).

6.5.2 Response Planning: GWF3 loss of well containment (Credible Scenario-01)

Deterministic modelling scenarios indicate that first shoreline impact would be on day 22.6 at Pilbara Islands – Southern Group (5 m³). Modelling results at defined response thresholds (>50 g/m²) where containment and recovery is likely to be effective indicate that surface hydrocarbons from the Credible Scenario-01 scenario are expected to be available for operations for up to 32 days. From approximately day 32, modelling predicts there are no longer sufficient surface hydrocarbons to remove due to spreading and weathering.

Table 6-11: GWF3 loss of well containment (Credible Scenario-01) – Release volumes

GWF3 loss of well containment (Credible Scenario-01) – Containment and Recovery		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3
	Hydrocarbons on sea surface												
A	Total volume of oil released (surface) - m^3	5,931	5,931	5,931	5,931	5,931	5,931	5,931	40,285	39,417	38,451	144,774	73,019
B	Total volume of surface oil remaining after weathering (per day) - m^3	175	366	162	55	54	58	145	0	111	59	51	75

A - This volume represents the total volume of hydrocarbons released from the identified Worst-Case Credible discharge, Credible Scenario-01. The total volume for this spill is released over approximately 71 days at a rate of 5931 m³ per day.

B - The GWF3 Condensate contains a low proportion (~0.8% by mass) of hydrocarbon compounds that will not evaporate at atmospheric temperatures. These compounds will persist in the marine environment. The unweathered mixture has a dynamic viscosity of 1.61 cP. The pour point of the whole oil (< -30 °C) ensures that it will remain in a liquid state over the annual temperature range observed on the North West Shelf. The mixture is composed of hydrocarbons that have a wide range of boiling points and volatilities at atmospheric temperatures, and which will begin to evaporate at different rates on exposure to the atmosphere. Evaporation rates will increase with temperature, but in general about 65.9% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 22.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 10.8% should evaporate over several days (265 °C < BP <

380 °C). Selective evaporation of the lower boiling-point components will lead to a shift in the physical properties of the remaining mixture, including an increase in the viscosity and pour point. Soluble aromatic hydrocarbons contribute approximately 16.3% by mass of the whole oil, with a large proportion (65.9%) in the C4-C10 range of hydrocarbons.

Table 6-12: GWF3 loss of well containment (Credible Scenario-01) – Recoverable hydrocarbons

GWF3 loss of well containment (Credible Scenario-01)		Day	Day	Day	Day	Day	Day	Day		Week	Week	Week		Month	Month
		1	2	3	4	5	6	7		2	3	4		2	3
C	**Recoverable hydrocarbons following weathering**														
C1	**Total volume of surface oil >50g/m² – m³**	175	366	162	55	54	58	145		0	111	59		51	75
C2	**Total surface area >50g/m²– km²**	3	5	2	1	1	1	2		0	2	1		1	1

C1 – indicates the total remaining volume of hydrocarbons in cubic metres (m³) on the sea surface above 50g/m². Based on the information outlined in Section 2.3.2.1 regarding surface concentration thresholds, this is the total volume of oil that can be treated by containment and recovery and surface dispersant spraying operations.

C2 – indicates the total surface area in square kilometres (km²) of hydrocarbons above 50g/m². This is the total surface area of BAOAC 4 and above that can be treated by containment and recovery and surface dispersant spraying operations.

6.5.2.1 Response Planning Need: GWF3 loss of well containment (Credible Scenario-01) – Summary

Offshore response operations will always be guided by Operational Monitoring to target the thickest part of the slick, typically BAOAC 5 – continuous true oil colour with a surface oil concentration >200 g/m² and BAOAC 4 – discontinuous true oil colour with a surface oil concentration between 50 and 200 g/m². For a surface release, the thickest oil is typically in the leading edge of the slick, driven by wind and currents. As the spill continues to weather and spread over a number of days and weeks, the surface concentration and surface area of continuous oil colour spreads and reduces to discontinuous true oil colour and finally sheen as shown above.

The response need is calculated from the surface area and volume of treatable hydrocarbons following weathering as outlined in Table 6-12 above. While surface dispersant operations target the leading edge of the slick where surface concentration and viscosity thresholds are met, containment and recovery operations would be deployed behind the surface dispersant application area to target discrete patches of thick oil at BAOAC 4 and 5 and remaining oil that is not dispersed.

Table 6-13: GWF3 loss of well containment (Credible Scenario-01) – Response Planning Need

GWF3 loss of well containment (Credible Scenario-01) – Containment and Recovery		Day	Day	Day	Day	Day	Day	Day		Week	Week	Week		Month	Month
		1	2	3	4	5	6	7		2	3	4		2	3
D	**Response Planning Need**														
D1	**Bonn Agreement Oil Appearance Code (BAOAC) 5 – Continuous True oil colour**														
	Surface area of BAOAC 5 (>200 g/m²) – km²	0	0	0	0	0	0	0		0	0	0		0	0
	Volume of surface oil BAOAC 5 (>200 g/m²) – m³	0	0	0	0	0	0	0		0	0	0		0	0
D2															
	Surface area of BAOAC 4 (50-200 g/m²) – km²	3	5	2	1	1	1	2		0	2	1		1	1
	Volume of surface oil BAOAC 4 (50-200 g/m²) – m³	175	366	162	55	54	58	145		0	111	59		51	75
D3	**Bonn Agreement Oil Appearance Code (BAOAC) 3, 2 and 1 – Sheen**														
	Surface area of BAOAC 3, 2 and 1 (<50 g/m²) – km²	25	33	52	12	6	14	28		0	90	77		240	0
	Volume of surface oil BAOAC 3, 2 and 1 (<50 g/m²) - m³	149	385	683	41	50	107	263		0	441	411		1,244	0

6.5.2.2 Containment and Recovery Operations – GWF3 loss of well containment (Credible Scenario-01): Surface area and surface volume

Containment and recovery operations would target discrete patches of oil identified by operational monitoring activities for a surface release as this technique is secondary to surface dispersant application. These operations cannot be conducted under or near the surface dispersant spraying operations due to personnel safety reasons and dispersants will also reduce the effectiveness of skimming operations.

To remove the majority of the surface hydrocarbons before shoreline contact (day 22.6) would require the removal of available surface oil (1126 m³ at >50g/m² present on days 1-18). Based on volume, the capability required would be 16 operations each recovering 22.5-67.5 m³ per day. Woodside would have 2 operations available on day 2 and would expect to have 6 operations undertaking containment and recovery activities, covering around 5.4 km² per day and recovering 135-405 m³ per day by day 6. By week 2, 42 operations would be available covering 37.8 km² and recovering 945-3915 m³ thus providing sufficient capability to recover surface hydrocarbons prior to first shoreline impact.

The total surface volume and surface area of the release and the volume and area of BAOAC 4 decrease rapidly due to weathering, spreading and the effect of wind and current. As expected, the volume and area of sheen (BAOAC 3, 2, 1) increase over this period as BAOAC 4 decreases.

6.5.3 Containment and Recovery – Control Measure Options Analysis

6.5.3.1 Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Dedicated response vessel in region (exclusive to Woodside)	The environmental benefits associated with containment and recovery are described above. The additional environmental benefit obtained from immediate access to this equipment, permitting deployment as soon as conditions became favourable, would result in a negligible environmental benefit – 22.5-67.5 m^3 of oil recovered per operating unit per day.	Chartering and equipping additional vessels on standby has been considered. The option is reasonably practicable but the sacrifice (charter costs and organisational complexity) is significant, particularly when compared with the anticipated effectiveness of dispersant operations to treat the spill which are available from day 2. The effectiveness of this control (encounter rate, weather dependency, availability) is rated as very low.	The cost (A$15 m per annum for the PAP) and organisational complexity of employing a dedicated response vessel is considered disproportionate to the insignificant environmental benefit to be realised by implementing this control.	This option is not adopted as it has low effectiveness and cost is disproportionate to the minimal potential environmental benefit.	No
Dedicated response vessel in region (shared resource)	The environmental benefit would be similar to that described above for Woodside integrated fleet vessels.	Additional containment and recovery resources and capability can be contracted should the need arise.	The cost and complexity of implementing and maintain this alternative control measure is considered high given the predicted effectiveness. Even with consideration of shared costs, the minor benefit of this control measure does not justify the cost.	This option is not adopted as it has low effectiveness and cost is disproportionate to the minimal potential environmental benefit.	No
Regional oil spill response contractor	This option may achieve minor incremental improvements in surface oil and residual oil volumes similar to those described for integrated fleet vessels. However, given the likely vessel transit times involved to/from the offshore spill location, this option is unlikely to realise material environmental benefits additional the capability selected.	No current private response contracting capability exists that would significantly improve response timing or effectiveness in the Dampier or Exmouth regions.	N/A – not currently feasible	This option is not adopted as it is not currently feasible.	No

6.5.3.2 Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Train additional Woodside personnel in Dampier to coordinate containment and recovery operations	Limited environmental benefit to be gained by training additional personnel as the number of operations will be governed by the availability of response vessels.	Woodside has a pool of trained, competent offshore responders / team leaders at strategic locations to ensure timely and sustainable response. Additional personnel are available through current contracts with AMOSC and OSRL and agreements with AMSA. Marine standards and guidelines ensure vessel masters are competent for their roles. Regular audits of oil spill response organisations ensure training and competency is maintained.	Minor additional cost regarding training and maintenance of competency.	This option is not adopted as the current capability meets the need.	No

6.5.3.3 Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Prioritise rapid sweep systems (NOFI Buster series, DESMI Speed Sweep, etc.) for mobilisation from service providers	The environmental benefit of containment and recovery as a response strategy is minor. This response strategy is not considered to be as effective as surface dispersant application to prevent hydrocarbons reaching the shore, but there is expected to be a minor environmental benefit since each rapid sweep containment and recovery operation could remove an additional 10-45 m^3 per operation per day.	Rapid sweep systems allow containment and recovery operations to be undertaken at speeds of up to 3 knots. This allows for greater encounter rates and surface coverage. AMOSC has recently purchased a Speed Sweep system and a number of NOFI systems are available through Mutual Aid arrangements.	Additional costs for prioritising rapid sweep systems are negligible	Although containment and recovery remains a low-efficiency response technique, this control measure is adopted as the costs and complexity are not considered disproportionate to any environmental benefit that might be realised.	Yes

Prioritise active booming systems (Ro-skim, etc.) for mobilisation from service providers	The environmental benefit of containment and recovery as a response strategy is minor. This response strategy is not considered to be as effective as surface dispersant application to prevent hydrocarbons reaching the shore, but there is expected to be a minor environmental benefit since each rapid sweep containment and recovery operation could remove an additional 10-45 m^3 per operation per day.	Active booming systems allow containment and recovery operations without the need for an additional skimming system. This allows for greater effectiveness and continued skimming operations. Active booming systems are available through OSRL and Mutual Aid arrangements and would be prioritised for mobilisation.	Additional costs for prioritising active booming systems are negligible	Although containment and recovery remains a low-efficiency response technique, this control measure is adopted as the costs and complexity are not considered disproportionate to any environmental benefit that might be realised.	Yes
Pre-position additional containment and recovery equipment (Exmouth)	It is unlikely that faster mobilisation and deployment from Exmouth would significantly increase response effectiveness or removal of oil to create an increased environmental benefit	Facilities at Exmouth are currently limited by tides and draft for the loading and unloading of vessels with heavy plant and equipment. Access to the Navy Pier to provide an additional loading location is subject to Defence Force approval and cannot be relied upon for rapid approval in the event of an oil spill.	Limited additional cost considerations.	This option is not adopted as the complexity is disproportionate to the minimal potential environmental benefit due to the low efficiency of containment and recovery as a response technique.	No
Re-locate containment and recovery equipment on in-field vessels	The additional environmental benefit obtained from faster mobilisation and deployment would be limited by safety considerations during the initial period following the release. Once operations were considered safe, the vessels would increase recovery capacity to 23-90 m^3/day per operation. The limited oil treatment of containment and recovery and expected effectiveness of dispersant application from vessels indicates the preference would be for greater surface dispersant application capability.	Operations close to the release location are unlikely to be feasible during the initial period due to the uncertainty of the situation and potential safety impacts on personnel. Vessels may require time to return to port and load equipment, fuel etc. to allow response duration to be the maximum possible once deployed. Shortening the timeframes for vessel availability would require equipment to be pre-positioned on-board vessels.	The cost and organisational complexity of employing two dedicated response vessels (approximately A$15 m per year per vessel) is considered disproportionate to the limited environmental benefit to be realised by adopting this control	This option is not adopted as the cost is disproportionate to the minimal potential environmental benefit due to the low efficiency of containment and recovery as a response technique.	No
Purchase or pre-position larger skimmers	The environmental benefit of containment and recovery for the loss of well containment scenario is minor. This response strategy is not considered to be as effective as surface dispersant application to prevent hydrocarbons reaching the shore.	Larger systems such as the DESMI Octopus or Transrec with >200 m^3 per hour capacity, could improve recovery rates, however are not readily available in Australia and not easily compatible with booming, waste and hydraulic power systems. If required and deemed to be of benefit, these systems are available through Service Providers such as OSRL.	Cost of purchasing Octopus system is A$600,000 plus additional transport, training and commissioning costs and ongoing maintenance costs. Cost for pre-positioning in Australia for the life of the asset/activity is greater than the purchase costs.	This option is not adopted as the cost is disproportionate to the minimal potential environmental benefit due to the low efficiency of containment and recovery as a response technique.	No

6.5.4 Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - Prioritise rapid sweep systems (NOFI Buster series, DESMI Speed Sweep, etc.) for mobilisation from service providers
  - Prioritise active booming systems (Ro-skim, etc.) for mobilisation from service providers.

6.6 Shoreline Protection & Deflection – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.6.1 Existing Capability – Shoreline Protection and Deflection

Woodside's exiting level of capability is based on internal and third-party resources that are available 24 hours, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft/vehicle location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, re-fuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.6.2 Response Planning: GWF3 (Credible Scenario-01) and Lambert Deep (Credible Scenario-02) loss of well containment– Shoreline Protection and Deflection

Planning for shoreline protection is based upon identification of Response Protection Areas (RPAs) from deterministic modelling and the logistics associated with deploying protection at these locations. The response planning scenarios indicate that this would require effective mobilisation to priority shorelines and maintenance of protection until operational monitoring confirms that the locations were no longer at risk. Woodside has identified the RPAs from deterministic modelling results provided from specific scenarios.

The control measures selected provide capability to mobilise shoreline protection equipment by Day 2 (if required). Deterministic modelling scenarios indicate that first shoreline impact at Barrow Island within 17 days for Credible Scenario-02 and 22.6 days for Credible Scenario-01. There is no shoreline impact predicted at threshold for Credible Scenario-03. The existing capability is, therefore, considered sufficient to mobilise and deploy protection at RPAs prior to hydrocarbon contact, guided by predictive modelling, direct observation/surveillance and remote sensing methods (OM01, OM02 and OM03) employed from the outset of a spill to track the oil and assess receptors at risk. This will then trigger the undertaking of pre-emptive assessments of sensitive receptors at risk (OM04) if required. OM04 would only be undertaken in liaison with WA DoT. Tactical response plans exist for many of the RPAs identified.

Table 6-14 below outlines the capability required (number of RPAs predicted to be impacted) against the capability available (number of shoreline protection and deflection operations that can be mobilised and deployed). As can be seen from the table below. Woodside's capability exceeds the response planning need identified for shoreline protection and deflection operations.

Table 6-14: Response Planning – Shoreline Protection and Deflection

	Shoreline Protection & Deflection (SPD)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3	Month 4
	Oil on shoreline (from deterministic modelling) m^3 – GWF3 (Credible Scenario-01)	0	0	0	0	0	0	0	0	0	5	73	6	0
	Oil on shoreline (from deterministic modelling) m^3 – Lambert Deep (Credible Scenario-02)	0	0	0	0	0	0	0	0	45	0	14	182	0
A	Capability Required													
A1	RPAs impacted by maximum accumulated volume – GWF3 (Credible Scenario-01)	0	0	0	0	0	0	0	0	0	1	3	1	0
A2	RPAs impacted by maximum accumulated volume – Lambert Deep (Credible Scenario-02)	0	0	0	0	0	0	0	0	2	0	2	5	0
B	Capability Available (operations per day)													
B1	SPD operations available – per day (lower)	0	1	1	2	2	4	6	70	70	70	330	330	0
B2	SPD operations available – per day (upper)	1	2	3	4	6	8	10	84	84	84	336	336	0
C	Capability Gap (operations per day)													
C1	SPD operations gap – per day (lower)	0	0	0	0	0	0	0	0	0	0	0	0	0
C2	SPD operations gap – per day (upper)	0	0	0	0	0	0	0	0	0	0	0	0	0

A1 – the number of Response Protection Areas contacted at the maximum accumulated volume.

B1 and B2 – the upper and lower number of shoreline protection and deflection operations available (based on response planning assumptions in Section 5.6).

C1 and C2 – the gap between the upper and lower number of shoreline protection and deflection operations required in A1 compared to the operations available in B1 and B2

Pre-emptive mobilisation of equipment and personnel would commence as soon as practicable prior to oil contact. Additional resources would be mobilised depending on the scale of the event to increase the length or number of shorelines being protected.

A shoreline protection and deflection response would be launched and additional TRPs drafted only when operational monitoring (OM02 and OM03) and modelling (OM01) indicate that contact could occur at RPA(s) within 14 days. The outputs from the monitoring will inform the need for and/or direct any additional response techniques and, additionally, if/when the spill enters State Waters and control of the incident passes to WA DoT.

Table 6-15: RPAs for GWF3 (Credible Scenario-01) and Lambert Deep (Credible Scenario-02)

Areas of coastline contacted	Conservation status	IUCN protection category	Minimum time to shoreline contact (above 100g/m²) in days [19]	Maximum shoreline accumulation (above 100g/m²) in m³ [20]	Minimum time to shoreline contact (above 100g/m²) in days	Maximum shoreline accumulation (above 100g/m²) in m³
			Credible Scenario-01		Credible Scenario-02	
Montebello Islands and State Marine Park	State Marine Park Australian Marine Park	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone IUCN II and IV – Recreational Use Zone IUCN II – Marine National Park Zone	58.2 days (2 m^3)	2 m^3 (58.2 days)	45 days (4 m^3)	86.7 m^3 (61.3 days)
Barrow Island	Australian Marine Park Marine Management Area	IUCN IA – Strict Nature Reserve IUCN IV – Recreational Use Zone IUCN VI – Multiple Use Zone	*No contact at threshold*	*No contact at threshold*	17 days (27 m^3)	27 m^3 (17 days)
Lowendal Islands	State Marine Park	IUCN VI – Multiple Use Zone	*No contact at threshold*	*No contact at threshold*	65.3 days (33 m^3)	33 m^3 (65.3 days)
Pilbara Islands – Southern Islands Group	State Marine Park Australian Marine Park	IUCN IV – Recreational Use Zone	22.6 days (5 m^3)	70 m^3 (49.6 days)	21.5 days (18 m^3)	48 m^3 (68.5 days)
Muiron Islands Marine Management Area & World Heritage Area	Marine Management Area World Heritage Area	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone	51.7 days (3 m^3)	4 m^3 (65.7 days)	70.5 days (9 m^3)	9 m^3 (70.5 days)
Dampier Archipelago	National Heritage Property	N/A	*No contact at threshold*	*No contact at threshold*	55.5 days (10 m^3)	10 m^3 (55.5 days)
Pilbara - Northern Pilbara - Islands & Shoreline	Australian Marine Park	IUCN IA – Strict Nature Reserve	*No contact at threshold*	*No contact at threshold*	70.3 days (5 m^3)	5 m^3 (70.3 days)

[19] This volume and time represent the first time to contact on defined shoreline polygon and the maximum volume ashore for that 24 hour period.
[20] This volume and time represent the maximum volume ashore on defined shoreline polygon for any 24 hour time period

6.6.3 Shoreline Protection and Deflection – Control Measure Options Analysis

6.6.3.1 Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Pre-position equipment at Response Protection Areas (RPAs)	Additional environmental benefit of having equipment prepositioned is considered minor. Equipment is currently available to protect RPAs and additional shorelines, within estimated minimum times until shoreline contact at RPAs, enabling mobilisation of the selected delivery options.	The incremental environmental benefit associated with these delivery options is considered minor and unlikely to reduce the environmental consequence of a significant hydrocarbon release beyond the adopted delivery options. Considering the highly unlikely nature of a significant hydrocarbon release and the costs and organisational complexity associated with prepositioning and maintenance of equipment, the sacrifice is considered disproportionate to the limited environmental benefit that might be realised. Furthermore, these options would conflict with the mutual aid philosophy being adopted under the selected delivery options. The selected delivery options for shoreline protection and deflection meet the relevant objectives of this control measure and do not require prepositioned or additional equipment in Exmouth.	Total cost to preposition protection/ deflection packages at each site of potential impact would be approx. A$6100 per package per day.	This option is not adopted as the existing capability meets the need.	No

6.6.3.2 Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Supplemented stockpiles of equipment in Exmouth to protect additional shorelines	Additional equipment would increase the number of receptor areas that could be protected from hydrocarbon contact. However, current availability of personnel and equipment is capable of protecting up to 30 km of shoreline, commensurate with the scale and progressive nature of shoreline impact. Additional stocks would be made available from international sources if long term up scaling were necessary. A reduction in environmental consequence from a 'B' rating (serious long-term impacts) is unlikely to be realised as a result of having more equipment available locally.	The incremental environmental benefit associated with these delivery options is considered minor and unlikely to reduce the environmental consequence of a significant hydrocarbon release beyond the adopted delivery options. Considering the highly unlikely nature of a significant hydrocarbon release and the costs and organisational complexity associated with prepositioning and maintenance of equipment, the sacrifice is considered disproportionate to the limited environmental benefit that might be realised. Furthermore, these options would conflict with the mutual aid philosophy being adopted under the selected delivery options. The selected delivery options for shoreline protection and deflection meet the relevant objectives of this control measure and do not require prepositioned or additional equipment in Exmouth.	Total cost for purchase supplemental protection and deflection equipment would be approx. A$455,000 per package.	This option is not adopted as the existing capability meets the need.	No
Additional trained personnel	The level of training and competency of the response personnel ensures the shoreline protection and deflection operation is delivered with minimum secondary impact to the environment. Training additional personnel does not provide an increased environmental benefit.	Additional personnel required to sustain an extended response can be sourced through the Woodside *People & Global Capability Surge Labour Requirement Plan*. Additional personnel sourced from contracted OSRO's (OSRL/AMOSC) to manage other responders. Response personnel are trained and exercised regularly in shoreline response techniques and methods. All personnel involved in a response will receive a full operational/safety brief prior to commencing operations.	Additional Specialist Personnel would cost A$2000 per person per day.	This option is not adopted as the existing capability meets the need.	No

6.6.3.3 Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster response/ mobilisation time	Given modelling does not predict floating or shoreline impacts at threshold until day 17 (Credible Scenario-02) or day 22.6 (Credible Scenario-01) Woodside considers that there is sufficient time for deployment of protection and deflection operations prior to impact.	Response teams, trained personnel, contracted oil spill response service providers, government agencies and the associated mitigation equipment required to enact an initial protection and deflection response will be available for mobilisation within 24-48 hrs of activation. Additional equipment from existing stockpiles and oil spill response service providers can be on scene within days. Hydrocarbons are not predicted to strand at threshold until day 17 at Barrow Island (Credible Scenario-02) or day 22.6 (Credible Scenario-01) therefore allowing enough time to re-locate existing equipment, personnel and other resources to the most appropriate areas.	The cost of establishing a local stockpile of new mitigation equipment (including protection and deflection boom) closer to the expected hydrocarbon stranding areas is not commensurate with the need.	This option is not adopted as the existing capability meets the need.	No

6.6.4 Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.7 Shoreline Clean-up – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.7.1 Existing Capability – Shoreline Clean-up

Woodside's existing level of capability is based on internal and third-party resources that are available 24 hours per day, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft/vehicle location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, re-fuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.7.2 Response planning: GWF3 and Lambert Deep – Shoreline Clean-up

Woodside has assessed existing capability against the WCCS and has identified that the range of techniques provide an ongoing approach to shoreline clean-up at identified RPAs. Woodside's capability can cover all required shoreline clean-up operations for the PAP.

Deterministic modelling indicates that first shoreline impact is at Barrow Island within 17 days for Credible Scenario-02 (27 m^3) and at Pilbara Islands – Southern Group within 22.6 days for Credible Scenario-01 (5 m^3). There is no shoreline impact predicted at threshold for Credible Scenario-03. The largest volumes ashore are at Montebello Islands and State Marine Park with approximately 87 m^3 predicted on day 61.3 (Credible Scenario-02) and 65.1 m^3 at Pilbara Islands – Southern Group on day 63.6 (Credible Scenario-01). These volumes assume no treatment of floating surface oil by containment and recovery or surface dispersant application prior to contact so are considered very conservative.

These figures have been combined into a single response planning need scenario that provides a worst-case scenario for planning purposes as outlined below. Given all other shoreline contact scenarios identified from deterministic modelling are longer time frames and lesser volumes, demonstration of capability against this need will ensure Woodside can meet requirements for any other outcome. Woodside is satisfied that the current capability is managing risks and impacts to ALARP.

In the event of a real spill, predictive modelling, direct observation/surveillance and remote sensing methods (OM01, OM02 and OM03) will be employed from the outset of a spill to track the oil real-time and assess receptors at risk of impact. This will then trigger the undertaking of pre-emptive assessments of sensitive receptors at risk (OM04) and shoreline assessments (OM05) to establish the extent and distribution of oiling and thus direct any shoreline clean-up operations. OM04 and OM05 would only be undertaken in liaison with WA DoT.

Due to the timeframe of predicted contact for shoreline clean-up, and deterministic modelling predicting ongoing stranding after this peak, this response may not be as time critical compared to other response techniques and the scale will depend on the success of other techniques preventing oiling occurring. Further, the potential scale and remoteness of a response coupled with the uncertainty of which locations will be affected precludes the stockpiling or prepositioning of equipment specific to shorelines. The most significant constraint is accommodation and transport of personnel in the Dampier region to undertake clean-up operations and to manage wastes generated during the response effort. From previous assessment of facilities in the Dampier region, Woodside estimates that current accommodation can cater for a range of 500-700 personnel per day.

Woodside has identified several options which could be mobilised to achieve defined response objectives. Evaluation considers the benefit in terms of the time to respond and the scale of response made possible by each option. The evaluation of possible control measures is summarised in Section 6.7.3

Table 6-16: Response planning – shoreline clean-up

	Shoreline Clean-up (Phase 2)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Week 2	Week 3	Week 4	Month 2	Month 3	Month 4
	Oil on shoreline (from deterministic modelling) m^3													
	Shoreline accumulation (above 100 g/m^2) - m^3	0	0	0	0	0	0	0	0	45	5	87	188	0
	Oil remaining following response operations - m^3	0	0	0	0	0	0	0	0	0	0	0	0	0
A	Capability Required (number of operations)													
A1	Shoreline clean-up operations required (lower)	0	0	0	0	0	0	0	0	5	1	9	19	0
A2	Shoreline clean-up operations required (upper)	0	0	0	0	0	0	0	0	6	1	12	27	0
B	Capability Available (number of operations)													
B1	Shoreline clean-up operations available - Stage 2 - Manual (lower)	0	1	3	5	8	12	15	105	105	105	560	560	560
B2	Shoreline clean-up operations available - Stage 2 - Manual (upper)	0	2	5	8	10	15	20	140	140	140	560	560	560
C	Capability Gap													
C1	Shoreline clean-up operations gap (lower)	0	0	0	0	0	0	0	0	0	0	0	0	0
C2	Shoreline clean-up operations gap (upper)	0	0	0	0	0	0	0	0	0	0	0	0	0

A1 and A2 – the number of shoreline clean-up operations required based on the hydrocarbon volumes ashore above 100 g/m^2.

B1 and B2 – the upper and lower number of shoreline clean-up operations available (based on response planning assumptions in Section 5.7).

C1 and C2 – the gap between the upper and lower number of shoreline clean-up operations required in A1 and A2 compared to the operations available in B1 and B2.

Table 6-17: RPAs for GWF3 (Credible Scenario-01) and Lambert Deep (Credible Scenario-02)

Areas of coastline contacted	Conservation status	IUCN protection category	Minimum time to shoreline contact (above 100g/m^2) in days [21]	Maximum shoreline accumulation (above 100g/m^2) in m^3 [22]	Minimum time to shoreline contact (above 100g/m^2) in days	Maximum shoreline accumulation (above 100g/m^2) in m^3
			Credible Scenario-01		Credible Scenario-02	
Montebello Islands and State Marine Park	State Marine Park Australian Marine Park	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone IUCN II and IV – Recreational Use Zone IUCN II – Marine National Park Zone	58.2 days (2 m^3)	2 m^3 (58.2 days)	45 days (4 m^3)	86.7 m^3 (61.3 days)
Barrow Island	Australian Marine Park Marine Management Area	IUCN IA – Strict Nature Reserve IUCN IV – Recreational Use Zone IUCN VI – Multiple Use Zone	*No contact at threshold*	*No contact at threshold*	17 days (27 m^3)	27 m^3 (17 days)
Lowendal Islands	State Marine Park	IUCN VI – Multiple Use Zone	*No contact at threshold*	*No contact at threshold*	65.3 days (33 m^3)	33 m^3 (65.3 days)
Pilbara Islands – Southern Islands Group	State Marine Park Australian Marine Park	IUCN IV – Recreational Use Zone	22.6 days (5 m^3)	70 m^3 (49.6 days)	21.5 days (18 m^3)	48 m^3 (68.5 days)
Muiron Islands Marine Management Area & World Heritage Area	Marine Management Area World Heritage Area	IUCN IA – Strict Nature Reserve IUCN VI – Multiple Use Zone	51.7 days (3 m^3)	4 m^3 (65.7 days)	70.5 days (9 m^3)	9 m^3 (70.5 days)
Dampier Archipelago	National Heritage Property	N/A	*No contact at threshold*	*No contact at threshold*	55.5 days (10 m^3)	10 m^3 (55.5 days)
Pilbara - Northern Pilbara - Islands & Shoreline	Australian Marine Park	IUCN IA – Strict Nature Reserve	*No contact at threshold*	*No contact at threshold*	70.3 days (5 m^3)	5 m^3 (70.3 days)

[21] This volume and time represent the first time to contact on defined shoreline polygon and the maximum volume ashore for that 24 hour period.
[22] This volume and time represent the maximum volume ashore on defined shoreline polygon for any 24 hour time period

6.7.3 Shoreline Clean-up – Control measure options analysis

6.7.3.1 Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
No reasonably practical alternative control measures identified.					

6.7.3.2 Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Additional trained personnel available	The level of training and competency of the response personnel ensures the shoreline clean-up operation is delivered with minimum secondary impact to the environment. Training additional personnel does not provide an increased environmental benefit.	Additional personnel required to sustain an extended response can be sourced through the Woodside *People & Global Capability Surge Labour Requirement Plan*. Additional personnel sourced from contracted OSROs (OSRL/AMOSC) to manage other responders Response personnel are trained and exercised regularly in shoreline response techniques and methods. All personnel involved in a response will receive a full operational/safety brief prior to commencing operations.	Additional Specialist Personnel would cost A$2000 per person per day.	This option is not adopted as the existing capability meets the need.	No
Additional trained personnel deployed	Maintaining a span of control of 200 competent personnel is deemed manageable and appropriate for this activity. Additional personnel conducting clean-up activities may be able to complete the clean-up in a shorter timeframe, but modelling predicts ongoing stranding of hydrocarbons over a period of weeks. Managing a smaller, targeted response is expected to achieve an environmental benefit through ensuring the shoreline clean-up response is suitable and scalable for the shoreline substrate and sensitivity type. This will ensure there is no increased impact from the shoreline clean-up through the presence of unnecessary personnel and equipment.	The figure of 200 personnel is broken down to include on 1-2 x Trained Supervisors managing 8-10 personnel/labour hire responders. This allows for multiple operational teams to operate along the extended shoreline at different locations. Typically, an additional 30-50% of the tactical workforce is required to support ongoing operations including On-Scene control, logistics, safety/medical/welfare and transport. Personnel on site will include members with the appropriate specialties to ensure an efficient shoreline clean-up. Additional personnel are available through existing contracts with oil spill response organisations, labour hire organisations and environmental panel contractors	Additional Specialist Personnel would cost A$2000 per person per day.	This option is not adopted as the existing capability meets the need.	No

6.7.3.3 Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster response/ mobilisation time	Given modelling does not predict floating or shoreline impacts at threshold until day 17 (Credible Scenario-02) or day 22.6 (Credible Scenario-01) Woodside considers that there is sufficient time for deployment of protection and deflection operations prior to impact.	Response teams, trained personnel, contracted oil spill response service providers, government agencies and the associated mitigation equipment required to enact an initial protection and deflection response will be available for mobilisation within 24-48 hrs of activation. Additional equipment from existing stockpiles and oil spill response service providers can be on scene within days. Hydrocarbons are not predicted to strand at threshold until day 17 at Barrow Island (Credible Scenario-02) or day 22.6 (Credible Scenario-01) therefore allowing enough time to re-locate existing equipment, personnel and other resources to the most appropriate areas.	The cost of establishing a local stockpile of new shoreline clean-up equipment closer to the expected hydrocarbon stranding areas is not commensurate with the need.	This option is not adopted as the existing capability meets the need.	No

6.7.4 Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.8 Oiled Wildlife Response – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.8.1 Existing Capability – Wildlife Response

Woodside's exiting level of capability is based on internal and third-party resources that are available 24 hours per day, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft/vehicle location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, refuelling/re-stocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.8.2 Oiled Wildlife Response – Control Measure Options Analysis

6.8.2.1 Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Direct contracts with service providers	This option duplicates the capability accessed through AMOSC and OSRL and would compete for the same resources. Does not provide a significant increase in environmental benefit.	These delivery options provide increased effectiveness through more direct communication and control of specialists. However, no significant net benefit is anticipated.	Duplication of capability – already subscribed to through contracts with AMOSC and OSRL	This option is not adopted as the existing capability meets the need.	No

6.8.2.2 Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Additional wildlife treatment systems	The selected delivery options provide access to call-off contracts with selected specialist providers. The agreements ensure that these resources can be mobilised to meet the required response objectives, commensurate with the progressive nature of environmental impact and the time available to monitor hydrocarbon plume trajectories. Provides response equipment and personnel by Day 3. The additional cost in having a dedicated oiled wildlife response (equipment and personnel) in place is disproportionate to environmental benefit. These selected delivery options provide capacity to carry out an oiled wildlife response if contact is predicted; and to scale up the response if required to treat widespread contamination. Current capability meets the needs required and there is no additional environmental benefit in adopting the improvements.	Although hydrocarbon contact above threshold concentrations with offshore waters is expected on day 17 (Credible Scenario-02) or day 22.6 (Credible Scenario-01), given the low likelihood of such an event occurring and that the current capability meets the need, the cost of implementing measures to reduce the mobilisation time is considered disproportionate to the benefit. Additionally, the remote offshore location of the release site, with an earliest impact on day 17, provides sufficient opportunity for the ongoing monitoring and surveillance operations to inform the scale of the response. Numbers of oiled wildlife are expected to be low in the remote offshore setting of the oiled wildlife response, given the distance from known aggregation areas. Oiled wildlife response capacity would be addressed for open Commonwealth waters through the AMOSC arrangements, as informed by operational monitoring. The cost and organisational complexity of this approach is moderate, and the overall delivery effectiveness is high.	Additional wildlife response resources could total A$1700 per operational site per day.	This option is not adopted as the existing capability meets the need.	No
Additional trained wildlife responders	Current numbers meet the needs required and additional personnel are available through existing contracts with oil spill response organisations and environmental panel contractors. Numbers of oiled wildlife are expected to be low in the remote offshore setting of the oiled wildlife response, given the distance from known aggregation areas. The potential environmental benefit of training additional personnel is expected to be low.	The capability provides the capacity to treat approximately 600 wildlife units (primarily avian wildlife) by Day 6, with additional capacity available from OSRL. Additional equipment and facilities would be required to support ongoing response, depending on the scale of the event and the impact to wildlife. Materials for holding facilities, portable pools, enclosures and rehabilitation areas would be sourced as required.	Additional wildlife response personnel cost A$2000 per person per day	This option is not adopted as the existing capability meets the need.	No

6.8.2.3 Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster mobilisation time for wildlife response	Response time is limited by specialist personnel mobilisation time. Current timing is sufficient for expected first shoreline contact. This control measure provides increased effectiveness through faster mobilisation of specialists. However, no significant net environmental benefit is expected due to shoreline stranding times.	Pre-positioning vessels or equipment would reduce mobilisation time for oiled wildlife response activities. However, given the effectiveness of an oiled wildlife response is expected to be low, an earlier response would provide a marginal increase in environmental benefit. The selected delivery options provide the capacity to mobilise an oiled wildlife response capable of treating up to 600 wildlife from at least Day 6 and exceeds the estimated Level 1-2 oiled wildlife response thought to be applicable. This delivery option provides the maximum expertise pooled across the participating operators, backed up by the international resources provided by OSRL. The availability of vessels and personnel meets the response need.	Wildlife response packages to preposition at vulnerable sites identified through the deterministic modelling cost A$700 per package per day. The cost of having dedicated equipment and personnel available to respond faster is considered disproportionate to the environmental benefit.	This option is not adopted as the existing capability meets the need.	No

6.8.3 Selected control measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.9 Waste Management – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.9.1 Existing Capability – Waste Management

Woodside's exiting level of capability is based on internal and third-party resources that are available 24 hours per day, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft/vehicle location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, refuelling/restocking provisions, and other similar logistic and operational limitation that are beyond Woodside's direct control.

6.9.2 Waste Management – Control Measure Options Analysis

6.9.2.1 Alternative Control Measures

Alternative Control Measures Considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
No reasonably practical alternative control measures identified.					

6.9.2.2 Additional Control Measures

Additional Control Measures Considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Increased waste storage capability	The procurement of waste storage equipment options on the day of the event will allow immediate response and storage of collected waste. The environmental benefit of immediate waste storage is to reduce ecological consequence by safely securing waste, allowing continuous response operations to occur.	Access to Veolia's storage options provides the resources required to store and transport sufficient waste to meet the need. Access to waste contractors existing facilities enables waste to be stockpiled and gradually processed within the regional waste handling facilities. Additional temporary storage equipment is available through existing contract and arrangements with OSRL. Existing arrangements meet identified need for the PAP.	Cost for increased waste disposal capability would be approx. A$1300 per m^3. Cost for increased onshore temporary waste storage capability would be approx. A$40 per unit per day.	This option is not adopted as the existing capability meets the need.	No

6.9.2.3 Improved Control Measures

Improved Control Measures considered *Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures in terms of functionality, availability, reliability, survivability, independence and compatibility*					
Option considered	**Environmental consideration**	**Feasibility**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster response time	The access to Veolia waste storage options provides the resources to store and transport waste, permitting the wastes to be stockpiled and gradually processed within the regional waste handling facilities. Bulk transport to Veolia's licensed waste management facilities would be undertaken via controlled-waste-licensed vehicles and in accordance with Environmental Protection (Controlled Waste) Regulations 2004. The environmental benefit from successful waste storage will reduce pressure on the treatment and disposal facilities reducing ecological consequences by safely securing waste. In addition, waste storage and transport will allow continuous response operations to occur. This delivery option would increase known available storage, eliminating the risk of additional resources not being available at the time of the event. However, the environmental benefit of Woodside procuring additional waste storage is considered minor as the risk of additional storage not being available at the time of the event is considered low and existing arrangements provide adequate storage to support the response.	Woodside already maintains an equipment stockpile in Exmouth to enable shorter response times to incidents. This stockpile includes temporary waste storage equipment. Woodside has access to stockpiles of waste storage and equipment in Dampier and Exmouth through existing contracts and arrangements.	The incremental benefit of having a dedicated local Woodside owned stockpile of waste equipment and transport is considered minor and cost is considered disproportionate to the benefit gained given predicted shoreline contact times.	This option is not adopted as the existing capability meets the need.	No

6.9.3 Selected control measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

6.10 Scientific Monitoring – ALARP Assessment

Alternative, Additional and Improved options have been identified and assessed against the base capability described in Section 5 with those that have been selected for implementation highlighted in green. Items highlighted in red have been considered and rejected on the basis that they are not feasible, the costs are clearly disproportionate to the environmental benefit, and/or the option is not reasonably practical. Control measures where there is not a clear justification for their inclusion or exclusion may be subject to a detailed ALARP assessment.

6.10.1 Existing Capability – Scientific Monitoring

Woodside's existing level of capability is based on internal and third-party resources that are available 24 hours, 7 days per week. The capability presented below is displayed as ranges to incorporate operational factors such as weather, crew/vessel/aircraft/vehicle location and duties, survey or classification society inspection requirements, overflight/port/quarantine permits and inspections, crew/pilot duty and fatigue hours, re-fuelling/re-stocking provisions, and other similar logistic and operational limitations that are beyond Woodside's direct control.

6.10.2 Scientific Monitoring – Control Measure Options Analysis

Table 6-18: Scientific Monitoring - Control Measure Options considered – A. alternative control measures

Evaluate Alternative, Additional and Improved Control Measures					
Alternative Control Measures considered *Alternative, including potentially more effective and/or novel control measures are evaluated as replacements for an adopted control*					
Ref	Control Measure Category	Option considered	Implemented	Environmental Consideration	Feasibility / Cost
SM01	System	Analytical laboratory facilities closer to the likely spill affected area	No	SM01 water quality monitoring requires water samples to be transported to National Association of Testing Authorities (NATA) rated laboratories in Perth or interstate. Consider the benefit of laboratory access and transportation times to deliver water samples and complete lab analysis. There is a time lag from collection of water samples to being in receipt of results and confirming hydrocarbon contact to sensitive receptors). The environmental consideration of having access to suitable laboratory facilities in Exmouth or Karratha to carry out the hydrocarbon analysis would provide faster turnaround in reporting of results only by a matter of days (as per the time to transport samples to laboratories).	Laboratory facilities and staff available at locations closer to the spill affected area can reduce reporting times only to a moderate degree (days) with associated high costs of maintaining capability do not improve the environmental benefit.
SM01	System	Dedicated contracted SMP vessel (exclusive to Woodside)	No	Would provide faster mobilisation time of scientific monitoring resources, environmental benefit associated with faster mobilisation time would be minor compared to selected options.	Chartering and equipping additional vessels on standby for scientific monitoring has been considered. The option is reasonably practicable but the sacrifice (charter costs and organisational complexity) is significant, particularly when compared with the anticipated availability of vessels and resources within in the required timeframes. The selected delivery provides capability to meet the scientific monitoring objectives, including collection of pre-emptive data where baseline knowledge gaps are identified for receptor locations where spill predictions of time to contact are >10 days. The effectiveness of this alternative control (weather dependency, availability and survivability) is rated as very low The cost and organisational complexity of employing a dedicated response vessel is considered disproportionate to the potential environmental benefit by adopting these delivery options.

Table 6-19: Scientific Monitoring - Control Measure Options considered – B. Additional control measures

Additional Control Measures considered *Additional control measures are evaluated in terms of them reducing an environmental impact or an environmental risk when added to the existing suite of control measures*					
Ref	**Control Measure Category**	**Option considered**	**Implemented**	**Environmental Consideration**	**Feasibility / Cost**
SM01	System	Determine baseline data needs and provide implementation plan in the event of an unplanned hydrocarbon release	Yes	Address resourcing needs to collect post spill (pre-contact) baseline data as spill expands in the event of a loss of well containment from the PAP activities.	Woodside relies on existing environmental baseline for receptors which have predicted hydrocarbon contact (above environment threshold) <10 days and acquiring pre-emptive data in the event of a loss of well containment from the PAP activities based on receptors predicted to have hydrocarbon contact >10 days. Ensure there is appropriate baseline for key receptors for all geographic locations that are potentially impacted <10 days of spill event, where practicable. Address resourcing needs to collect pre-emptive baseline as spill expands in the event of a loss of well containment from the PAP activities.

6.10.3 Improved Control Measures

Improved Control Measures considered – No reasonably practicable improved Control Measures identified.

6.10.4 Selected Control Measures

Following review of alternative, additional and improved control measures as outlined above, the following controls were selected for implementation for the PAP.

- Alternative
  - None selected
- Additional
  - Determine baseline data needs and activate SMPs for any identified PBAs in the event of an unplanned hydrocarbon release
- Improved
  - None selected

6.10.5 Operational Plan

Key actions from the Scientific Monitoring Program Operational Plan for implementing the response are outlined in Table 6-20.

Table 6-20: Scientific monitoring program operational plan actions

Responsibility	Action
Activation	
Perth ICC Planning (ICC Planning – Environment Unit)	Mobilise SMP Lead/Manager and SMP Coordinator to the ICC Planning function.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager and SMP Coordinator)	Constantly assess all outputs from OM01, OM02 and OM03 (Section 5 and ANNEX B: Operational Monitoring Activation and Termination Criteria) to determine receptor locations and receptors at risk. Confirm sensitive receptors likely to be exposed to hydrocarbons, timeframes to specific receptor locations and which SMPs are triggered. Review baseline data for receptors at risk.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager and SMP Coordinator)	SMP co-ordinator stands up the SMP contractor. Stands up subject matter experts, if required.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager SMP Coordinator, SMP standby contractor SMP manager)	Establish if, and where, pre-contact baseline data acquisition is required. Determine practicable baseline acquisition program based on predicted timescales to contact and anticipated SMP mobilisation times. Determine scope for preliminary post-contact surveys during the Response Phase. Determine which SMP activities are required at each location based on the identified receptor sensitivities.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager, SMP Coordinator, SMP standby contractor SMP manager)	If response phase data acquisition is required, stand up the contractor SMP teams for data acquisition and instruct them to standby awaiting further details for mobilisation from the ICC.
Perth ICC Planning (ICC Planning – Environment Unit)	SMP contractor, SMP standby contractor to prepare the Field Implementation Plan. Prepare and obtain sign-off of the Response Phase SMP work plan and Field Implementation Plan. Update the IAP.

Responsibility	Action
(SMP Lead/Manager, SMP Coordinator, SMP standby contactor SMP manager)	
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager, SMP Coordinator SMP standby contactor SMP manager)	Liaise with ICC Logistics, and determine the status and availability of aircraft, vessels and road transportation available to transport survey personnel and equipment to point of departure. Engage with SMP standby contactor SMP Manager and ICC Logistics to establish mobilisation plan, secure logistics resources and establish ongoing logistical support operations, including: • Vessels, vehicles and other logistics resources • Vessel fit-out specifications (as • Detailed in the Scientific Monitoring Program Operational Plan • Equipment storage and pick-up locations • Personnel pick-up/airport departure locations • Ports of departure • Land based operational centres and forward operations bases Accommodation and food requirements.
Perth ICC Planning (ICC Planning – Environment Unit) (SMP Lead/Manager, SMP Coordinator, SMP standby contactor (SMP manager)	Confirm communications procedures between Woodside SMP team, SMP contractor SMP Duty Manager, SMP Team Leads and Operations Coordinator (ICC).
Mobilisation	
Perth ICC Logistics	Engage vessels and vehicles and arrange fitting out as specified by the mobilisation Plan Confirm vessel departure windows and communicate with the SMP contractor SMP Duty Manager. Agree SMP mobilisation timeline and induction procedures with the Operations Coordinator (ICC).
Perth ICC Logistics	Coordinate with SMP contactor SMP Duty Manager to mobilise teams and equipment according to the logistics plan and Sector induction procedures.
SMP Survey Team Leads	SMP Survey Team Leader(s) coordinate on-ground/on-vessel mobilisations and support services with the Operations Coordinator (ICC).

Document to be read in conjunction with GWF3 and Lambert Deep Drilling and Subsea Installation Environment Plan.

6.10.6 ALARP and Acceptability Summary

<table>
<tr><th colspan="3">ALARP and Acceptability Summary</th></tr>
<tr><td colspan="3">Scientific Monitoring</td></tr>
<tr><td rowspan="4">ALARP Summary</td><td>X</td><td>All known reasonably practicable control measures have been adopted</td></tr>
<tr><td>X</td><td>No additional, alternative and improved control measures would provide further benefit</td></tr>
<tr><td>X</td><td>No reasonably practical additional, alternative, and/or improved control measure exists</td></tr>
<tr><td colspan="2">The resulting scientific monitoring capability has been assessed against the worst-case credible spill scenarios. The range of strategies provide an ongoing approach to monitoring operations to assess and evaluate the scale and extent of impacts.

All known reasonably practicable control measures have been adopted with the cost and organisational complexity of these options determined to be Moderate and the overall delivery effectiveness considered Medium. The SMP’s main objectives can be met, with the addition of one alternative control measures to provide further benefit.</td></tr>
<tr><td>Acceptability Summary</td><td colspan="2">• The control measures selected for implementation manage the potential impacts and risks to ALARP.
• In the event of a hydrocarbon spill for the PAP, the control measures selected, meet or exceed the requirements of Woodside Management System and industry best-practice.
• Throughout the PAP, relevant Australian standards and codes of practice will be followed to evaluate the impacts from a loss of well containment.
• The level of impact and risk to the environment has been considered with regard to the principles of Environmentally Sustainable Development (ESD); and risks and impacts from a range of identified scenarios were assessed in detail. The control measures described consider the conservation of biological and ecological diversity, through both the selection of control measures and the management of their performance. The control measures have been developed to account for the worst-case credible case scenarios, and uncertainty has not been used as a reason for postponing control measures.</td></tr>
<tr><td colspan="3">On the basis from the impact assessment above and in Section 6 of the EP Woodside considers the adopted controls discussed manage the impacts and risks associated with implementing scientific monitoring activities to a level that is ALARP and acceptable.</td></tr>
</table>

7 ENVIRONMENTAL RISK ASSESSMENT OF SELECTED RESPONSE TECHNIQUES

The implementation of response techniques may modify the impacts and risks identified in the EP and response activities can introduce additional impacts and risks from response operations themselves. Therefore, it is necessary to complete an assessment to ensure these impacts and risks have been considered and specific measures are put in place to continually review and manage these further impacts and risks to ALARP and Acceptable levels. A simplified assessment process has been used to complete this task which covers the identification, analysis, evaluation and treatment of impacts and risks introduced by responding to the event.

7.1 Identification of impacts and risks from implementing response techniques

Each of the control measures can modify the impacts and risks identified in the EP. These impacts and risks have been previously assessed within the scope of the EP. Refer to the EP for details regarding how these risks are being managed. They are not discussed further in this document.

- atmospheric emissions
- routine and non-routine discharges
- physical presence, proximity to other vessels (shipping and fisheries)
- routine acoustic emissions vessels
- lighting for night work/navigational safety
- invasive marine species
- collision with marine fauna
- disturbance to seabed.

Additional impacts and risks associated with the control measures not included within the scope of the EP include:

- drill cuttings and drilling fluids environmental impact assessment for relief well drilling
- vessel operations and anchoring
- distribution of entrained hydrocarbons
- toxicity of dispersant
- presence of personnel on the shoreline
- vegetation cutting
- additional stress or injury caused to wildlife
- waste generation.

7.2 Analysis of impacts and risks from implementing response techniques

The table below compares the adopted control measures for this activity against the environmental values that can be affected when they are implemented.

Table 7-1: Analysis of risks and impacts

	Environmental Value						
	Soil & groundwater	Marine sediment quality	Water quality	Air quality	Ecosystems/ habitat	Species	Socio-economic
Monitor and evaluate		✓	✓		✓	✓	
Source control		✓	✓	✓	✓	✓	✓
Subsea dispersant injection		✓	✓		✓	✓	✓
Surface dispersant application			✓		✓	✓	✓
Containment and Recovery			✓		✓	✓	✓
Shoreline protection and deflection	✓	✓	✓		✓	✓	✓
Shoreline clean-up	✓	✓	✓		✓	✓	✓
Oiled wildlife response					✓	✓	
Scientific monitoring	✓	✓	✓	✓	✓	✓	✓
Waste management	✓			✓	✓	✓	✓

7.3 Evaluation of impacts and risks from implementing response techniques

Drill cuttings and drilling fluids environmental impact assessment for relief well drilling

The identified potential impacts associated with the discharge of drill cuttings and fluids during a relief well drilling activity include a localised reduction in water and seabed sediment quality, and potential localised changes to benthic biota (habitats and communities).

A number of direct and indirect ecological impact pathways are identified for drill cuttings and drilling fluids as follows:

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

Potential impacts from the discharge of cuttings range from the complete burial of benthic biota in the immediate vicinity of the well site due to sediment deposition, smothering effects from raised sedimentation concentrations as a result of elevated TSS, changes to the physico-chemical properties of the seabed sediments (particle size distribution and potential for reduction in oxygen levels within the surface sediments due to organic matter degradation by aerobic bacteria) and subsequent changes to the composition of infauna communities to minor sediment loading above background and no associated ecological effects. Predicted impacts are generally confined to within a few hundred metres of the discharge point (International Association of Oil and Gas Producers 2016) (i.e. within the EMBA for a hydrocarbon spill event).

The discharge of drill cuttings and unrecoverable fluids from relief well drilling is expected to increase turbidity and TSS levels in the water column, leading to an increased sedimentation rate above ambient levels associated with the settlement of suspended sediment particles in close proximity to the seabed or below sea surface, depending on location of discharge. Cuttings with retained (unrecoverable) drilling fluids are discharged below the water line at the MODU location, resulting in drill cuttings and drilling fluids rapidly diluting, as they disperse and settle through the water column. The dispersion and fate of the cuttings is determined by particle size and density of the retained (unrecoverable) drilling fluids, therefore, the sediment particles will primarily settle in proximity to the well locations with potential for localised spread downstream (depending on the speed of currents throughout the water column and seabed) (IOGP 2016). The finer particles will remain in suspension and will be transported further before settling on the seabed.

These conclusions were supported by discharge modelling which was undertaken by Woodside in support of the Greater Enfield Development EP. Modelling results indicating that the TSS plume of suspended cuttings will typically disperse to the south-west while oscillating with the tide and diminish rapidly with increasing distance from the well locations. Maximum TSS concentrations predicted for 100 m; 250 m and 1 km distances from the wellsite were 7, 5 and 1 mg/L, respectively. Furthermore, water column concentrations below 10 mg/L remain within 235 m of the discharge location for each modelled well. For all well discharge locations (outside of direct discharge sites), TSS concentration did not exceed 10 mg/l. Nelson et al. (2016) identified <10 mg/L as a no effect or sub-lethal minimal effect concentration.

The low sensitivity of the deep-water benthic communities/habitats within and in the vicinity of relief well locations, combined with the relatively low toxicity of water based muds (WBM) and non-water based muds (NWBMs), there being no bulk discharges of NWBM and the highly localised nature and scale of predicted physical impacts to seabed biota, indicate that any localised impact would likely be of a slight magnitude (especially when considering the broader consequence of the loss of well containment event that a relief well drilling activity would be responding too).

Vessel operations and anchoring

During the implementation of response techniques, where water depths allow, it is possible that response vessels will be required to anchor (e.g. during shoreline surveys). The use of vessel anchoring will be minimal and likely to occur when the impacted shoreline is inaccessible via road. Anchoring in the nearshore environment of sensitive receptor locations will have the potential to impact coral reef, seagrass beds and other benthic communities in these areas. Recovery of benthic communities from anchor damage depends on the size of anchor and frequency of anchoring. Impacts would be highly localised (restricted to the footprint of the vessel anchor and chain) and temporary, with full recovery expected.

Distribution of entrained hydrocarbons

Surface dispersant application is intended to treat floating hydrocarbons, thereby reducing the risk of air breathing marine fauna (e.g. cetaceans, dugongs, marine turtles, seabirds and shorebirds) from becoming oiled. It also has the potential to reduce/eliminate contamination of sensitive intertidal habitats such as mangroves, coral reefs, salt marshes and sandy shores (recreational and tourist areas) through the reduction in shoreline loadings.

Chemical dispersants act to break up hydrocarbons by reducing surface tension between the oil and the surrounding water. Dispersants, whether applied on the surface or subsea, result in the breakup of hydrocarbons into micron-sized droplets, which are easier to disperse throughout the water column. These small, dispersed hydrocarbons droplets are degraded by bacteria due to the increased surface area presented by the small droplets. The application of dispersants can enhance biodegradation and dissolution, reducing the volume of hydrocarbons that have the potential to impact shorelines.

Surface application of dispersants results in the micron-sized droplets being mixed into the upper layer of the water column, usually the first 10 to 20m, through wave and wind energy. These elevated concentrations of dispersed hydrocarbons within the upper layer of the water column are rapidly diluted through vertical and horizontal mixing. The application of surface dispersants may result in a greater risk that water column and subtidal habitats could be exposed to elevated concentrations of dispersed hydrocarbons.

Toxicity of dispersants

The evaluation of the potential impacts to the receiving environment needs to consider not only the redistribution of hydrocarbons into the water column, but also the potential toxic nature of the dispersant applied and the toxicity effects of dispersed hydrocarbons.

The potential toxicity to the marine environment can be from the chemical/dispersant itself but also chemical dispersion of hydrocarbon can increase the concentration of toxic hydrocarbon compounds in the water column (Anderson et al 2014). Subtidal habitats and communities such as coral reefs, seagrass meadows, plankton, fish, known spawning grounds and periods of increased reproductive outputs (early life stages of fish and invertebrates i.e. meroplankton) are susceptible to toxic effects of chemically dispersed hydrocarbons.

Presence of personnel on the shoreline

Presence of personnel on the shoreline during shoreline operations could potentially result in disturbance to wildlife and habitats. During the implementation of response techniques, it is possible that personnel may have minimal, localised impacts on habitats, wildlife and coastlines. The impacts associated with human presence on shorelines during shoreline surveys and response operations may include:

- damage to vegetation/habitat, especially in sensitive locations such as mangroves and turtle nesting beaches, to gain access to areas of shoreline oiling
- damage or disturbance to wildlife during shoreline surveys
- removal of surface layers of intertidal sediments (potential habitat depletion)
- excessive removal of substrate causing erosion and instability of localised areas of the shoreline
- compaction of sediments.

Any impacts are expected to be localised with full recovery expected.

Additional stress or injury caused to wildlife

Additional stress or injury to wildlife could be caused through the following phases of a response:

- capturing wildlife
- transporting wildlife
- stabilisation of wildlife
- cleaning and rinsing of oiled wildlife
- rehabilitation (e.g. diet, cage size, housing density)
- release of treated wildlife.

Inefficient capture techniques have the potential to cause undue stress, exhaustion or injury to wildlife, additionally pre-emptive capture could cause undue stress and impacts to wildlife when there are uncertainties in the forecast trajectory of the spill. During the transportation and stabilisation phases there is the potential for additional thermoregulation stress on captured wildlife. Additionally, during the cleaning process, it is important personnel undertaking the tasks are familiar with the relevant techniques to ensure that further injury and the removal of water proofing feathers are managed and mitigated. Finally, during the release phase it's important that wildlife is not released back into a contaminated environment.

Waste generation

Implementing the selected response techniques will result in the generation of the following waste streams that will require management and disposal:

- liquids (recovered oil/water mixture), recovered from shoreline clean-up operations
- semi-solids/solids (oily solids), collected during shoreline clean-up operations

- debris (e.g. seaweed, sand, woods, plastics), collected during shoreline clean-up operations and oiled wildlife response.

If not managed and disposed of correctly, wastes generated during the response have the potential for secondary contamination similar to that described above, impacts to wildlife through contact with or ingestion of waste materials and contamination risks if not disposed of correctly onshore.

Cutting back vegetation prior to impact could minimise the amount of contaminated organic material and thus reduce the amount of oiled/hazardous waste to be handled. However, removal of vegetation also allows more extensive penetration of oil into the substrate and may lead to habitat loss. Any impacts are expected to be localised with full recovery expected.

7.4 Treatment of impacts and risks from implementing response techniques

In respect of the impacts and risks assessed the following treatment measures have been adopted. It must be recognised that this environmental assessment is seeking to identify how to maintain the level of impact and risks at levels that are ALARP and of an acceptable level rather than exploring further impact and risk reduction. It is for this reason that the treatment measures identified in this assessment will be captured in Operational Plans, TRPs, and/or the FSP.

Vessel operations and access in the nearshore environment

- The boom will be monitored and maintained to ensure trapped fauna are released as early as possible, with containment and recovery activities occurring in daylight hours only (PS 21.1).
- If vessels are required for access, anchoring locations will be selected to minimise disturbance to benthic primary producer habitats. Where existing fixed anchoring points are not available, locations will be selected to minimise impact to nearshore benthic environments with a preference for areas of sandy seabed where they can be identified (PS 21.2, PS 24.1, PS 28.1).
- Shallow draft vessels will be used to access remote shorelines to minimise the impacts associated with seabed disturbance on approach to the shorelines (PS 24.2, PS 28.2).

Distribution of entrained hydrocarbons

- Only apply surface dispersants within the Zone of Application and on BAOAC 4 and 5 (PS 17.4).
- Continuous monitoring of dispersed oil plume and visual monitoring of effectiveness (PS 17.5).

Toxicity of dispersants

- OSCA approved dispersants prioritised for surface and subsea use (PS 14.3, PS 17.3).

Presence of personnel on the shoreline

- Oversight by trained personnel who are aware of the risks (PS 28.6).
- Trained unit leaders brief personnel prior to operations of the environmental risks of presence of personnel on the shoreline (PS 28.7).
- Shoreline access route (foot, car, vessel and helicopter) with the least environmental impact identified will be selected by a specialist in SCAT operations\ (PS 28.4).
- Vehicular access will be restricted on dunes, turtle nesting beaches and in mangroves (PS 28.3).

Additional stress or injury caused to wildlife

- Oiled wildlife operations (including hazing) would be implemented with advice and assistance from the Oiled Wildlife Advisor from the DBCA and in accordance with the processes and methodologies described in the WA OWRP and the relevant regional plan (PS 30.3).

Waste generation

- All shorelines zoned and marked before clean-up operations commence to prevent secondary contamination and minimise the mixing of clean and oiled sediment and shoreline substrates (PS 25.5).
- Limiting vegetation removal to only that vegetation that has been moderately or heavily oiled (PS 28.5).

8 ALARP CONCLUSION

An analysis of alternative, additional and improved control measures has been undertaken to determine their reasonableness and practicability. The tables in Section 6 document the considerations made in this evaluation. Where the costs of an alternative, additional, or improved control measure has been determined to be clearly disproportionate to the environmental benefit gained from its adoption it has been rejected. Where this is not considered to be the case the control measure has been adopted.

The risks from a hydrocarbon spill have been reduced to ALARP because:

- Woodside has a significant hydrocarbon spill response capability to respond to the WCCS through the control measures identified
- new and modified impacts and risks associated with implementing response techniques have been considered and will not increase the risks associated with the activity
- a consideration of alternative, additional, and improved control measures identified any other control measures that delivered proportionate environmental benefit compared to the cost of adoption for this activity ensuring that:
  - all known, reasonably practicable control measures have been adopted
  - no additional, reasonably practicable alternative and/or improved control measures would provide further environmental benefit
  - no reasonably practical additional, alternative, and/or improved control measure exists.
- a structured process for considering alternative, additional, and improved control measures was completed for each control measure
- the evaluation was undertaken based on the outputs of the WCCS so that the capability in place is sufficient for all other scenarios from this activity
- the likelihood of the WCCS spill has been ignored in evaluating what was reasonably practicable.

9 ACCEPTABILITY CONCLUSION

Following the ALARP evaluation process, Woodside considers the hydrocarbon spill risks and impacts to have been reduced to an acceptable level by meeting all of the following criteria:

- Techniques are consistent with Woodside's processes and relevant internal requirements including policies, culture, processes, standards, structures and systems.
- Levels of risk/ impact are deemed acceptable by relevant persons (external stakeholders) and are aligned with the uniqueness of, and/or the level of protection assigned to the environment, its sensitivity to pressures introduced by the activity, and the proximity of activities to sensitive receptors, and have been aligned with Part 3 of the EPBC Act.
- Selected control measures meet requirements of legislation and conventions to which Australia is a signatory (e.g. International Convention for the Prevention of Pollution from Ships (MARPOL), the World Heritage Convention, the Ramsar Convention, and the Biodiversity Convention etc.). In addition to these, other non-legislative requirements met include:
    - Australian IUCN reserve management principles for Commonwealth marine protected areas and bioregional marine plans
    - National Water Quality Management Strategy and supporting guidelines for marine water quality)
    - conditions of approval set under other legislation
    - national and international requirements for managing pollution from ships
    - national biosecurity requirements.
- Industry standards, best practices and widely adopted standards and other published materials have been used and referenced when defining acceptable levels. Where these are inconsistent with mandatory/ legislative regulations, explanation has been provided for the proposed deviation. Any deviation produces the same or a better level of environmental performance (or outcome).

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11 GLOSSARY & ABBREVIATIONS

11.1 Glossary

Term	Description / Definition
ALARP	Demonstration through reasoned and supported arguments that there are no other practicable options that could reasonably be adopted to reduce risks further.
Availability	The availability of a control measure is the percentage of time that it is capable of performing its function (operating time plus standby time) divided by the total period (whether in service or not). In other words, it is the probability that the control has not failed or is undergoing a maintenance or repair function when it needs to be used.
Control	The means by which risk from events is eliminated or minimised.
Control effectiveness	A measure of how well the control measures perform their required function.
Control measure (risk control measure)	The features that eliminate, prevent, reduce or mitigate the risk to environment associated with PAP.
Credible spill scenario	A spill considered by Woodside as representative of maximum volume and characteristics of a spill that could occur as part of the PAP.
Dependency	The degree of reliance on other systems in order for the control measure to be able to perform its intended function.
Environment that may be affected	The summary of quantitative modelling where the marine environment could be exposed to hydrocarbons levels exceeding hydrocarbon threshold concentrations.
Incident	An event where a release of energy resulted in or had (with) the potential to cause injury, ill health, damage to the environment, damage to equipment or assets or company reputation.
Major Environment Event	The events with potential environment, reputation, social or cultural consequences of category C or higher (as per Woodside's operational risk matrix) which are evaluated against credible worst-case scenarios which may occur when all controls are absent or have failed.
Performance outcome	A statement of the overall goal or outcome to be achieved by a control measure
Performance standard	The parameters against which [risk] controls are assessed to ensure they reduce risk to ALARP. A statement of the key requirements (indicators) that the control measure has to achieve in order to perform as intended in relation to its functionality, availability, reliability, survivability and dependencies.
Preparedness	Measures taken before an incident in order to improve the effectiveness of a response
Reasonably practicable	... a computation ... made by the owner, in which the quantum of risk is placed on one scale and the sacrifice involved in the measures necessary for averting the risk (whether in money, time or trouble) [showing whether or not] that there is a gross disproportion between them ... made by the owner at a point of time anterior to the accident. (Judgement: Edwards v National Coal Board [1949])
Receptors at risk	Physical, biological and social resources identified as at risk from hydrocarbon contact using oil spill modelling predictions.
Receptor areas	Geographically referenced areas such as bays, islands, coastlines and/or protected area (WHA, Commonwealth or State marine reserve or park) containing one or more receptor type.

Term	Description / Definition
Receptor Sensitivities	This is a classification scheme to categorise receptor sensitivity to an oil spill. The Environmental Sensitivity Index (ESI) is a numerical classification of the relative sensitivity of a particular environment (particularly different shoreline types) to an oil spill. Refer to the Woodside OPEA for more details.
Regulator	NOPSEMA are the Environment Regulator under the Environment Regulations.
Reliability	The probability that at any point in time a control measure will operate correctly for a further specified length of time.
Response technique	The key priorities and objectives to be achieved by the response plan Measures taken in response to an event to reduce or prevent adverse consequences.
Survivability	Whether or not a control measure is able to survive a potentially damaging event is relevant for all control measures that are required to function after an incident has occurred.
Threshold	Hydrocarbon threshold concentrations applied to the risk assessment to evaluate hydrocarbon spills.
Zone of Application	The zone in which Woodside may elect to apply dispersant. The zone is determined based on a range of considerations, such as hydrocarbon characteristics, weathering and metocean conditions. The zone is a key consideration in the Net Environmental Benefit Analysis for dispersant use.

11.2 Abbreviations

Abbreviation	Meaning
AIIMS	Australasian Inter-Service Incident Management System
AHV	Anchor Handling Vessel
ALARP	As low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
APASA	Asia Pacific Applied Science Associates
APPEA	Australian Petroleum Production and Exploration Association
AUV	Autonomous Underwater Vehicle
BAOAC	Bonn Agreement Oil Appearance Code
BOP	Blowout Preventer
CEDRE	Centre for Documentation, Research and Experimentation on Accidental Water Pollution
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (US)
CFD	Computational Fluid Dynamic
CICC	Corporate Incident Coordination Centre
CMT	Crisis Management Team
cSt	Centistokes
DBCA	Western Australia Department of Biodiversity, Conservation and Attractions (former Western Australian Department of Parks and Wildlife)
DM	Duty Manager
DOR	Dispersant to Oil Ratio
EMBA	Environment that May Be Affected
EMSA	European Maritime Safety Agency
Environment Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
EP	Environment Plan
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESI	Environmental Sensitivity Index
ESD	Environmentally Sustainable Development
ESP	Environmental Services Panel
FPSO	Floating Production Storage Offloading
FSP	First Strike Plan
FWADC	Fixed Wing Aerial Dispersant Contract
GDS	Global Dispersant Stockpile (service from OSRL)
GIS	Geographic Information System
GRN	Global Response Network
GWF3	Greater Western Flank 3
HAZID	Hazard Identification

Abbreviation	Meaning
HSEQ	Health Safety Environment and Quality
IAP	Incident Action Plan
ICC	Incident Coordination Centre
ICE	Incident Control Environment
IGEM	Industry-Government Environmental Meta-database
IMS	Incident Management System
IMSA	Index of Marine Surveys for Assessment
IMT	Incident Management Team
IOGP	International Association of Oil and Gas Producers
IPIECA	International Petroleum Industry Environment Conservation Association
ISV	Infield support vessel
IT	Information Technology
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for Conservation of Nature
KBSF	King Bay Support Facility
LEL	Lower Explosive Limit
LOWC	Loss of Well Containment
MARPOL	International Convention for the Prevention of Pollution from Ships
MMA	Marine Management Area
MODU	Mobile Offshore Drilling Unit
MOU	Memorandum of Understanding
MSRC	Marine Spill Response Corporation
NATA	National Association of Testing Authorities (Australia)
NEBA	Net Environmental Benefit Analysis
NOAA	National Oceanic and Atmospheric Administration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NRDA	Natural Resource Damage Assessment
NWBM	Non-Water Based Muds
OIE	Offset Installation Equipment
OILMAP	Oil Spill Model and Response System
OM	Operational Monitoring
OPEA	Oil Pollution Emergency Arrangements
OPEP	Oil Pollution Emergency Plan
OSCA	Oil Spill Cleaning Agent (registered for use within the National Plan)
OSPRMA	Oil Spill Preparedness and Response Mitigation Assessment
OSRL	Oil Spill Response Limited
OSRO	Oil Spill Response Organisations
OSTM	Oil Spill Trajectory Modelling
OWRP	Oiled Wildlife Response Plan

Abbreviation	Meaning
OWROP	Regional Oiled Wildlife Response Operational Plan
PAP	Petroleum Activities Program
PBA	Pre-emptive Baseline Areas
PPB	Parts per billion
PPM	Parts per million
PS	Performance Standard
QA/QC	Quality Assurance/ Quality Control
ROV	Remotely Operated Vehicle(s)
RPA	Response Protection Area
S&EM	Security & Emergency Management
SCAT	Shoreline Clean-up Assessment Technique
SDA	Surface Dispersant Application
SFRT	Subsea First Response Toolkit
SIMA	Spill Impact Mitigation Assessment
SIMAP	Integrated Oil Spill Impact Model System
SIMOPs	Simultaneous Operations
SMP	Scientific Monitoring Program
SSDI	Subsea Dispersant Injection
SFRT	Subsea First Response Toolkit
SIMA	Spill Impact Mitigation Assessment
SM	Scientific Monitoring
SME	Subject Matter Expert
SMP	Scientific Monitoring Program
SPD	Shoreline Protection and Deflection
TRP	Tactical Response Plan
TRSV	Tubing Retrievable Safety Valve
TSS	Total Suspended Solids
UAS	Unmanned Aerial Systems
UAV	Unmanned Aerial Vehicles
VOC	Volatile Organic Compound
WA DoT	Western Australia Department of Transport
WBM	Water Based Muds
WCCS	Worst Case Credible Scenario
WHA	World Heritage Area
WiRCS	Woodside Integrated Risk & Compliance System
Woodside	Woodside Energy Limited
WWCI	Wild Well Control Inc
ZoA	Zone of Application

ANNEX A: NET ENVIRONMENTAL BENEFIT ANALYSIS DETAILED OUTCOMES

Pre-operational NEBAs have been conducted to assess the net environmental benefit of different response techniques to selected receptors in the event of an oil spill from the PAP for a loss of well containment of GWF3 Condensate from the GDA05 well (Credible Scenario-01), a loss of well containment of Lambert Deep Condensate from the LDA01 wells (Credible Scenario-02) and a spill of marine diesel from a vessel collision (Credible Scenario-03). The complete list of potential receptor locations within the EMBA within the PAP is included in Section 6 of the EP.

The locations utilised for the NEBA were limited to the identified RPAs of the PAP identified from modelling (see Section 3 for outline of selection). These include receptors which have potential for the following:

- Surface contact (>50 g/m^2)
- Shoreline accumulation (100g/m^2) at any time

The detailed NEBA assessment outcomes are shown below. The GWF3 and Lambert Deep Drilling and Subsea Installation project preoperational NEBAs contains the full assessments.

Table A-1: NEBA assessment technique recommendations for GWF3 (Credible Scenario-01)

Receptor	Monitor and evaluate	Source control and well intervention	Source control (vessel)	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled wildlife response
Montebello Islands and State Marine Park	Yes	Yes	N/A	Yes	No	No	No	Yes	Yes	Yes	Yes	No	Yes
Pilbara Islands – Southern Islands Group	Yes	Yes	N/A	Yes	No	No	No	Yes	Yes	Yes	Yes	No	Yes
Muiron Islands Marine Management Area & World Heritage Area	Yes	Yes	N/A	Yes	No	No	No	Yes	Yes	Yes	Yes	No	Yes
Open water	Yes	Yes	N/A	Yes	Yes	No	No	Yes	No	No	No	No	Yes

Overall assessment

Sensitive receptor (sites identified in EP)	Monitor and evaluate	Source control and well intervention	Source control (vessel)	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled wildlife response
Is this response Practicable?	Yes	Yes	N/A	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
NEBA identifies response potentially of net environmental benefit?	Yes	Yes	N/A	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes

Table A-2: NEBA assessment technique recommendations for Lambert Deep (Credible Scenario-02)

Receptor	Monitor and evaluate	Source control and well intervention	Source control (vessel)	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled wildlife response
Montebello Islands and State Marine Park	Yes	Yes	N/A	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes
Barrow Island	Yes	Yes	N/A	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes
Lowendal Islands	Yes	Yes	N/A	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes
Pilbara Islands – Southern Islands Group	Yes	Yes	N/A	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes
Muiron Islands Marine Management Area & World Heritage Area	Yes	Yes	N/A	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes
Dampier Archipelago	Yes	Yes	N/A	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes
Pilbara - Northern Pilbara - Islands & Shoreline	Yes	Yes	N/A	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes
Open water	Yes	Yes	N/A	Yes	No	No	No	No	No	No	No	No	Yes

Overall assessment

Sensitive receptor (sites identified in EP)	Monitor and evaluate	Source control and well intervention	Source control (vessel)	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled wildlife response
Is this response Practicable?	Yes	Yes	N/A	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes
NEBA identifies response potentially of net environmental benefit?	Yes	Yes	N/A	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes

Table A-3: NEBA assessment technique recommendations for marine diesel (Credible Scenario-03)

Receptor	Monitor and evaluate	Source control and well intervention	Source control (vessel)	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled wildlife response
Open water	Yes	N/A	Yes	N/A	No	No	No	No	No	No	No	No	Yes

Overall assessment

Sensitive receptor (sites identified in EP)	Monitor and evaluate	Source control and well intervention	Source control (vessel)	Dispersant application: sub-sea	Dispersant application: > 20 m water depth and > 10 km from shore/reefs	Mechanical dispersion	In situ burning	Containment and recovery	Shoreline protection	Shoreline clean-up (manual)	Shoreline clean-up (mechanical)	Shoreline clean-up (chemical)	Oiled wildlife response
Is this response Practicable?	Yes	N/A	Yes	N/A	No	No	No	No	No	No	No	No	Yes
NEBA identifies response potentially of net environmental benefit?	Yes	N/A	Yes	N/A	No	No	No	No	No	No	No	No	Yes

NEBA Impact Ranking Classification Guidance

To reduce variability between assessments, the following ranking descriptions have been devised to guide the workshop process:

			Degree of impact	Potential duration of impact	Equivalent Woodside Corporate Risk Matrix Consequence Level
Positive	3P	Major	Likely to prevent: • behavioural impact to biological receptors • behavioural impact to socio-economic receptors e.g. changes to day-today business operations, public opinion/behaviours (e.g. avoidance of amenities such as beaches) or regulatory designations.	Decrease in duration of impact by >5 years	N/A
	2P	Moderate	Likely to prevent: • significant impact to a single phase of reproductive cycle of biological receptors • detectable financial impact, either directly (e.g. loss of income) or indirectly (e.g. via public perception), for socio-economic receptors.	Decrease in duration of impact by 1–5 years	N/A
	1P	Minor	Likely to prevent impacts on: • significant proportion of population or breeding stages of biological receptors • socio-economic receptors such as: ○ significant impact to the sensitivity of protective designation; or ○ significant and long-term impact to business/industry.	Decrease in duration of impact by several seasons (< 1 year)	N/A
	0	Non-mitigated spill impact	**No detectable difference to unmitigated spill scenario.**		
Negative	1N	Minor	Likely to result in: • behavioural impact to biological receptors • behavioural impact to socio-economic receptors e.g. changes to day-to-day business operations, public opinion/behaviours (e.g. avoidance of amenities such as beaches), or regulatory designations. **[Note 1]**	Increase in duration of impact by several seasons (< 1 year)	Increase in risk by one sub-category, without changing category (e.g. Minor (E) to Minor (D))
	2N	Moderate	Likely to result in: • significant impact to a single phase of reproductive cycle for biological receptors; or • detectable financial impact, either directly (e.g. loss of income) or indirectly (e.g. via public perception), for socio-economic receptors. This level of negative impact is recoverable and unlikely to result in closure of business/industry in the region.	Increase in duration of impact by 1–5 years	Increase in risk by one category (e.g. Minor (D) to Moderate (C or B))
	3N	Major	Likely to result in impacts on: • significant proportion of population or breeding stages of biological receptors • socio-economic receptors resulting in either: ○ significant impact to the sensitivity of protective designation; or ○ significant and long-term impact to business/industry.	Increase in duration of impact by >5 years or unrecoverable	Increase in risk by two categories (e.g. Minor (E) to Major (A))

NOTE: the maximum likely impact should be considered; for example, if a spill were to directly impact the behaviour that results in an impact to reproduction and/or the breeding population (such as fish failing to aggregate to spawn), then the score should be a 2 or 3 rather than a 1. Similarly, if a change in behaviour resulted in an increased risk of mortality of a population, then it should be scored as a 2 or 3.

ANNEX B: OPERATIONAL MONITORING ACTIVATION AND TERMINATION CRITERIA

Table B-1: Operational monitoring objectives, triggers and termination criteria

Operational Monitoring Operational Plan	Objectives	Activation triggers	Termination criteria
Operational Monitoring Operational Plan 1 (OM01) Predictive Modelling of Hydrocarbons to Assess Resources at Risk	OM01 focuses on the conditions that have prevailed since a spill commenced, as well as those that are forecasted in the short term (1–3 days ahead) and longer term. OM01 utilises computer-based forecasting methods to predict hydrocarbon spill movement and guide the management and execution of spill response operations to maximise the protection of environmental resources at risk. The objectives of OM01 are to: • Provide forecasting of the movement and weathering of spilled hydrocarbons • Identify resources that are potentially at risk of contamination • Provide simulations showing the outcome of alternative response options (booming patterns etc.) to inform on-going Net Environmental Benefit Analysis (NEBA) and continually assess the efficacy of available response options in order to reduce risks to ALARP	OM01 will be triggered immediately following a level 2/3 hydrocarbon spill.	The criteria for the termination of OM01 are: • The hydrocarbon discharge has ceased and no further surface oil is visible • Response activities have ceased • Hydrocarbon spill modelling (as verified by OM02 surveillance observations) predicts no additional natural resources will be impacted

Operational Monitoring **Operational Plan**	Objectives	Activation triggers	Termination criteria
Operational Monitoring Operational Plan 2 (OM02) Surveillance and reconnaissance to detect hydrocarbons and resources at risk	OM02 aims to provide regular, on-going hydrocarbon spill surveillance throughout a broad region, in the event of a spill. The objectives of OM02 are: • Verify spill modelling results and recalibrate spill trajectory models (OM01). • Understand the behaviour, weathering and fate of surface hydrocarbons. • Identify environmental receptors and locations at risk or contaminated by hydrocarbons. • Inform ongoing Net Environmental Benefit Analysis (NEBA) and continually assess the efficacy of available response options in order to reduce risks to ALARP. • To aid in the subsequent assessment of the short- to long-term impacts and/or recovery of natural resources (assessed in SMPs) by ensuring that the visible cause and effect relationships between the hydrocarbon spill and its impacts to natural resources have been observed and recorded during the operational phase.	OM02 will be triggered immediately following a level 2/3 hydrocarbon spill.	The termination triggers for the OM02 are: • 72 hours has elapsed since the last confirmed observation of surface hydrocarbons. • Latest hydrocarbon spill modelling results (OM01) do not predict surface exposures at visible levels.
Operational Monitoring Operational Plan 3 (OM03) Monitoring of hydrocarbon presence, properties, behaviour and weathering in water	OM03 will measure surface, entrained and dissolved hydrocarbons in the water column to inform decision-making for spill response activities. The specific objectives of OM03 are as follows: • Detect and monitor for the presence, quantity, properties, behaviour and weathering of surface, entrained and dissolved hydrocarbons. • Verify predictions made by OM01 and observations made by OM02 about the presence and extent of hydrocarbon contamination. Data collected in OM03 will also be used for the purpose of longer-term water quality monitoring during SM01.	OM03 will be triggered immediately following a level 2/3 hydrocarbon spill.	The criteria for the termination of OM03 are as follows: • The hydrocarbon release has ceased. • Response activities have ceased. • Concentrations of hydrocarbons in the water are below available ANZECC/ ARMCANZ (2018) trigger values for 99% species protection.

Operational Monitoring **Operational Plan**	Objectives	Activation triggers	Termination criteria
Operational Monitoring Operational Plan 4 (OM04) Pre-emptive assessment of sensitive receptors at risk	OM04 aims to undertake a rapid assessment of the presence, extent and current status of shoreline sensitive receptors prior to contact from the hydrocarbon spill, by providing categorical or semi-quantitative information on the characteristics of resources at risk. The primary objective of OM04 is to confirm understanding of the status and characteristics of environmental resources predicted by OM01 and OM02 to be at risk, to further assist in making decisions on the selection of appropriate response actions and prioritisation of resources. Indirectly, qualitative/semi-quantitative pre-contact information collected by OM04 on the status of environmental resources may also aid in the verification of environmental baseline data and provide context for the assessment of environmental impacts, as determined through subsequent SMPs. OM04 would be undertaken in liaison with WA DoT as the control agency once the oil is in State Waters (if a Level 2/3 incident).	Triggers for commencing OM04 include: • Contact of a sensitive habitat or shoreline is predicted by OM01, OM02 and/or OM03. • The pre-emptive assessment methods can be implemented before contact from hydrocarbons (once a receptor has been contacted by hydrocarbons it will be assessed under OM05).	The criteria for the termination of OM04 at any given location are: • Locations predicted to be contacted by hydrocarbons have been contacted. • The location has not been contacted by hydrocarbons and is no longer predicted to be contacted by hydrocarbons (resources should be reallocated as appropriate).

Operational Monitoring Operational Plan	Objectives	Activation triggers	Termination criteria
Operational monitoring operational plan 5 (OM05) Monitoring of contaminated resources	OM05 aims to implement surveys to assess the condition of wildlife and habitats contacted by hydrocarbons at sensitive habitat and shoreline locations. The primary objectives of OM05 are: • Record evidence of oiled wildlife (mortalities, sub-lethal impacts, number, extent, location) and habitats (mortalities, sub-lethal impacts, type, extent of cover, area, hydrocarbon character, thickness, mass and content) throughout the response and clean-up at locations contacted by hydrocarbons to inform and prioritise clean-up efforts and resources, while minimising the potential impacts of these activities. Indirectly, the information collected by OM05 may also support the assessment of environmental impacts, as determined through subsequent SMPs. OM05 would be undertaken in liaison with WA DoT as the control agency once the oil is in State Waters (if a Level 2/3 incident).	OM05 will be triggered when a sensitive habitat or shoreline is predicted to be contacted by hydrocarbons by OM01, OM02 and/or OM03.	The criteria for the termination of OM05 at any given location are: • No additional response or clean-up of wildlife or habitats is predicted. • Spill response and clean-up activities have ceased. OM05 survey sites established at sensitive habitat and shoreline locations will continue to be monitored during SM02. The formal transition from OM05 to SM02 will begin on cessation of spill response and clean-up activities.

ANNEX C: OIL SPILL SCIENTIFIC MONITORING PROGRAM

Oil Spill Environmental Monitoring

The following provides some further detail on Woodside's oil spill Scientific Monitoring Program and includes the following:

- the organisation, roles and responsibilities of the woodside oil spill scientific monitoring team and external resourcing
- a summary table of the ten scientific monitoring programs as per the specific focus receptor, objectives, activation triggers and termination criteria
- details on the oil spill environmental monitoring activation and termination decision-making processes
- baseline knowledge and environmental studies knowledge access via geo-spatial metadata databases
- an outline of the reporting requirements for oil spill scientific monitoring programs.

Oil Spill Scientific Monitoring – Delivery Team Roles and Responsibilities

Woodside Oil Spill Scientific Monitoring Delivery Team

The Woodside science team are responsible for the delivery of the oil spill scientific monitoring. The roles and responsibilities of the Woodside scientific monitoring delivery team are presented in Table C-1 and the organisational structure and Incident Control Centre (ICC) linkage provided in Figure C-1.

Woodside Oil Spill Scientific monitoring program - External Resourcing

In the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors, scientific monitoring personnel and scientific equipment to implement the appropriate SMPs will be provided by standby SMP contractor who hold a standby contract for SMP via the Woodside Environmental Services Panel (ESP). In the event, that additional resources are required other consultancy capacity within the Woodside ESP will be utilised (as needed and may extend to specialist contractors such as research agencies engaged in long-term marine monitoring programs). In consultation with the standby SMP contractor and/or specialist contractors, the selection, field sampling and approach of the SMPs will be determined by the nature and scale of the spill.

Table C-1: Woodside and Environmental Service Provider – Oil Spill Scientific Monitoring Program Delivery Team Key Roles and Responsibilities

Role	Location	Responsibility
Woodside Roles		
SMP Lead/Manager	Onshore (Perth)	• Approves activated the SMPs based on operational monitoring data provided by the Planning Function • Provides advice to the ICC in relation to scientific monitoring • Provides technical advice regarding the implementation of scientific monitoring • Approves detailed sampling plans prepared for SMPs • Directs liaison between statutory authorities, advisors and government agencies in relation to SMPs.
SMP Co-ordinator	Onshore (Perth)	• Activates the SMPs based on operational monitoring data provided by the Planning Function • Sits in the Planning function of the ICC. • Liaises with other ICC functions to deliver required logistics, resources and operational support from Woodside to support the Environmental Service Provider in delivering on the SMPs. Acts as the conduit for advice from the Chief Environmental Scientist to the Environmental Service Provider • Manages the Environmental Service Provider's implementation of the SMPs • Liaises with the Environmental Service Provider on delivery of the SMPs • Arranges all contractual matters, on behalf of Woodside, associated with the Environmental Service Provider's delivery of the SMPs.
Environmental Service Provider Roles		
SMP Standby Contractor – SMP Duty Manager/Project Manager (SMP Liaison Officer)	Onshore (Perth)	• Coordinates the delivery of the SMPs • Provides costings, schedule and progress updates for delivery of SMPs • Determines the structure of the Environmental Service Provider's team to necessitate delivery of the SMPs • Verifies that HSE Plans, detailed sampling plans and other relevant deliverables are developed and implemented for delivery of the SMPs • Directs field teams to deliver SMPs • Arranges all contractual matters, on behalf of Environmental Service Provider, associated with the delivery of the SMPs to Woodside • Manages sub-consultant delivery to Woodside • Provides required personnel and equipment to deliver the SMPs.
SMP Field Teams	Offshore – Monitoring Locations	• Delivers the SMPs in the field consistent with the detailed sampling plans and HSE requirements, within time and budget. • Early communication of time, budget, HSE risks associated with delivery of the SMPs to the Environmental Service Provider – Project Manager • Provides start up, progress and termination updates to the Environmental Service Provider – Project Manager (will be led in-field by a party chief).

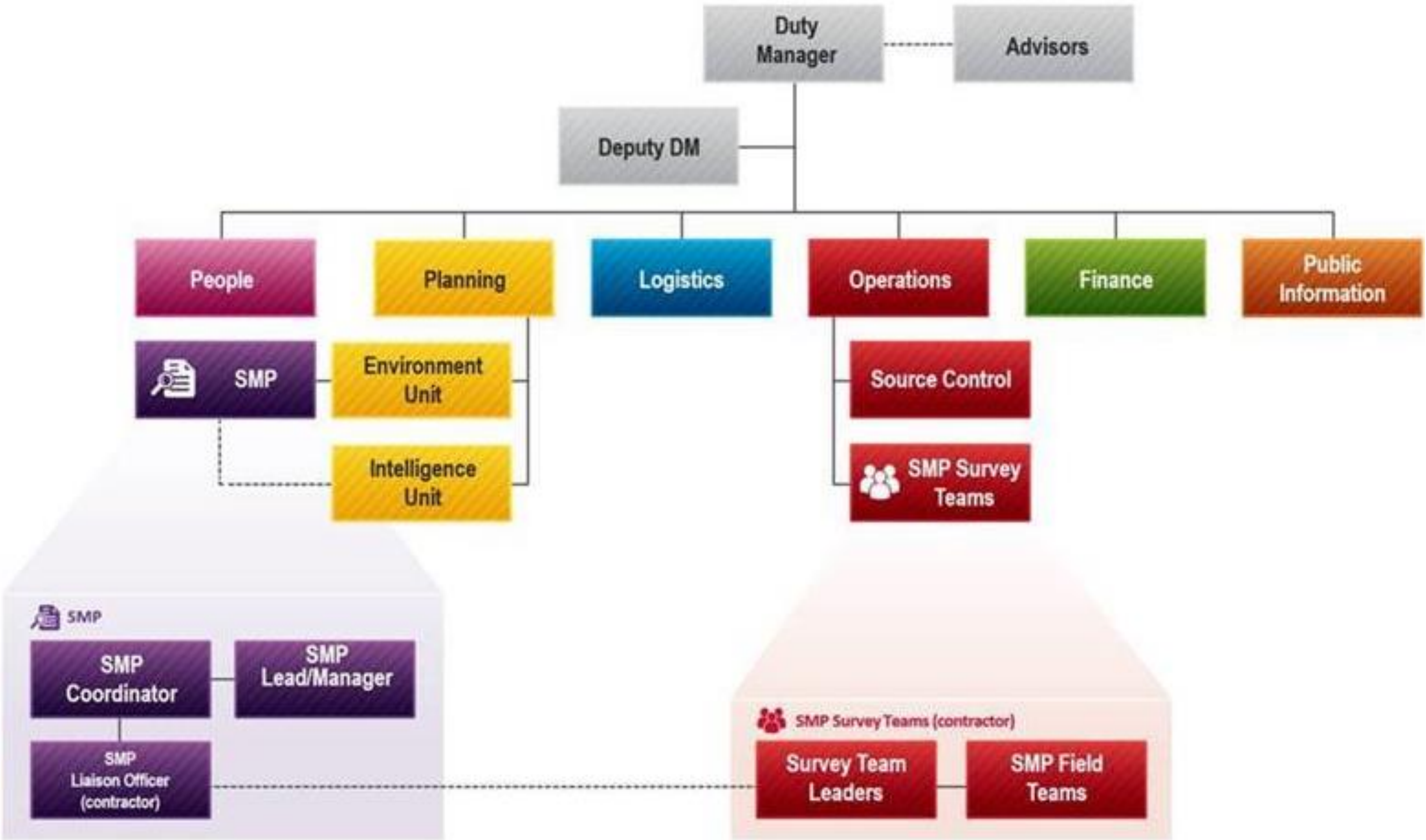

Figure C-1: Woodside Oil Spill Scientific Monitoring Program Delivery Team and Linkage to Incident Control Centre (ICC) organisational structure.

Table C-2: Oil Spill Environmental Monitoring: Scientific Monitoring Program – Objectives, Activation Triggers and Termination Criteria

Scientific monitoring Program (SMP)	Objectives	Activation Triggers	Termination Criteria
Scientific monitoring program 1 (SM01) **Assessment of Hydrocarbons in Marine Waters**	SM01 will detect and monitor the presence, extent, persistence and properties of hydrocarbons in marine waters following the spill and the response. The specific objectives of SM01 are as follows: • Assess and document the extent, severity and persistence of hydrocarbon contamination with reference to observations made during surveillance activities and / or in-water measurements made during operational monitoring; and • Provide information that may be used to interpret potential cause and effect drivers for environmental impacts recorded for sensitive receptors monitored under other SMPs.	SM01 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors	SM01 will be terminated when: • Operational monitoring data relating to observations and / or measurements of hydrocarbons on and in water have been compiled, analysed and reported; and • The report provides details of the extent, severity and persistence of hydrocarbons which can be used for analysis of impacts recorded for sensitive receptors monitored under other SMPs. SMP monitoring of sensitive receptor sites: • Concentrations of hydrocarbons in water samples are below NOPSEMA guidance note (2019[23]) concentrations of 1 g/m2 for floating, 10 ppb for entrained and dissolved; and • Details of the extent, severity and persistence of hydrocarbons from concentrations recorded in water have been documented at sensitive receptor sites monitored under other SMPs.
Scientific monitoring program 2 (SM02) **Assessment of the Presence, Quantity and Character of Hydrocarbons in Marine Sediments**	SM02 will detect and monitor the presence, extent, persistence and properties of hydrocarbons in marine sediments following the spill and the response. The specific objectives of SM02 are as follows: • Determine the extent, severity and persistence of hydrocarbons in marine sediments across selected sites where hydrocarbons were observed or recorded during operational monitoring; and • Provide information that may be used to interpret potential cause and effect drivers for environmental impacts recorded for sensitive receptors monitored under other SMPs.	SM02 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented as follows: • Response activities have ceased; and • Operational monitoring results made during the response phase indicate that shoreline, intertidal or sub-tidal sediments have been exposed to surface, entrained or dissolved hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation).	SM02 will be terminated once pre-spill condition is reached and agreed upon as per the SMP termination criteria process and include consideration of: • Concentrations of hydrocarbons in sediment samples are below ANZECC/ ARMCANZ (2013[24]) sediment quality guideline values (SQGVs) for biological disturbance; and • Details of the extent, severity and persistence of hydrocarbons from concentrations recorded in sediments have been documented.
Scientific monitoring program 3 (SM03) **Assessment of Impacts and Recovery of Subtidal and Intertidal Benthos**	The objectives of SM03 are: • Characterize the status of intertidal and subtidal benthic habitats and quantify any impacts to functional groups, abundance and density that may be a result of the spill; and • Determine the impact of the hydrocarbon spill and subsequent recovery (including impacts associated with the implementation of response options). Categories of intertidal and subtidal habitats that may be monitored include: • Coral reefs • Seagrass • Macro-algae • Filter-feeders SM03 will be supported by sediment contamination records (SM02) and characteristics of the spill derived from OMPs.	SM03 will be activated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented as follows: • As part of a pre-emptive assessment of PBAs of receptor locations identified by time to hydrocarbon contact >10 days, to target receptors and sites where it is possible to acquire pre-hydrocarbon contact baseline; and • Operational monitoring identified shoreline potential contact of hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) for subtidal and intertidal benthic habitat.	SM03 will be terminated once pre-spill condition is reached and agreed upon as per the SMP termination criteria process and include consideration of: • Overall impacts to benthic habitats from hydrocarbon exposure have been quantified. • Recovery of impacted benthic habitats has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 4 (SM04) **Assessment of Impacts and Recovery of Mangroves / Saltmarsh**	The objectives of SM04 are: • Characterize the status of mangroves (and associated salt marsh habitat) at shorelines exposed/contacted by spilled hydrocarbons; • Quantify any impacts to species (abundance and density) and mangrove/saltmarsh community structure; and	SM04 will be activated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented as follows:	SM04 will be terminated once pre-spill condition is reached and agreed upon as per the SMP termination criteria process and include consideration of: • Impacts to mangrove and saltmarsh habitat from hydrocarbon exposure have been quantified.

[23] NOPSEMA (2019) Bulletin #1 – Oil spill modelling – April 2019, https://www.nopsema.gov.au/assets/Bulletins/A652993.pdf

[24] Simpson SL, Batley GB and Chariton AA (2013). Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines. CSIRO and Water Science Report 08/07. Land and Water, pp. 132.

Scientific monitoring Program (SMP)	Objectives	Activation Triggers	Termination Criteria
	• Determine and monitor the impact of the hydrocarbon spill and potential subsequent recovery (including impacts associated with the implementation of response options). SM03 will be supported by sediment sampling undertaken in SM02 and characteristics of the spill derived from OMPs.	• As part of a pre-emptive assessment of receptor locations identified by time to hydrocarbon contact >10 days; and • Operational monitoring identified shoreline potential contact of hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) for mangrove/saltmarsh habitat.	• Recovery of impacted mangrove/saltmarsh habitat has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 5 (SM05) **Assessment of Impacts and Recovery of Seabird and Shorebird Populations**	The Objectives of SM05 are to: • Collate and quantify impacts to avian wildlife from results recorded during OM02 and OM05 (such as mortalities, oiling, rescue and release counts) and undertake a desk-based assessment to infer potential impacts at species population level; and • Undertake monitoring to quantify and assess impacts of hydrocarbon exposure to seabirds and shorebird populations at targeted breeding colonies / staging sites / important coastal wetlands where hydrocarbon contact was recorded.	SM05 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented as follows: • As part of a pre-emptive assessment of receptor locations identified by time to hydrocarbon contact >10 days; • Operational monitoring predicts shoreline contact of hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) at important bird colonies / staging sites / important coastal wetland locations; or • Records of dead, oiled or injured bird species made during the hydrocarbon spill or response.	SM05 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Impacts to seabird and shorebird populations from hydrocarbon exposure have been quantified. • Recovery of impacted seabird and shorebird populations has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 6 (SM06) **Assessment of Impacts and Recovery of Nesting Marine Turtle Populations**	The objectives of SM06 are to: • To quantify impacts of hydrocarbon exposure or contact on marine turtle nesting populations (including impacts associated with the implementation of response options); • Collate and quantify impacts to adult and hatchling marine turtles from results recorded during OM02 and OM05 (such as mortalities, oiling, rescue and release counts) and undertake a desk-based assessment to infer potential impacts at species population levels (including impacts associated with the implementation of response options); .and • Undertake monitoring to quantify and assess impacts of hydrocarbon exposure to nesting marine turtle populations at known rookeries (including impacts associated with the implementation of response options).	SM06 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented if operational monitoring has: • As part of a pre-emptive assessment of receptor locations identified by time to hydrocarbon contact >10 days; • Predicted shoreline contact of hydrocarbons (at or above 0.5 g/m^2 surface, 5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) at known marine turtle rookery locations; or • Records of dead, oiled or injured marine turtle species made during the hydrocarbon spill or response.	SM06 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Impacts to nesting marine turtle populations from hydrocarbon exposure have been quantified. • Recovery of impacted nesting marine turtle populations has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 7 (SM07) **Assessment of Impacts to Pinniped Colonies including Haul-out Site Populations**	The objectives of SM07 are to: • Quantify impacts on pinniped colonies and haul-out sites as a result of hydrocarbon exposure/contact. • Collate and quantify impacts to pinniped populations from results recorded during OM02 and OM05 (such as mortalities, oiling, rescue and release counts) and undertake a desk-based assessment to infer potential impacts at species population levels.	SM07 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented if operational monitoring has: • As part of a pre-emptive assessment of receptor locations identified by time to hydrocarbon contact >10 days; • Identified shoreline contact of hydrocarbons ((at or above 0.5 g/m^2 surface, ≥5 ppb for entrained/dissolved hydrocarbons and ≥1 g/m^2 for shoreline accumulation) at known pinniped colony or haul-out site(s) (i.e. most northern site is the Houtman Abrolhos Islands); or • Records of dead, oiled or injured pinniped species made during the hydrocarbon spill or response.	SM07 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Impacts to pinniped populations from hydrocarbon exposure have been quantified. • Recovery of pinniped populations has been evaluated. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 8 (SM08) **Desk-Based Assessment of Impacts to Other Non-Avian Marine Megafauna**	The objective of SM08 is to provide a desk-based assessment which collates the results of OM02 and OM05 where observations relate to the mortality, stranding or oiling of mobile marine megafauna species not addressed in SM06 or SM07, including: • Cetaceans;	SM08 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented if operational monitoring reports	SM08 will be terminated when the results of the post-spill monitoring have quantified impacts to non-avian megafauna.

Scientific monitoring Program (SMP)	Objectives	Activation Triggers	Termination Criteria
	• Dugongs; • Whale sharks and other shark and ray populations; • Sea snakes; and • Crocodiles. The desk-based assessment will include population analysis to infer potential impacts to marine megafauna species populations.	records of dead, oiled or injured non-avian marine megafauna during the spill/ response phase.	• Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 9 (SM09) **Assessment of Impacts and Recovery of Marine Fish associated with SM03 habitats**	The objectives of SM09 are: • Characterise the status of resident fish populations associated with habitats monitored in SM03 exposed/contacted by spilled hydrocarbons; • Quantify any impacts to species (abundance, richness and density) and resident fish population structure (representative functional trophic groups); and • Determine and monitor the impact of the hydrocarbon spill and potential subsequent recovery (including impacts associated with the implementation of response options).	SM09 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented with SMO3.	SM09 will be undertaken and terminated concurrent with monitoring undertaken for SM03, as per the SMP termination criteria process • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.
Scientific monitoring program 10 (SM10) **SM10 - Assessment of physiological impacts important fish and shellfish species (fish health and seafood quality/safety) and recovery**	SM10 aims to assess any physiological impacts to important commercial fish and shellfish species (assessment of fish health) and if applicable, seafood quality/safety. Monitoring will be designed to sample key commercial fish and shellfish species and analyse tissues to identify fish health indicators and biomarkers, for example: • Liver Detoxification Enzymes (ethoxyresorufin-O-deethylase (EROD) activity) • PAH Biliary Metabolites • Oxidative DNA Damage • Serum SDH • Other physiological parameters, such as condition factor (CF), liver somatic index (LSI), gonado-somatic index (GSI) and gonad histology, total weight, length, condition, parasites, egg development, testes development, abnormalities. Seafood tainting may be included (where appropriate) using applicable sensory tests to objectively assess targeted finfish and shellfish species for hydrocarbon contamination. Results will be used to make inferences on the health of commercial fisheries and the potential magnitude of impacts to fishing industries.	SM10 will be initiated in the event of a Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors and implemented if operational monitoring (OM01, OM02 and OM05) indicates the following: • The hydrocarbon spill will or has intersected with active commercial fisheries or aquaculture activities. • Commercially targeted finfish and/or shellfish mortality has been observed/recorded. • Commercial fishing or aquaculture areas have been exposed to hydrocarbons (≥0.5 g/m^2 surface and ≥5 ppb for entrained/dissolved hydrocarbons); and • Taste, odour or appearance of seafood presenting a potential human health risk is observed.	SM10 will be terminated once it is agreed that the receptor has returned to pre-spill condition. The SMP termination criteria process will be followed and include consideration of: • Physiological impacts to important commercial fish and shellfish species from hydrocarbon exposure have been quantified. • Recovery of important commercial fish and shellfish species from hydrocarbon exposure has been evaluated. • Impacts to seafood quality/safety (if applicable) have been assessed and information provided to the relevant stakeholders and regulators for the management of any impacted fisheries. • Agreement with relevant stakeholders and regulators based on the nature and scale of the hydrocarbon spill impacts and/or that observed impacts can no longer be attributed to the spill.

Activation Triggers and Termination Criteria

Scientific monitoring program activation

The Woodside oil spill scientific monitoring team will be stood up immediately with the occurrence of a hydrocarbon spill (actual or suspected) Level 2 or 3 hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors via the First Strike plan for the petroleum activity programme. The presence of any level of hydrocarbons in the marine environment triggers the activation of the oil spill scientific monitoring program (SMP). This is to ensure the full range of eventualities relating to the environmental, socio-economic and health consequences of the spill are considered in the planning and execution of the SMP. The activation process also takes into consideration the management objectives, species recovery plans, conservation advices and conservations plans for any World Heritage Area (WHA), AMPs, State Marine Parks, other protected area designations (e.g., State nature reserves) and Matters of National Environmental Significance (including listed species under part 3 of the EPBC Act) potentially exposed to hydrocarbons. With the first 24-48 hours of a spill event, such information will be sourced and evaluated as part of the SMP planning process guided by Appendix D (identified receptors vulnerable to hydrocarbon contact), the information presented in the Existing Environment section of the EP as well as other information sources such as the Woodside Baseline Environmental Studies Database.

The starting point for decision-making on which SMPs are activated, and the spatial extent of monitoring activities, will be based on the predictive modelling results (OM01) in the first 24-48 hours until more information is made available from other operational monitoring activities such as aerial surveillance and shoreline surveys. Pre-emptive Baseline Areas (WHA, AMPs and State Marine Parks encompassing key ecological and socio-economic values) are a key focus of the SMP activation decision-making process, particularly, in the early spill event/response phase. As the operational monitoring progresses and further situational awareness information becomes available, it will be possible to understand the nature and scale of the spill. The SMP activation and implementation decision-making will be revisited on a daily basis to account for the updates on spill information. One of the priority focus areas in the early phase of the incident will be to identify and execute pre-emptive SMP assessments at key receptor locations, as required. The SMP activation and implementation decision tree is presented in Figure C-2.

Scientific monitoring program termination

The basis of the termination process for the active SMPs (SMPs 1-10) will include quantification of impacts, evaluation of recovery for the receptor at risk and consultation with relevant authorities, persons and organisations. Termination of each SMP will not be considered until the results (as presented in annual SMP reports for the duration of each program) indicate that the target receptor has returned to pre-spill condition.

Once the SMP results indicate impacted receptor(s) have returned to pre-spill condition (as identified by Woodside) a termination decision-making process will be triggered and a number of steps will be undertaken as follows:

- Woodside will engage expert opinion on whether the receptor has returned to pre-spill condition (based on monitoring data). Subject Matter Expert (SMEs) will be engaged (via the Woodside SME scientific monitoring terms of reference) to review program outcomes, provide expert advice and recommendations for the duration of each SMP.
- Where expert opinion agrees that the receptor has returned to pre-spill condition, findings will then be presented to the relevant authorities, persons and organisations (as defined by the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulation 11A). Stakeholder identification, planning and engagement will be managed by Woodside's Reputation Functional Support Team (FST) and follow the stakeholder management FST guidelines. These guidelines outline the FST roles and responsibilities, competencies, stakeholder communications and planning processes. An assessment of the merits of any objection to termination will be documented in the SMP final report.
- Woodside will decide on termination of SMP based on expert opinion and merits of any stakeholder objections. The final report following termination will include: monitoring results, expert opinion and stakeholder consultation including merits of any objections.
- Termination of SMPs will also consider applicable management objectives, species recovery plans, conservation advices and conservations plans for any World Heritage Area (WHA), AMPs, State

Marine Parks, other protected area designations (e.g., State nature reserves) and Matters of National Environmental Significance (including listed species under part 3 of the EPBC Act).

The SMP termination decision-making process will be applied to each active SMP and an iterative process of decision steps continued until each SMP has been terminated (refer to decision-tree diagram for SMP termination criteria, Figure C-3).

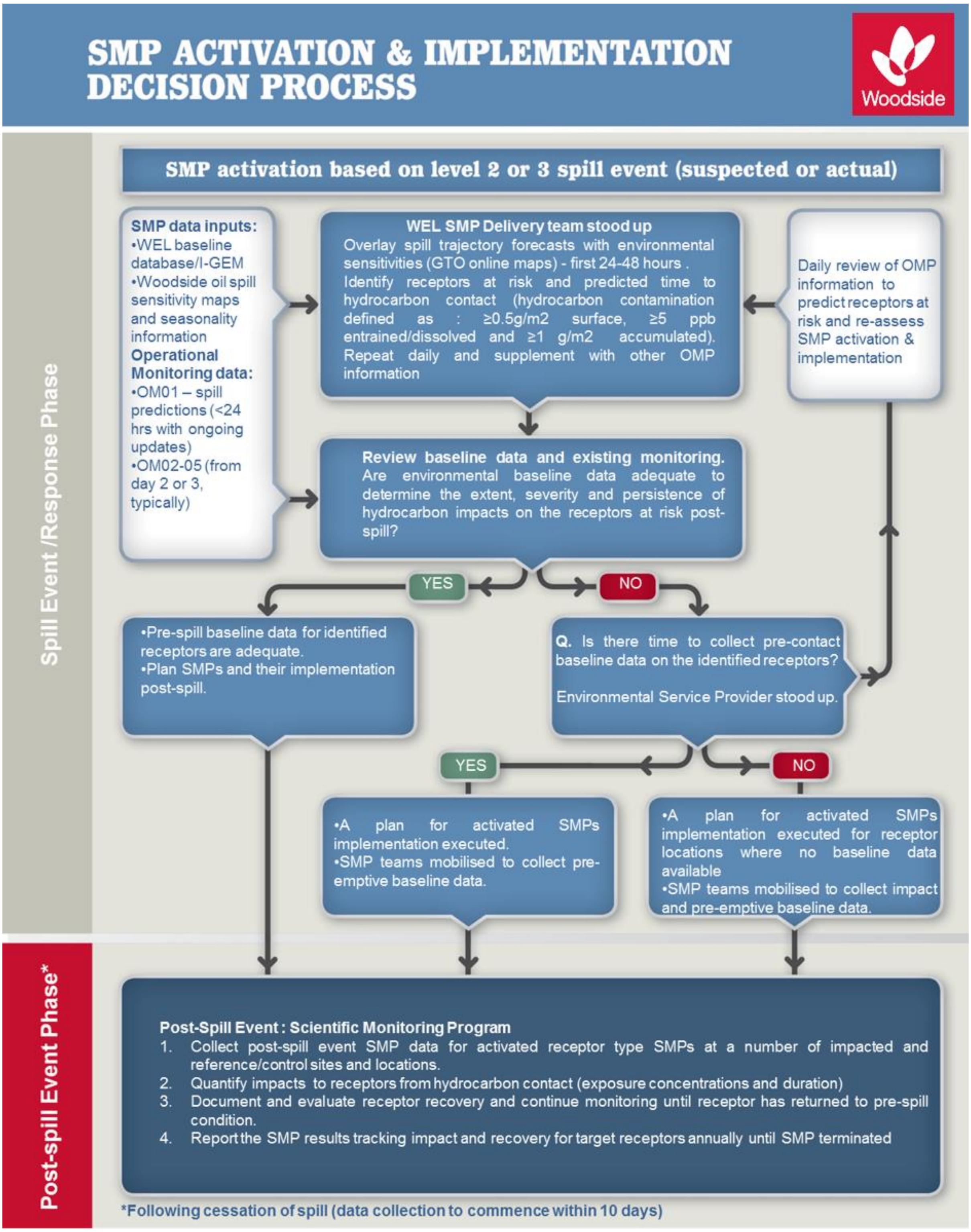

Figure C-2: Activation and Implementation Decision-tree for Oil Spill Environmental Monitoring

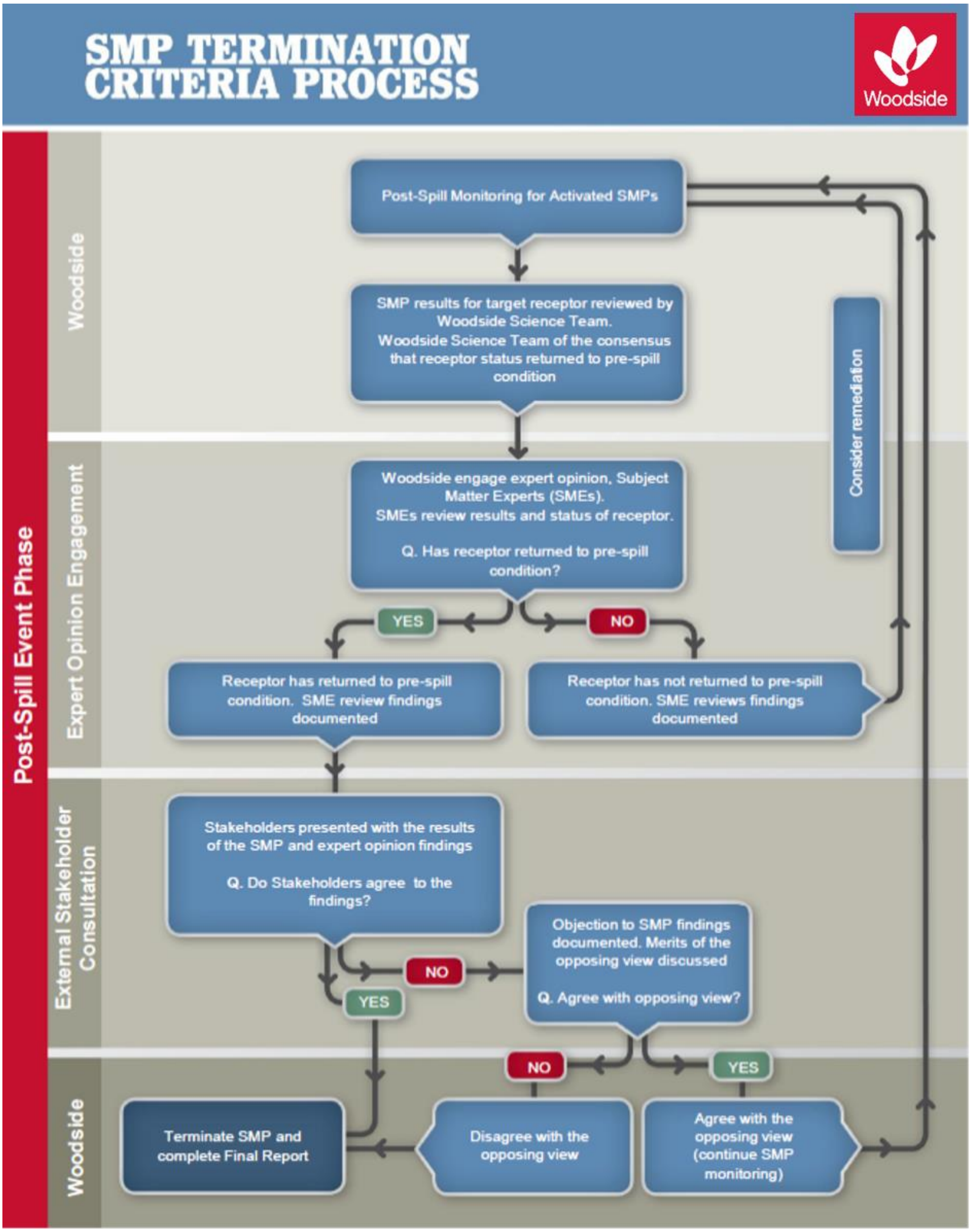

Figure C-3: Termination Criteria Decision-tree for Oil Spill Environmental Monitoring

Receptors at Risk and Baseline Knowledge

In order to assess the baseline studies available and suitability for oil spill scientific monitoring, Woodside maintains knowledge of environmental baseline studies through the upkeep and use of its Environmental Knowledge Management System.

Woodside's Environmental Knowledge Management System is a centralised platform for scientific information on the existing environment, marine biodiversity, Woodside environmental studies, key environmental impact topics, key literature and web-based resources. The system comprises a number of data directories and an environmental baseline database, as well as folders within the 'Corporate Environment' server space. The environmental baseline database was set up to support Woodside's SMP preparedness and as a SMP resource in the event of an unplanned hydrocarbon spill. The environmental baseline database is subject to updates including annual reviews completed as part of the contracted SMP standby, SMP standby contract. This database is accessed pre-PAP to identify Pre-emptive Baseline Areas (PBAs) where hydrocarbon contact is predicted to occur <10 days.

In addition to Woodside's Environmental Knowledge Management System, it is acknowledged that many relevant baseline datasets are held by other organisations (e.g. other oil and gas operators, government agencies, state and federal research institutions and non-governmental organisations). In order to understand the present status of environmental baseline studies a spatial environmental metadata database for Western Australia (Industry-Government Environmental Metadata, I-GEM) was established. IGEM is a collaboration comprising oil and gas operators (including Woodside), government and research agencies and other organisations. IGEM held data were integrated into the Department of Water and Environmental Regulation (WA) Index of Marine Surveys for Assessment (IMSA)[25] in 2020. The Index of Marine Surveys for Assessments (IMSA) is an online portal to information about marine-based environmental surveys in Western Australia. IMSA is a project of the Department of Water and Environmental Regulation for the systematic capture and sharing of marine data created as part of an environmental impact assessment (EIA). In the event of an unplanned hydrocarbon release, Woodside intends to interrogate the information on baseline studies status as held by the various databases (e.g. Woodside Environmental Knowledge Management System, IMSA and other sources of existing baseline data) to identify Pre-emptive Baseline Areas (PBAs), i.e., receptors at risk where hydrocarbon contact is predicted to be >10 days, and baseline data can be collected before hydrocarbon contact.

Reporting

For the scientific monitoring program relevant regulators will be provided with:

- Annual reports summarising the SMPs deployed and active, data collection activities and available findings; and
- Final reports for each SMP summarising the quantitative assessment of environmental impacts and recovery of the receptor once returned to pre-spill condition and termination of the monitoring program.

The reporting requirements of the scientific monitoring program will be specific to the individual SMPs deployed and terms of responsibilities, report templates, schedule, QA/QC and peer-review will be agreed with the contractors engaged to conduct the SMPs. Compliance and auditing mechanisms will be incorporated into the reporting terms.

[25] https://biocollect.ala.org.au/imsa#max%3D20%26sort%3DdateCreatedSort

ANNEX D: SCIENTIFIC MONITORING PROGRAM AND BASELINE STUDIES FOR THE PETROLEUM ACTIVITIES PROGRAM

Table D-1: Oil Spill Environmental Monitoring – scientific monitoring program scope for the Petroleum Activities Program based on Spill EMBA for Credible Scenario-01 and Credible Scenario-02 (Table 2-1)

Receptors to be Monitored	Applicable SMP	Receptor Areas - Potential Impact and Reference Scientific Monitoring Sites (marked X): Kimberley AMP	Agro-Rowley Terrace AMP	Montebello AMP	Dampier AMP	Carnarvon Canyon AMP	Ningaloo AMP	Gascoyne AMP	Shark Bay Open Ocean (including AMP)	Abrolhos AMP	Jurien AMP	Two Rocks AMP	Perth Canyon AMP	Geographe AMP	South-west Corner AMP	Ashmore Reef and AMP	Seringapatam Reef	Scott Reef (North and South)	Mermaid Reef and AMP	Clerke Reef and State Marine Park	Imperieuse Reef and State Marine Park	Rankin Bank	Glomar Shoal	Rowley Shoals (including Sate Maine Park)	Fantome Shoal	Adele Island	Lacepede Islands	Montebello Islands (including State Marine Park)	Lowendal Islands (including State Nature Reserves)	Barrow Island (including State Nature Reserves, State Marine Park and Marine Management Area)	Muiron Islands (WHA, Marine Management Area)	Pilbara Islands - Southern Island Group (Serrurier, Thevenard and Bessieres Islands - State Nature Reserves)	Pilbara Islands - Northern Island Group (Sandy Island Passage Islands - State nature reserves)	Abrolhos Islands	Kimberley Coast	Dampier Peninsula	Northern Pilbara Shoreline	Ningaloo Coast (North/North West Cape, Middle and South) (WHA, and State Marine Park)	Shark Bay - Open Ocean Coast	Shark Bay (WHA, State Marine Park)	Ngari Capes State Marine Park
Habitat																																									
Water Quality	SM01	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marine Sediment Quality	SM02	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Coral Reef	SM03	X		X												X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	
Seagrass / Macro-Algae	SM03	X									X					X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Deeper Water Filter Feeders	SM03	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						X							X			
Mangroves and Saltmarsh	SM04																											X						X	X	X	X	X		X	
Species																																									
Sea Birds and Migratory Shorebirds (significant colonies / staging sites / coastal wetlands)	SM05	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Marine Turtles (significant nesting beaches)	SM06	X	X	X	X		X	X	X							X	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Pinnipeds (significant colonies / haul-out sites)	SM07									X	X	X			X																										X
Cetaceans - Migratory Whales	SM08	X	X	X	X		X	X	X	X	X	X	X	X	X			X									X	X	X	X	X			X	X	X		X		X	X
Oceanic and Coastal Cetaceans	SM08	X	X	X	X		X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Dugongs	SM08	X							X							X												X	X	X	X	X	X		X	X	X	X	X	X	
Sea Snakes	SM08	X		X	X			X	X	X						X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Whale Sharks	SM08			X			X	X										X										X	X	X	X							X			
Other Shark and Ray Populations	SM08, SM09	X	X	X	X		X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fish Assemblages	SM09	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Socio-economic																																									
Fisheries - Commercial	SM10		X	X	X	X	X	X	X	X	X	X										X	X	X	X			X	X	X		X	X	X	X	X	X	X	X	X	X
Fisheries - Traditional	SM10															X	X	X									X													X	
Tourism (incl. recreational fishing)	SM10	X		X			X	X	X		X			X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X

(dark red)	Receptor areas identified as Pre-emptive Baseline Areas (based on criteria of surface contact and/or entrained hydrocarbon contact ≤10 days (Offshore Australian Marine Parks contacted by hydrocarbons in this timeframe also noted)
(light red)	Receptor areas identified as Pre-Emptive Basline Areas in the response phase >10 days (based on criteria of surface contact and/or entrained hydrocarbon contact >10 days)
(white)	Receptor areas that may be identified as impact or reference sites in the event of major hydrocarbon release and would be identified as part of the SMP planning process

Table D-2: Baseline Studies for the SMPs applicable to identified Pre-emptive Baseline Areas for the Petroleum Activities Program

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Rankin Bank & Glomar Shoal	Montebello Islands	Barrow Island	Lowendal Islands	Pilbara Islands – Southern Island Group (Serrurier, Thevenard and Bessieres Islands – State Nature Reserve)	Montebello AMP
Benthic Habitat (Coral Reef)	**SM03** Quantitative assessment using image capture using either diver held camera or towed video. Post analysis into broad groups based on taxonomy and morphology.	**Studies:**					
		1. Glomar Shoal and Rankin Bank Environmental Survey Report, 2013, quantitatively surveyed benthic habitats and communities. AIMS report to Woodside. Scientific Publication - Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems, 2018. 2. Rankin Bank Environmental Survey Extension, 2014, Habitat assessment of an area southeast of Rankin Bank. 3. Glomar Shoal and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoal, 2018.	1. Broad benthic habitat classifications and habitat maps for the Montebello islands by DBCA. 2. Coral monitoring at sites across Barrow Island, Lowendal and the Montebello islands. Most recent survey 2012 3. Benthic community monitoring as part of DBCA Western Australian Marine Monitoring Program (2015-ongoing). 4. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Chevron LTM of corals for the Gorgon Gas Development. Marine Baseline Program (2008), Marine Monitoring Program (2010) Post Development Surveys (2011 – 2013). 2.Coral monitoring at sites around Barrow Island, Lowendal and the Montebello islands. Most recent survey 2012. 3.Benthic community (coral, seagrass and macroalgae) monitoring as part of DBCA's Western Australian Marine Monitoring Program (2015-ongoing). 4.Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Benthic habitats surrounding the Lowendal Islands for the Gorgon Gas Development. Coral assemblages on the eastern side of Double Island, and coral bommies on the south-western edge of the Lowendal Shelf. 2. Coral monitoring at sites across Barrow Island, Lowendal and the Montebello islands. Most recent survey 2012. 3. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Benthic habitat mapping of the subtidal and intertidal habitats of the islands and shoals. Coral communities in shallow subtidal habitat, intertidal pavement. 2. Coral monitoring at Varanus and Airlie Islands (2000 to present) to identify corals, growth from and percentage cover 3. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013; 2016)	Coral Reefs & Filter Feeders 1. Montebello Marine Park, 2019, Identification and qualitative descriptions of benthic habitat. 2. Montebello Australian Marine Parks – 2019 – Baseline survey on benthic habitats. 3. Pluto Trunkline within Montebello Marine Park – Monitoring marine communities.
		Methods:					
		1. Towed video transects, photo quadrats using towed video system. 2. Towed video transects, photo quadrats using towed video system. 3. Towed video transects, photo quadrats using towed video system. 4. Towed video transects, photo quadrats using towed video system.	1. Habitat mapping. 2. Quantitative assessment details not available. 3. Drop camera. 4. Fixed long-term monitoring sites. Diver video transect. 5. Towed video, benthic trawl and sled.	1. Belt transect, size class frequency, video transects, photo quadrat, tagged colonies and terracotta tiles for coral recruitment. 2. Quantitative assessment 3. Fixed long-term monitoring sites. Diver video transects. 4. Towed camera, benthic trawl and sled.	Benthic habitat mapping, diver swum transects, tagged colonies. Quantitative assessment Towed video, benthic trawl and sled.	1. ROV transects. 2. ROV transects and driver surveys 3. Towed video, benthic trawl and sled	1.ROV Transects 2. Benthic habitat mapping, multibeam acoustic swathing. 3. ROV video.
		References and Data:					
		1. AIMS 2014a and Abdul Wahab et al., 2018. DATAHOLDER: AIMS. 2. AIMS 2014b. DATAHOLDER: AIMS. 3.Currey-Randall et. al., 2019. DATAHOLDER: AIMS 4. Currey-Randall et. al., 2019. DATAHOLDER: AIMS	1. DBCA 2007. DATAHOLDER: DBCA. 2. RPS, 2012. DATAHOLDER: Santos. 3. DATAHOLDER: DBCA. 4. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. Baseline: Chevron Australia 2010. Marine Monitoring Program: Chevron Australia 2011 Post Dredge: Chevron Australia 2013 DATAHOLDER: Chevron Australia. 2. RPS, 2012. DATAHOLDER: Santos. 3. Bancroft 2009. DATAHOLDER: DBCA. 4. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. RPS-Bowman Bishaw Gorham 2005. DATAHOLDER: Chevron. 2. RPS, 2012. DATAHOLDER: Santos. 3. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. Chevron 2010. DATAHOLDER: Chevron. 2. Quadrant Energy/Santos 2016 DATAHOLDER: Santos 3. CSIRO (2013; 2016). Roland Pitcher. DATAHOLDER	1. Advisian 2019 2. Keesing 2019 3. McLean et al. 2019

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Rankin Bank & Glomar Shoal	Montebello Islands	Barrow Island	Lowendal Islands	Pilbara Islands – Southern Island Group (Serrurier, Thevenard and Bessieres Islands – State Nature Reserve)	Montebello AMP
Benthic Habitat (Seagrass and Macro-algae)	**SM03** Quantitative assessment using image capture using either diver held camera or towed video. Post analysis into broad groups based on taxonomy and morphology.	**Studies:**					
		1. Glomar Shoal and Rankin Bank Environmental Survey Report, 2013, quantitatively surveyed benthic habitats and communities. AIMS report to Woodside. Scientific Publication - Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems, 2018. 2. Rankin Bank Environmental Survey Extension, 2014, Habitat assessment of an area southeast of Rankin Bank. 3. Glomar Shoal and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoal, 2018.	1. Santos, macroalgae monitoring at sites across Lowendal and the Montebello islands in 2012. 2. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Chevron LTM of Seagrass and Macro algae habitats for the Gorgon Gas Development project. Marine baseline Program (2008, 2009), Marine Monitoring Program (2010), Post Dredge Survey one (2011) 2. Chevron study by RPS in 2004 on Barrow Island intertidal zone. 3. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Benthic habitats including seagrass and macroalgae for the (Lowendal Islands, Chevron Janz Feed Gas Pipeline Project.) Gorgon Gas Development Project. 2. Santos macroalgae monitoring at sites across Lowendal and the Montebello islands in 2012. 3. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013).	1. Benthic habitat mapping of the subtidal and intertidal habitats of the islands and shoals. Algae communities in shallow subtidal habitat, intertidal pavement. 3. Pilbara Marine Conservation Partnership Seabed biodiversity survey (2013; 2016)	N/A – see Table D-1
		Methods:					
		1. Towed video transects, photo quadrats using towed video system. 2. Towed video transects, photo quadrats using towed video system. 3. Towed video transects, photo quadrats using towed video system. 4. Towed video transects, photo quadrats using towed video system	1. Quantitative assessment details not available. 2. Towed video, benthic trawl and sled.	1. Diver transects, photo quadrats, biomass. 2. Physical observational survey of intertidal habitats on Barrow Island. 3. Towed video, benthic trawl and sled.	1. Diver Transects, Photo Quadrats. 2. Quantitative assessment details not available. 3. Towed video, benthic trawl and sled.	1. ROV transects. 2. Towed video, benthic trawl and sled	N/A – see Table D-1
		References and Data:					
		1. AIMS 2014a and Abdul Wahab et al., 2018. DATAHOLDER: AIMS. 2. AIMS 2014b. DATAHOLDER: AIMS. 3. Currey-Randall et. al., 2019. DATAHOLDER: AIMS 4. Currey-Randall et. al., 2019. DATAHOLDER: AIMS	1. RPS 2012. DATAHOLDER: Santos. 2. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. Baseline: Chevron Australia 2010. Marine Monitoring Program: Chevron Australia 2011 Post Dredge: Chevron Australia 2013 DATAHOLDER: Chevron Australia. 2. RPS-Bowman Bishaw Gorham 2005. DATAHOLDER: Chevron Australia. 3. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. RPS-Bowman Bishaw Gorham 2005. DATAHOLDER: Chevron. 2. RPS 2012. DATAHOLDER: Santos. 3. Pitcher et al. (2016). DATAHOLDER: CSIRO.	1. Chevron 2010. DATAHOLDER: Chevron 2. CSIRO (2013, 2016). Roland Pitcher. DATAHOLDER	N/A – see Table D-1

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Rankin Bank & Glomar Shoal	Montebello Islands	Barrow Island	Lowendal Islands	Pilbara Islands – Southern Island Group (Serrurier, Thevenard and Bessieres Islands – State Nature Reserve)	Montebello AMP
Benthic Habitat (Deeper Water Filter Feeders)	**SM03** Quantitative assessment using image capture using towed video. Post analysis into broad groups based on taxonomy and morphology.	**Studies:**					
		1. Glomar Shoal and Rankin Bank Environmental Survey Report, 2013, quantitatively surveyed benthic habitats and communities. AIMS report to Woodside. Scientific Publication - Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems, 2018. 2. Rankin Bank Environmental Survey Extension, 2014, Habitat assessment of an area southeast of Rankin Bank. 3. Glomar Shoal and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoal, 2018.	N/A – See Table D-1	N/A – See Table D-1	N/A – See Table D-1	N/A – See Table D-1	N/A – see Table D-1
		Methods:					
		1. Towed video transects, photo quadrats using towed video system. 2. Towed video transects, photo quadrats using towed video system. 3. Towed video transects, photo quadrats using towed video system. 4. Towed video transects, photo quadrats using towed video system.	N/A – See Table D-1	N/A – See Table D-1	N/A – See Table D-1	N/A – See Table D-1	N/A – see Table D-1
		References and Data:					
		1. AIMS 2014a and Abdul Wahab et al., 2018. DATAHOLDER: AIMS. 2. AIMS 2014b. DATAHOLDER: AIMS. 3. Currey-Randall et. al., 2019. DATAHOLDER: AIMS 4. Currey-Randall et. al., 2019. DATAHOLDER: AIMS	N/A – See Table D-1	N/A – See Table D-1	N/A – See Table D-1	N/A – See Table D-1	N/A – see Table D-1

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Rankin Bank & Glomar Shoal	Montebello Islands	Barrow Island	Lowendal Islands	Pilbara Islands – Southern Island Group (Serrurier, Thevenard and Bessieres Islands – State Nature Reserve)	Montebello AMP
Mangroves and Saltmarsh	**SM04** Aerial photography and satellite imagery will be used in conjunction with field surveys to map the range and distribution of mangrove communities.	**Studies:**					
		N/A – See Table D-1	1. Atmospheric correct and land cover classification, NW Cape. 2. Advanced Land Observing Satellite (ALOS) images taken in 2006, 2008, and 2010 by DBCA. Digital Aerial Photos were taken in 2009, and the area ground-truthed in 2006. 3. Ground truthing aerial photography to map the spatial extent of mangroves on the Montebello Islands. 4. Mangrove monitoring as part of DBCA Western Australian Marine Monitoring Program (ongoing).	1. Chevron LTM of Mangroves for the Gorgon Gas Development project. Marine Baseline Program (2009), Post Dredge Survey 1 (2011), Post Dredge Survey 2 (2013). 2. Baseline state of the mangroves 2008.	1. Atmospheric correct and land cover classification, NW Cape. 2. Santos Mangrove baseline (2010). 3. Santos - Long-term mangrove monitoring (1999-2011).	1. Study conducted by URS (November 2008 to May 2009) to ground truth aerial photography taken between 2001 and 2009 and to identify mangrove species present in the area.	N/A – see Table D-1
		Methods:	Methods:				
		N/A – See Table D-1	1. Modular Inversion Program. May 2017 2. ALOS and Digital aerial photos, ground truthing, for Mangrove extent and mangrove relative canopy density. 3. Species Composition, LUX, canopy density. 4. Methods unknown.	1.Health scoring system, percentage cover, mean canopy density, qualitative health assessment. 2. Annual Mangrove composition, canopy density, pneumatophore density, leaf pathology, qualitative health.	1. Modular Inversion Program. May 2017 2.Aerial imagery (resolution of 0.2 m2 captured in 2010). 3. Qualitative data includes the presence of new growth, reproductive state, extent of defoliation and pneumatophore condition. Quantitative data, collected at the tree level, includes seedling density, stem diameter, number of defoliated branches and a number of canopy condition parameters.	1.Aerial Photography and Satellite imagery Species identification and community composition.	N/A – see Table D-1
		References and Data:					
		N/A – See Table D-1	1. EOMAP, 2017 DATAHOLDER: Woodside. 2.DBCA unpublished data. DATAHOLDER: DBCA. 3. Voga unpublish data DATAHOLDER: Voga Contact: voga.envrironment@vermilionenergy.com 4. DBCA. DATAHOLDER DBCA.	Baseline: Chevron Australia 2010. Marine Monitoring Program: Chevron Australia 2011 Post Dredge: Chevron Australia 2013 DATAHOLDER: Chevron Australia. Chevron 2014. DATAHOLDER: Chevron.	1. EOMAP, 2017 DATAHOLDER: Woodside. 2.Santos 2014. DATAHOLDER: Santos. 3. Santos 2011. DATAHOLDER: Santos.	1. URS (2010) DATAHOLDER: Chevron Australia	N/A – see Table D-1

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Rankin Bank & Glomar Shoal	Montebello Islands	Barrow Island	Lowendal Islands	Pilbara Islands – Southern Island Group (Serrurier, Thevenard and Bessieres Islands – State Nature Reserve)	Montebello AMP
Seabirds	**SM05** Visual counts of breeding seabirds, nest counts, intertidal bird counts at high tide.	**Studies:**					
		N/A – See Table D-1	1.No recent studies. A DBCA/WAM study of terrestrial fauna of the islands was published in 2000 (Burbidge et al 2000). The most recent bird survey referenced in this review was 1998 by DBCA (DPaW, CALM).	1. Barrow Island migratory behaviour, nesting and foraging behaviour. 2. Migratory waders at Barrow Island. 3. LTM on Barrow island (island wide) Study September 2003 – 2006. 4. Chevron - Gorgon Gas Development. Terrestrial and subterranean environment monitoring program (2008-2015). Monitoring of Wedge-tailed Shearwaters, Bridled Terns, Silver Gulls.	1. Ongoing study of Bridled Terns from 2009. 2. Quadrant Energy seabird nesting on Lowendal Island, study 2013. 3. Lowendal Islands, common breeding bird species, structure, feeding and disturbances to the population. 4. Quadrant Energy/Santos – Integrated Shearwater Monitoring Program (1994-2016).	1. Migratory waterbirds relevant to the Wheatstone Project on behalf of URS in 2008 - 2009. 2. Quadrant Energy/Santos – Integrated Shearwater Monitoring Program (1994-2016). 3. Exmouth Sub-basin Avifauna Monitoring Program (2013-2014)	Present, in open water, no breeding habitat.
		Methods:					
		N/A – See Table D-1	1. Bird observations and counts.	1. Species, total numbers, Distribution, Roosting locations and foraging numbers. Migratory behaviour. 2. High tide roost counts, abundance counts. 3. Nest burrow density (number of burrows per m2); presence/absence of eggs or chicks in burrows; collapsed burrows and predation and mortality records. 4. Barrow Island: Variation in abundance and spatial/temporal distribution on beaches. Middle Island: Abundance; nest density; Presence and absence of eggs/chicks in nest.	1. Nest Density, presence and absence of chicks, predation and mortality counts. 2. Nest burrow density (number of burrows per m2); presence/absence of eggs or chicks in burrows. 3. Burrow scopes, Ultrasonic monitors to monitor burrows. 4. The distribution and abundance of other nesting seabirds within the Lowendal Island group, including up to 45 islands and islets, also occurred from 2004 onwards.	1. Ground counts, aerial surveys of wetlands by helicopter. 2. Burrow count and observation data, burrow density, colony stability, breeding participation, incubation effort and reproductive success has been determined. Tagging data 3. Aerial surveys and onshore island surveys.	N/A
		References and Data:					
		N/A – See Table D-1	DBCA/WAM – Burbidge et al 2000.	1. Bamford M.J. & A.R 2004. DATAHOLDER: Chevron. 2. Bamford M.J & A.R 2011. DATAHOLDER: Chevron. 3. Chevron, 2013. DATAHOLDER: Chevron. 4. Chevron 2013. DATAHOLDER: Chevron.	1. Bamford M.J. & A.R 2004. DATAHOLDER: Chevron. 2. Surman 2012. DATAHOLDER: Santos. 3. Bamford M.J & A.R 2011. DATAHOLDER: Chevron. 4. DATAHOLDER: Santos.	1. Bamford, MJ & AR. 2011. DATAHOLDER: Chevron. 2. Quadrant Energy/Santos. Dataholders. Santos 3. Quadrant Energy/Santos. Dataholders. Santos	N/A

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Rankin Bank & Glomar Shoal	Montebello Islands	Barrow Island	Lowendal Islands	Pilbara Islands – Southern Island Group (Serrurier, Thevenard and Bessieres Islands – State Nature Reserve)	Montebello AMP
Turtles	**SM06** Beach surveys (recording species, nests, and false crawls).	**Studies:**					
		N/A – See Table D-1	1. LTM Study of Green, Flatback, Hawksbill turtles on beaches within the Barrow, Lowendal and Montebello Island Complex for Chevron. 2. Marine turtle monitoring as part of DBCA long-term turtle monitoring program (ongoing).	Chevron - Gorgon Gas Development. Long-term Turtle Monitoring Program - Flatback tagging program and marine turtle track census program (2005 –ongoing).	1. LTM Study of Green, Flatback, Hawksbill turtles on beaches within the Barrow, Lowendal and Montebello Island Complex. 2. Santos 2013 turtle nesting survey on the Lowendal islands. 3. Varanus Island Turtle monitoring program (2005 – present).	1. Baseline marine turtle surveys 2009 (included the islands of Serrurier, Bessieres and Thevenard), Pendoley (2009). 2. Exmouth Islands Turtle Monitoring Program (2013 and 2014) 3. North West Shelf Flatback Turtle Conservation Program's 4. Inter-nesting distribution of flatback turtles and industrial development in Western Australia (Thevenard Island)	Present, in open water, no nesting habitats.
		Methods:					
		N/A – See Table D-1	Nesting demographics (composition, spatial variability, seasonal distribution, post-nesting dispersion).	Island wide (though primary nesting occurs on east coast). Mundabullangana on mainland is the reference location for the Flatback tagging program.	1. Nesting demographics (composition, spatial variability, seasonal distribution, post-nesting dispersion). 2. Tagging and nest counts. 3. Tagging and nest counts. Varanus, Beacon, Bridled, Abutilon and Parakeelya islands.	1. Beach/Nesting surveys (counts by species). 2. Beach/Nesting surveys (counts by species). 3. Nesting and tagging studies 4. Satellite tracking methods	N/A
		References/Data:					
		N/A – See Table D-1	1. AMOSC/DPaW 2014. DATAHOLDER: Chevron. 2.DBCA.	Pendoley Environmental (2005-ongoing). DATAHOLDER: Chevron.	1. Pendoley 2005. AMOSC/DBCA (DPaW) 2014. DATAHOLDER: Chevron/ Santos. 2. Santos, 2014. DATAHOLDER: Santos. 3. Santos (2005 – present)	1. Pendoley 2009. DATAHOLDER: Chevron. 2. Quadrant Energy/Santos. Dataholders. Santos 3. DBCA. Dataholder 4. Pendoley Environment -Whittock, Pendoley and Hamann (2010-2011)	N/A

Major Baseline	Proposed Scientific monitoring operational plan and Methodology	Rankin Bank & Glomar Shoal	Montebello Islands	Barrow Island	Lowendal Islands	Pilbara Islands – Southern Island Group (Serrurier, Thevenard and Bessieres Islands – State Nature Reserve)	Montebello AMP
Fish	**SM09** Baited Remote Underwater Video Stations (BRUVS), Visual Underwater Counts (VUC), Diver Operated Video (DOV).	**Studies:**					
		1. Glomar Shoal and Rankin Bank Environmental Survey Report, 2013, quantitatively surveyed benthic habitats and communities. AIMS report to Woodside. Scientific Publication - Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems, 2018. 2. Rankin Bank Environmental Survey Extension, 2014, Habitat assessment of an area southeast of Rankin Bank. 3. Glomar Shoal and Rankin Bank surveys, 2017. GWF-2 Monitoring Programme. Quantitatively surveyed benthic habitats and communities. 4. Temporal Studies survey of Rankin Bank and Glomar Shoal, 2018.	1. DBCA diver surveys 2009-2012. 2. Pilbara Marine Conservation Partnership Stereo BRUVS drops in shallow water (~8-20m) in 2014 and deeper (20-60m) in 2015 inside and outside sanctuary zones at the Montebello Islands and in the area from Cape Preston to the Montebello Islands in 2015. 3. Finfish monitoring as part of DBCA Western Australian Marine Monitoring Program (2015-ongoing).	1. Chevron LTM of demersal fish for the Gorgon Gas Development project. Marine Baseline Program (2008, 2009), Post Dredge Survey 1 (2011), Post Dredge Survey 2 (2012). 2. Pilbara Marine Conservation Partnership Stereo BRUVS drops in shallow water (~10m) from Exmouth to Barrow Islands in 2015. 3. Finfish monitoring as part of DBCAs Western Australian Marine Monitoring Program (2015-ongoing).	1. Pilbara Marine Conservation Partnership Stereo BRUVS drops in shallow water (~10m) Montebello Sanctuaries 2015. 2. WA Museum fish surveys of Dampier Archipelago 1998-2000 (Hutchins 2004).	1.Pilbara Marine Conservation Partnership Stereo BRUVS drops in deep water (20-55m) offshore of Bessieres Island in 2016.	1. CSIRO – Fish Diversity. 2. Fish species richness and abundance.
		Methods:					
		1. BRUVs. 2. BRUVs. 3. BRUVs. 4. BRUVs.	1. Diver Operated Video - species richness, community composition, and biomass were recorded from 2009-2012. 2. Stereo BRUVS. 3. Diver UVS.	1. Intertidal and subtidal surveys using BRUVS and Netting. 2. Stereo BRUVS. 3. Diver UVS.	1. Stereo BRUVS 2. Diver surveys _ Underwater Visual Census (UVC).	1. Stereo BRUVs	1. Semi V Wing trawl net or an epibenthic sled. 2. ROV Video..
		References/Data:					
		1. AIMS 2014a and Abdul Wahab et al., 2018. DATAHOLDER: AIMS. 2. AIMS 2014b. DATAHOLDER: AIMS. 3. Currey-Randall et. al., 2019. DATAHOLDER: AIMS 4. Currey-Randall et. al., 2019. DATAHOLDER: AIMS	1. DBCA data. DATAHOLDER: DBCA 2. CSIRO Data DATAHOLDER: CSIRO Data centre (data-requests-hf@csiro.au) 3. DBCA.	1. Baseline: Chevron Australia 2010. Marine Monitoring Program: Chevron Australia 2011. Post Dredge: Chevron Australia 2013 DATAHOLDER: Chevron Australia. 2. CSIRO Data DATAHOLDER: CSIRO Data centre (data-requests-hf@csiro.au) 3. DBCA.	1. UWA. The UWA Oceans Institute & School of Biological Sciences. 2. DATAHOLDER: Woodside and WAM.	1. CSIRO. DATAHOLDER: CSIRO (data-requests-hf@csiro.au)	1. Keesing 2019. 2. McLean et al. 2019.

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Chevron Australia (2011). Gorgon Gas Development and Jansz Feed Gas Pipeline: Dredging and spoil disposal Management and Monitoring Plan, Document number: G1-NT-PLNX0000373. Pp. 255. https://www.chevronaustralia.com/docs/default-source/default-documentlibrary/gorgon-emp-dredging-and-spoil-disposal-plan.pdf?sfvrsn=2

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Chevron Australia (2014). Gorgon Gas Development and Jansz Feed Gas Pipeline: Post-Development Coastal and Marine State and Environment Impact Survey Report, Year 2:2012-2013. Document number G1-NT-REPX0005152. Pp. 362 https://www.chevronaustralia.com/docs/default-source/default-document-library/gorgon-emp-post-development-coastal-and-marine-state-and-environmental-impact-survey.pdf?sfvrsn=4

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ANNEX E: TACTICAL RESPONSE PLANS

TACTICAL RESPONSE PLANS
Exmouth
Mangrove Bay
Turquoise Bay
Yardie Creek
Muiron Islands
Jurabi to Lighthouse Beaches Exmouth
Ningaloo Reef - Refer to Mangrove/Turquoise bay and Yardie Creek
Exmouth Gulf
Shark Bay Area 1: Carnarvon to Wooramel
Shark Bay Area 2: Wooramel to Petite Point
Shark Bay Area 3: Petite Point to Dubaut Point
Shark Bay Area 4: Dubaut Point to Herald Bight
Shark Bay Area 5: Herald Bight to Eagle Bluff
Shark Bay Area 6: Eagle Bluff to Useless Loop
Shark Bay Area 7: Useless Loop to Cape Bellefin
Shark Bay Area 8: Cape Bellefin to Steep Point
Shark Bay Area 9: Western Shores of Edel Land
Shark Bay Area 10: Dirk Hartog Island
Shark Bay Area 11: Bernier and Dorre Islands
Abrohlos Islands: Pelseart Group
Abrohlos Islands: Wallabi Group
Abrohlos Islands: Easter Group
Dampier
Rankin Bank & Glomar Shoals
Barrow and Lowendal Islands
Pilbara Islands - Southern Island Group
Montebello Island - Stephenson Channel Nth TRP
Montebello Island - Champagne Bay and Chippendale channel TRP
Montebello Island - Claret Bay TRP
Montebello Island - Hermite/Delta Island Channel TRP
Montebello Island - Hock Bay TRP
Montebello Island - North and Kelvin Channel TRP
Montebello Island - Sherry Lagoon Entrance TRP
Withnell Bay
Holden Bay
King Bay
No Name Bay / No Name Beach
Enderby Is -Dampier
Rosemary Island - Dampier
Legendre Is - Dampier

Karratha Gas Plant
KGP to Whitnell Creek
KGP to Northern Shore
KGP Fire Pond & Estuary
KGP to No Name Creek
Broome
Sahul Shelf Submerged Banks and Shoals
Clerke Reef (Rowley Shoals)
Imperieuse Island (Rowley Shoals)
Mermaid Reef (Rowley Shoals)
Scott Reef
Oiled Wildlife Response
Exmouth
Dampier region
Shark Bay

APPENDIX E NOPSEMA REPORTING FORMS

NOPSEMA Recordable Environmental Incident monthly Reporting Form
https://www.nopsema.gov.au/assets/Forms/A198750.doc

Report of an accident, dangerous occurrence or environmental incident
https://www.nopsema.gov.au/assets/Forms/N-03000-FM0831-Report-of-an-Accident-Dangerous-Occurrence-or-Environmental-Incident-Rev-8-Jan-2015-MS-Word-2010.docx

APPENDIX F STAKEHOLDER CONSULTATION

Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation Environment Plan

June 2020
Revision: 0

TABLE OF CONTENTS

1. Stakeholder Consultation

1.1 Email sent to relevant stakeholders: ACS, DIIS, DMIRS, APPEA (13 December 2019)

Dear Stakeholder

Woodside is planning to undertake petroleum activities in in permit areas WA-5-L, WA-16-L and WA-3-L in Commonwealth waters to support ongoing production from the North West Shelf Project. Activities are planned from Q1 2021, pending approvals, vessel availability and weather constraints.

A Consultation Information Sheet about the planned activity is attached, which provides background on the activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity overview

<table>
<tr><td>Activity purpose:</td><td colspan="5">• Support ongoing production from the North West Shelf Project</td></tr>
<tr><td>Activity:</td><td colspan="5">• Drilling of four production wells and installation of subsea infrastructure in permits areas WA-5-L, WA-16-L and WA-3-L.
• Intervention, workover or re-drill of the GWF-3 and Lambert Deep production wells in permits area WA-5-L and WA-16-L, if required.
• Modifications to topside infrastructure aboard the Angel Platform in permit area WA-3-L.</td></tr>
<tr><td>Activity location:</td><td colspan="5">• 126 km north-west of Dampier, Western Australia.</td></tr>
<tr><td rowspan="7">Approximate locations:</td><td>Structure</td><td>Water Depth m</td><td>Latitude</td><td>Longitude</td><td>Permit Area</td></tr>
<tr><td>LDA-01 production well</td><td>129</td><td>19° 26’07.220” S</td><td>116° 28’51.314” E</td><td>WA-16-L</td></tr>
<tr><td>GDA-03 production well</td><td>125</td><td>19° 43’04.890” S</td><td>115° 51’58.911” E</td><td>WA-5-L</td></tr>
<tr><td>GDA-04 production well</td><td>125</td><td>19° 42’35.697” S</td><td>115° 53’14.475” E</td><td>WA-5-L</td></tr>
<tr><td>GDA-05 production well</td><td>125</td><td>19° 43’15.968” S</td><td>115° 51’10.743” E</td><td>WA-5-L</td></tr>
<tr><td>LDA Manifold</td><td>129</td><td>19° 26’15.029” S</td><td>116° 29’28.721” E</td><td>WA-16-L</td></tr>
<tr><td>Angel Platform</td><td>70</td><td>19° 29' 55.144" S</td><td>116° 35' 53.066" E</td><td>WA-3-L</td></tr>
<tr><td>Earliest commencement date:</td><td colspan="5">• Activities are to commence from Q1 2021, subject to approvals, vessel availability and weather constraints</td></tr>
<tr><td>Estimated duration:</td><td colspan="5">• 70 days per well
• 100 cumulative days to complete installation of subsea infrastructure and pre-commissioning. These activities may be performed over multiple campaigns
• Angel topside modifications estimated to be conducted over a 15-month period, commencing Q1 2021 until Q2 2022</td></tr>
<tr><td>Vessels:</td><td colspan="5">• Semi-submersible mobile offshore drilling unit (MODU)
• Subsea installation vessel
• Light well intervention vessel</td></tr>
</table>

	• Support vessels, including anchor handling vessels, and activity support vessels
Temporary exclusion zones:	• A temporary 500 m Petroleum Safety Zone will be in place around the MODU and installation vessel for the duration of activities.
Temporary cautionary areas:	• A temporary 4000 m Operational Area around each well centre. This Operational Area allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel related petroleum activities and will apply for the duration of activities. • A temporary 1500 m Operational Area for each subsea installation location, defined as the area in which subsea installation, pipelay and pre-commissioning petroleum activities will take place. This Operational Area allows for the movement and positioning of large vessels during subsea installation and pipelay activities and will apply for the duration of activities.

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by 24 January 2020 to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards,

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.2 Woodside Consultation Information Sheet

Woodside

STAKEHOLDER CONSULTATION
INFORMATION
SHEET

December 2019

GREATER WESTERN FLANK PHASE-3 AND LAMBERT DEEP DRILLING AND SUBSEA INSTALLATION

CARNARVON BASIN, NORTH-WEST AUSTRALIA

Woodside is planning to undertake drilling, construction, installation, pre-commissioning and topside modification activities to support the proposed Greater Western Flank Phase-3 (GWF-3) and Lambert Deep Projects, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

The planned activities will be undertaken in permit areas WA-5-L, WA-16-L and WA-3-L, in Commonwealth waters and are planned to commence in Q1 2021 subject to approvals, vessel availability and weather constraints.

The Environment Plan (EP) will cover drilling and subsea installation activities for four production wells. If required, Woodside may also need to intervene, workover or re-drill the existing GWF-3 and Lambert Deep production wells in permit areas WA-5-L and WA-16-L. The Environment Plan also covers the modifications to topside infrastructure aboard the Angel Platform in permit area WA-3-L.

The permit areas are held by Woodside (Operator) and other participants of the North West Shelf (NWS) Project: BHP Billiton Petroleum, BP Developments Australia, Chevron Australia, Japan Australia LNG (MIMI), Shell Australia, and China National Offshore Oil Corporation.

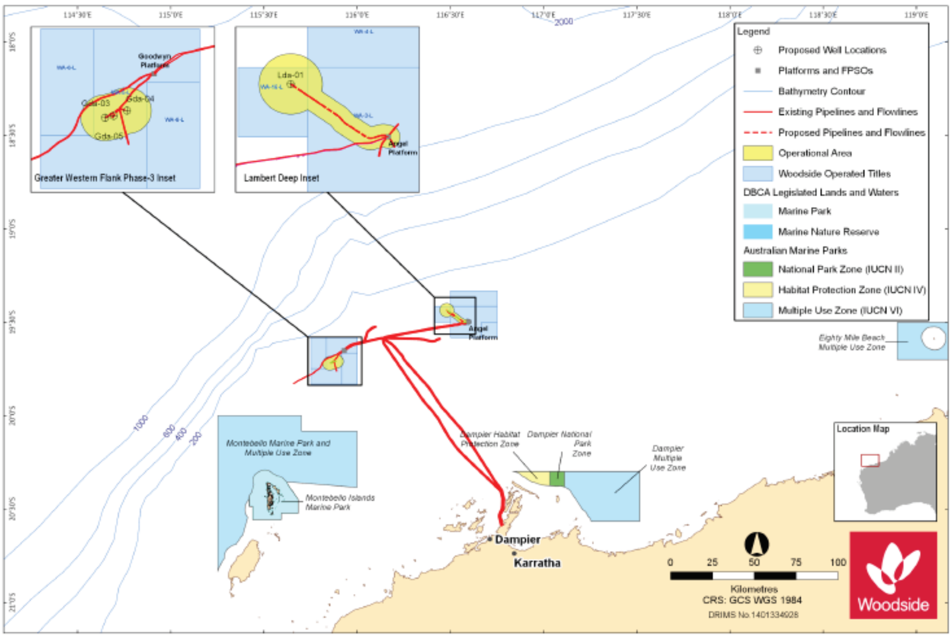

Table 1. Activity summary

Greater Western Flank Phase-3 and Lambert Deep Drilling and Subsea Installation	
Commencement date	+ Activities are to commence Q1 2021, subject to approvals, vessel availability and weather constraints
Approximate duration	+ 70 days per well + 100 cumulative days to complete installation of subsea infrastructure and pre-commissioning. These activities may be performed over multiple campaigns + Angel topside modifications estimated to be conducted over a 15-month period, commencing Q1 2021 until Q2 2022
Water depth	+ GWF-3: 125 m + Lambert Deep: 80 m to 130 m
Project vessels	+ Semi-submersible mobile offshore drilling unit (MODU) + Subsea installation vessel + Light well intervention vessel + Support vessels, including anchor handling vessels, and activity support vessels
Distance to nearest port	+ ~126 km north-west of Dampier
Distance to nearest marine park	+ ~31 km north-east of Montebello Marine Park - Multiple Use Zone (Cwlth) + ~68 km north-east of the Montebello Islands Marine Park (WA)

Proposed Activity

Woodside is proposing to develop and produce hydrocarbons from the Goodwyn GH Reservoir and Lambert Deep Field to support ongoing production from the North West Shelf Project.

The proposed activities comprise the drilling of four new production wells that will be tied-back to existing subsea infrastructure via subsea Xmas trees, flexible flowlines, production manifolds and service umbilicals. The proposed activities are planned to commence in Q1 2021, which will include the Lambert Deep well, the three GWF-3 wells and related subsea installation. Modifications to topside infrastructure aboard the Angel Platform will also occur to support the Lambert Deep Project.

Contingent intervention, workover or re-drill activities on the GWF-3 and Lambert Deep production wells may also be required. Relevant stakeholders will be advised prior to the commencement of activities if this work is required.

Drilling of the four production wells is expected to take approximately 70 days per well to complete. Installation of subsea infrastructure and pre-commissioning will commence on completion of drilling and is expected to take approximately 100 days. Angel topside modifications are expected to be conducted over a 15-month period, commencing Q1 2021 until Q2 2022.

Activities will be 24 hours per day, seven days per week and timing and duration of these activities is subject to change due to project schedule requirements, MODU and vessel availability, weather and unforeseen circumstances.

Project vessels

Several vessel types will be required to complete the activities associated with the activities identified under the Petroleum Activities Program.

For the drilling component of the Petroleum Activities Program, Woodside will either use a moored MODU, or a dynamically positioned MODU. Dynamic positioning is a computer-controlled system to automatically maintain a vessel or rig's position and heading by using its own propellers and thrusters.

Typically, two or three vessels will support drilling activities, with at least one vessel in the vicinity to complete standby duties, if required. Supply vessels will visit the MODU at regular intervals.

A subsea installation vessel will be used for the installation of the subsea infrastructure, with support from additional dedicated vessels.

Communications with mariners

For safety purposes a temporary petroleum safety zone (exclusion zone) of 500 m will be in place around the MODU for the duration of activities. There will be no access to this temporary zone.

The following Operational Areas (cautionary areas that allow access to other marine users when safe to do so) will also apply to the activities:

+ Temporary Operational Areas with a 4000m radius from each well centre. The 4000 m (radius) Operational Area allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel related petroleum activities.
+ Temporary Operational Areas with a 1500m radius around the subsea installation locations allowing for movement and positioning of large vessels to undertake subsea installation, pipelay and pre-commissioning petroleum activities will take place.

Marine notices will be issued prior to activity commencement to alert vessels which may be operating in waters nearby.

Implications for stakeholders

Woodside will consult relevant stakeholders whose interests, functions, and activities may be affected by the proposed activities. We will also keep informed other stakeholders who have an identified interest in the planned activities.

Woodside has undertaken an assessment to identify potential risks to the marine environment and relevant stakeholders, considering timing, duration, location and potential impacts arising from the drilling, construction and installation activities.

A number of mitigation and management measures will be implemented and are summarised in Table 3. Further details will be provided in the EP.

Table 2. Approximate locations

Structure	Water Depth m	Latitude	Longitude	Permit Area
Production wells				
Lambert Deep				
LDA-01 production well	129	19° 26'07.220" S	116° 28'51.314" E	WA-16-L
GWF-3				
GDA-03 production well	125	19° 43'04.890" S	115° 51'58.911" E	WA-5-L
GDA-04 production well	125	19° 42'35.697" S	115° 53'14.475" E	WA-5-L
GDA-05 production well	125	19° 43'15.968" S	115° 51'10.743" E	WA-5-L
Subsea infrastructure				
LDA Manifold	129	19° 26'15.029" S	116° 29'28.721" E	WA-16-L
Infrastructure				
Angel Platform	70	19° 29' 55.144" S	116° 35' 53.066" E	WA-3-L

Table 3. Summary of key risks and/or impacts and management measures

Potential Risk and/or impact	Mitigation and/or Management Measure
Planned	
Chemical Use	+ Chemical use will be managed in accordance with Woodside and contractor chemical selection and approval procedures.
Interests of relevant stakeholders with respect to: + Defence activities + Petroleum activities + Commercial fishing activities + Shipping activities	+ Consultation with government departments and agencies, petroleum titleholders and commercial fishers and their representative organisations to inform decision making for the proposed activity and development of the Environment Plan. + Advice to relevant stakeholders prior to the commencement of activities.
Marine fauna interactions	+ Measures will be taken to protect marine fauna and ecosystems from vessel activities and to prevent vessel collisions and groundings.
Marine Discharges	+ All routine marine discharges will be managed according to legislation and regulatory requirements and Woodside's Environmental Performance Standards where applicable.
Seabed Disturbance	+ Well location and site appraisal to identify and address well-specific hazards and drilling constraints. + MODU mooring analysis, anchor deployment and suction piling, if required, in accordance with internal standards. + No anchoring of support and installation vessels during drilling, construction and installation activities, as well as logging/ retrieval of wet-stored items.
Vessel interaction	+ Woodside will notify relevant fishery stakeholders and government maritime safety agencies of specific start and end dates, specific vessel-on-location dates and any exclusion zones prior to commencement of the activity. + A 500 m radius petroleum safety zone will be in place around the MODU for the duration of activities. + Commercial fishers and other marine users are permitted to use but should take care when entering the Operational Area around the MODU and subsea installation vessel. The Operational Area depending on the activity and vessel ranging from a 500 m radius for a dynamically positioned MODU or 4000 m radius for a moored MODU, and a 1500 m radius around subsea installation.
Waste generation	+ Waste generated on the vessels will be manages in accordance with legislation requirements and a Waste Management Plan. + Waste will be managed and disposed of in a safe and environmentally responsible manner that prevents accidental loss to the environment. + Waste transported onshore will be sent to appropriate recycling or disposal facilities by a licensed waste contractor.
Unplanned	
Hydrocarbon release	+ Appropriate spill response plans, equipment and materials will be in place and maintained. + Appropriate refuelling procedures and equipment will be used to prevent spills to the marine environment.
Introduction of invasive marine species	+ All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species. + Compliance with Australian biosecurity requirements and guidance.

Providing feedback

Our intent is to minimise environmental and social impacts associated with the proposed activities, and we are seeking any interest or comments you may have to inform our decision making.

An Environment Plan for the proposed activity will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for acceptance in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).

If you would like to comment on the proposed activities outlined in this information sheet, or would like additional information, please contact Woodside before 24 January 2020.

www.woodside.com.au

Ben Bin Sali Grant.
Corporate Affairs Graduate
Woodside Energy Ltd
E: Feedback@woodside.com.au
Toll free: 1800 442 977

Please note that stakeholder feedback will be communicated to NOPSEMA as required under legislation. Woodside will communicate any material changes to the proposed activity to affected stakeholders as they arise.

www.woodside.com.au

Woodside

1.3 Email sent to AHO, AMSA – Marine Safety (13 December 2019)

Dear stakeholder

Woodside is planning to undertake petroleum activities in in permit areas WA-5-L, WA-16-L and WA-3-L in Commonwealth waters to support ongoing production from the North West Shelf Project. Activities are planned from Q1 2021, pending approvals, vessel availability and weather constraints.

A Consultation Information Sheet about the planned activity is attached, which provides background on the activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

A map of shipping lanes relevant to the proposed activity is also attached.

Activity overview

<table>
<tr><td>Activity purpose:</td><td colspan="5">Support ongoing production from the North West Shelf Project</td></tr>
<tr><td>Activity:</td><td colspan="5">Drilling of four production wells and installation of subsea infrastructure in permits areas WA-5-L, WA-16-L and WA-3-L.
Intervention, workover or re-drill of the GWF-3 and Lambert Deep production wells in permits area WA-5-L and WA-16-L, if required.
Modifications to topside infrastructure aboard the Angel Platform in permit area WA-3-L.</td></tr>
<tr><td>Activity location:</td><td colspan="5">126 km north-west of Dampier, Western Australia.</td></tr>
<tr><td rowspan="7">Approximate locations:</td><td>Structure</td><td>Water Depth m</td><td>Latitude</td><td>Longitude</td><td>Permit Area</td></tr>
<tr><td>LDA-01 production well</td><td>129</td><td>19° 26’07.220” S</td><td>116° 28’51.314” E</td><td>WA-16-L</td></tr>
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<tr><td>Angel Platform</td><td>70</td><td>19° 29' 55.144" S</td><td>116° 35' 53.066" E</td><td>WA-3-L</td></tr>
<tr><td>Earliest commencement date:</td><td colspan="5">Activities are to commence from Q1 2021, subject to approvals, vessel availability and weather constraints</td></tr>
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100 cumulative days to complete installation of subsea infrastructure and pre-commissioning. These activities may be performed over multiple campaigns
Angel topside modifications estimated to be conducted over a 15-month period, commencing Q1 2021 until Q2 2022</td></tr>
<tr><td>Vessels:</td><td colspan="5">Semi-submersible mobile offshore drilling unit (MODU)
Subsea installation vessel</td></tr>
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	• Light well intervention vessel • Support vessels, including anchor handling vessels, and activity support vessels
Temporary exclusion zones:	• A temporary 500 m Petroleum Safety Zone will be in place around the MODU and installation vessel for the duration of activities.
Temporary cautionary areas:	• A temporary 4000 m Operational Area around each well centre. This Operational Area allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel related petroleum activities and will apply for the duration of activities. • A temporary 1500 m Operational Area for each subsea installation location, defined as the area in which subsea installation, pipelay and pre-commissioning petroleum activities will take place. This Operational Area allows for the movement and positioning of large vessels during subsea installation and pipelay activities and will apply for the duration of activities.

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Notification will be provided to relevant marine users closer to the time of the proposed activity.

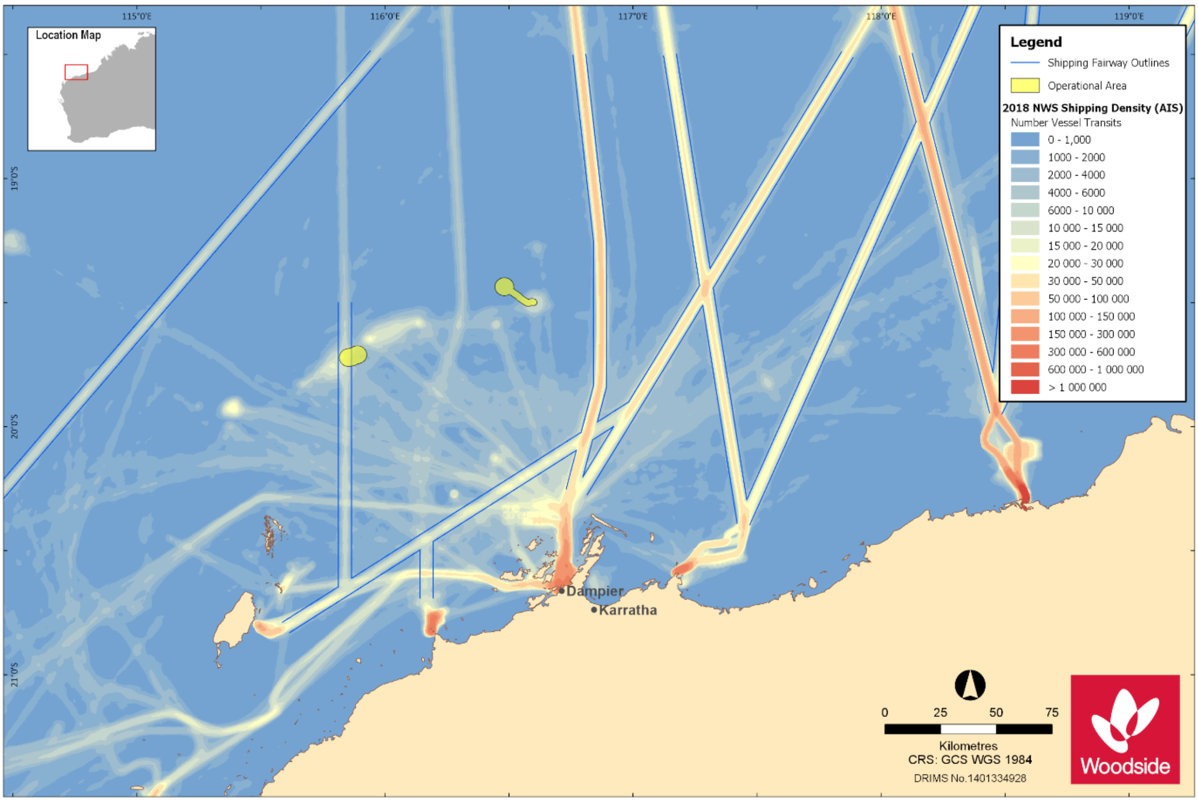
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by 24 January 2020 to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards,

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.4 Shipping Lanes map sent to AHO, AMSA – Marine Safety (13 December 2019)



1.5 Email sent to adjacent titleholders: Santos, Lightmark Enterprises, Sapura Energy, BP (13 December 2019)

Dear stakeholder

Woodside is planning to undertake petroleum activities in in permit areas WA-5-L, WA-16-L and WA-3-L in Commonwealth waters to support ongoing production from the North West Shelf Project. Activities are planned from Q1 2021, pending approvals, vessel availability and weather constraints.

A Consultation Information Sheet about the planned activity is attached, which provides background on the activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

A map of adjacent titles relevant to the proposed activity is also attached.

Activity overview

Activity purpose:	• Support ongoing production from the North West Shelf Project
Activity:	• Drilling of four production wells and installation of subsea infrastructure in permits areas WA-5-L, WA-16-L and WA-3-L. • Intervention, workover or re-drill of the GWF-3 and Lambert Deep production wells in permits area WA-5-L and WA-16-L, if required.

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<tr><td></td><td colspan="5">Modifications to topside infrastructure aboard the Angel Platform in permit area WA-3-L.</td></tr>
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Angel topside modifications estimated to be conducted over a 15-month period, commencing Q1 2021 until Q2 2022</td></tr>
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Subsea installation vessel
Light well intervention vessel
Support vessels, including anchor handling vessels, and activity support vessels</td></tr>
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A temporary 1500 m Operational Area for each subsea installation location, defined as the area in which subsea installation, pipelay and pre-commissioning petroleum activities will take place. This Operational Area allows for the movement and positioning of large vessels during subsea installation and pipelay activities and will apply for the duration of activities.</td></tr>
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Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).

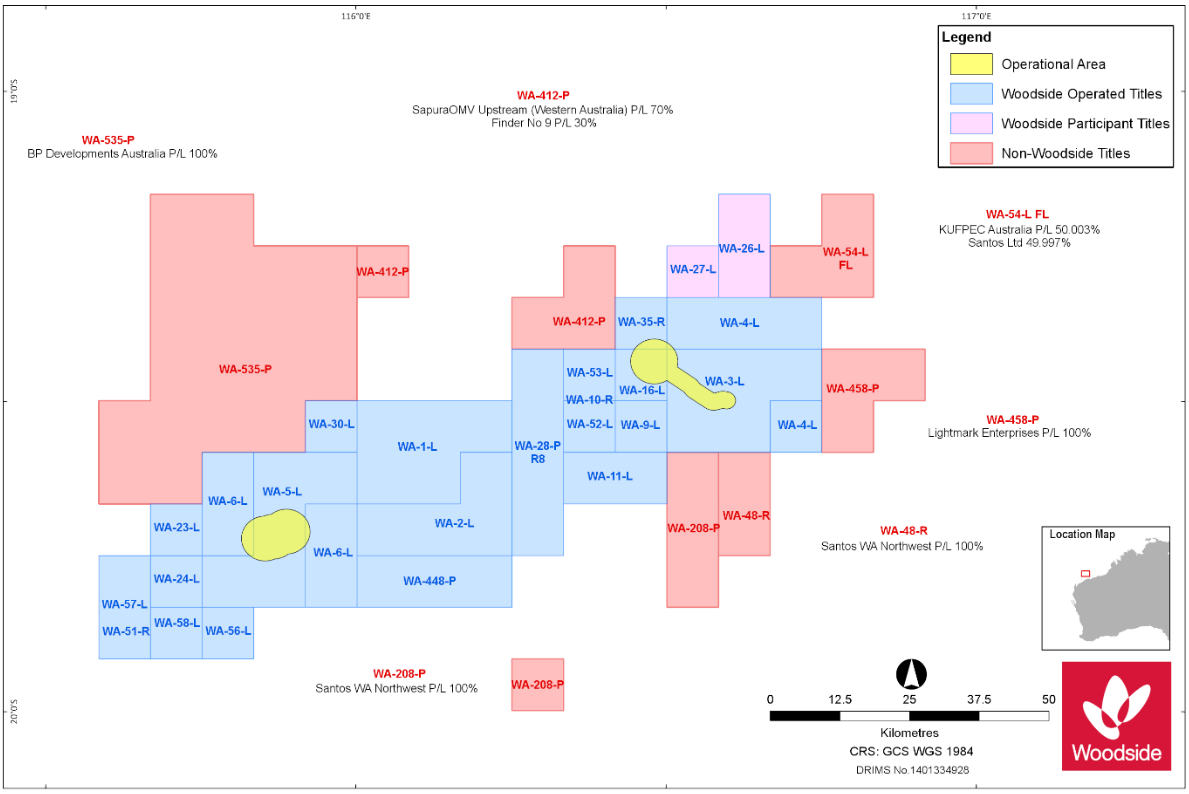
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by 24 January 2020 to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone

Regards,

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.6 Titles map sent to adjacent titleholders: Santos, Lightmark Enterprises, Sapura Energy, BP (13 December 2019), KUFPEC (16 December 2019)



1.7 Email sent to adjacent titleholder: KUFPEC (16 December 2019)

Dear *[Redacted]*,

My colleague *[Redacted]* has provided me with your contact email.

I am emailing you as Woodside is planning to undertake petroleum activities in in permit areas WA-5-L, WA-16-L and WA-3-L in Commonwealth waters to support ongoing production from the North West Shelf Project. Activities are planned from Q1 2021, pending approvals, vessel availability and weather constraints.

A Consultation Information Sheet about the planned activity is attached, which provides background on the activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

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Activity overview

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Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by 24 January 2020 to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.8 Email sent to DAWR (13 December 2019)

Dear Department of Agriculture and Water Resources

Woodside is planning to undertake petroleum activities in in permit areas WA-5-L, WA-16-L and WA-3-L in Commonwealth waters to support ongoing production from the North West Shelf Project. Activities are planned from Q1 2021, pending approvals, vessel availability and weather constraints.

A Consultation Information Sheet about the planned activity is attached, which provides background on the activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

Activity overview

Activity purpose:	• Support ongoing production from the North West Shelf Project
Activity:	• Drilling of four production wells and installation of subsea infrastructure in permits areas WA-5-L, WA-16-L and WA-3-L. • Intervention, workover or re-drill of the GWF-3 and Lambert Deep production wells in permits area WA-5-L and WA-16-L, if required. • Modifications to topside infrastructure aboard the Angel Platform in permit area WA-3-L.
Activity location:	• 126 km north-west of Dampier, Western Australia.

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</table>

Commercial fishing

Whilst the Western Tuna and Billfish, the Southern Bluefin Tuna and the Western Skipjack Tuna Commonwealth fisheries overlap the proposed Operational Area (see attached), it is our assessment based on the ABARES Fishery Status Reports since 2014, these fisheries have not been active in the Operational Area in the last five years.

Biosecurity

With respect to the biosecurity matters, please note the following information below.

Vessels:	• Four types of vessels may be utilised to undertake the activity
	    • Semi-submersible mobile offshore drilling unit (MODU)
	    • Subsea installation vessel
	    • Light well intervention vessel
	    • Support vessels, including anchor handling vessels, and activity support vessels
	• All vessels are required to undergo a Woodside Marine Assurance Inspection to review compliance with marine laws and Woodside safety and environmental requirements.
	• Support vessels may be sourced from the local area (Dampier, Karratha, etc) or from further afield, depending on the type of vessel required and availability.

Environment description:	• The seabed around both the GWF-3 and the Lambert Deep wells and subsea infrastructure is relatively flat and featureless. • Relatively complex bathymetric features in close proximity to the Operational Area include Rankin Bank (about 30 km north-west) and Glomar Shoals (about 1 km south-east). • The closest distance Marine Park o Approximately 31 km north-east of the Commonwealth boundary of the Montebello Marine Park
IMS risk:	• Introduction or translocation and establishment of invasive marine species to the area via vessels or biofouling. • Introducing invasive marine species into the local marine environment will alter the ecosystem, as invasive species have characteristics that make them superior (in a survival and/or reproductive sense) to the indigenous species. • Invasive marine species have also proven economically damaging to areas where they have been introduced and established.
Ballast and biofouling management:	• Compliance with National Ballast Water and Biofouling Management Requirements (as defined under the *Biosecurity Act 2015*). • Requirements are aligned with the International Convention for the Control and Management of Ships' Ballast Water and Sediments and the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry. • As a minimum, all vessels mobilised from outside of Australia will undertake ballast water exchange > 12 nm from land and > 50 m water depth. • The operator of a vessel must provide a ballast water report if it is intended that the vessel discharge, or the vessel discharges, ballast water in Australian seas.
IMS mitigation:	• Vessels will be assessed and managed to prevent the introduction of invasive marine species in accordance with Woodside's Invasive Marine Species Management Plan. • Woodside's Invasive Marine Species Management Plan includes a risk assessment process that is applied to vessels undertaking Activities. Based on the outcomes of each IMS risk assessment, Management measures commensurate with the risk (such as the treatment of internal systems, IMS inspections or cleaning) will be implemented to minimise the likelihood of IMS being introduced. • Vessels are required to comply with the *Australian Biosecurity Act 2015.*

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Notification will be provided to relevant marine users closer to the time of the proposed activity.

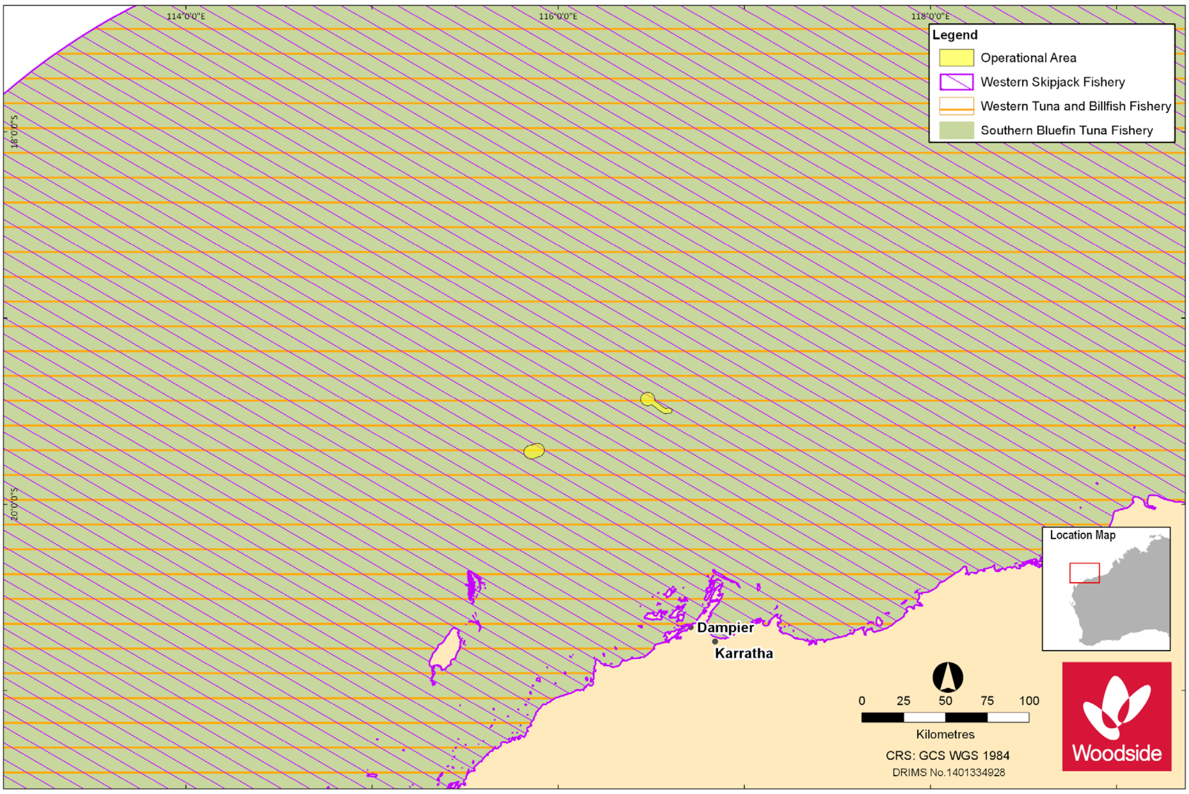
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by 24 January 2020 to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards,

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.9 Commonwealth Fisheries map sent to DAWR (13 December 2019)



1.10 Email sent to DoT (13 December 2019)

Dear Department of Transport

Woodside is planning to undertake petroleum activities in permit areas WA-5-L, WA-16-L and WA-3-L in Commonwealth waters to support ongoing production from the North West Shelf Project. Activities are planned from Q1 2021, pending approvals, vessel availability and weather constraints.

A Consultation Information Sheet about the planned activity is attached, which provides background on the activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

We are currently developing our First Strike Response Plan for the planned activity, and will provide a final copy of this Plan to you if relevant to the proposed activity.

Activity overview

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Support vessels, including anchor handling vessels, and activity support vessels</td></tr>
<tr><td>Temporary exclusion zones:</td><td colspan="5">A temporary 500 m Petroleum Safety Zone will be in place around the MODU and installation vessel for the duration of activities.</td></tr>
<tr><td>Temporary cautionary areas:</td><td colspan="5">A temporary 4000 m Operational Area around each well centre. This Operational Area allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel related petroleum activities and will apply for the duration of activities.
A temporary 1500 m Operational Area for each subsea installation location, defined as the area in which subsea installation, pipelay and pre-commissioning petroleum activities will take place. This</td></tr>
</table>

	Operational Area allows for the movement and positioning of large vessels during subsea installation and pipelay activities and will apply for the duration of activities.

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Notification will be provided to relevant marine users closer to the time of the proposed activity.

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by 24 January 2020 to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards,

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.11 Email sent to AMSA – Marine Pollution (13 December 2019)

Dear *[Redacted]*

Woodside is planning to undertake petroleum activities in permit areas WA-5-L, WA-16-L and WA-3-L in Commonwealth waters to support ongoing production from the North West Shelf Project. Activities are planned from Q1 2021, pending approvals, vessel availability and weather constraints.

A Consultation Information Sheet about the planned activity is attached, which provides background on the activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

We are currently developing our First Strike Response Plan for the planned activity, and will provide a final copy of this Plan to you if relevant to the proposed activity.

Activity overview

Activity purpose:	• Support ongoing production from the North West Shelf Project
Activity:	• Drilling of four production wells and installation of subsea infrastructure in permits areas WA-5-L, WA-16-L and WA-3-L. • Intervention, workover or re-drill of the GWF-3 and Lambert Deep production wells in permits area WA-5-L and WA-16-L, if required. • Modifications to topside infrastructure aboard the Angel Platform in permit area WA-3-L.
Activity location:	• 126 km north-west of Dampier, Western Australia.

	Structure	Water Depth m	Latitude	Longitude	Permit Area
Approximate locations:	LDA-01 production well	129	19° 26’07.220” S	116° 28’51.314” E	WA-16-L
	GDA-03 production well	125	19° 43’04.890” S	115° 51’58.911” E	WA-5-L
	GDA-04 production well	125	19° 42’35.697” S	115° 53’14.475” E	WA-5-L
	GDA-05 production well	125	19° 43’15.968” S	115° 51’10.743” E	WA-5-L
	LDA Manifold	129	19° 26’15.029” S	116° 29’28.721” E	WA-16-L
	Angel Platform	70	19° 29' 55.144" S	116° 35' 53.066" E	WA-3-L
Earliest commencement date:	• Activities are to commence from Q1 2021, subject to approvals, vessel availability and weather constraints				
Estimated duration:	• 70 days per well • 100 cumulative days to complete installation of subsea infrastructure and pre-commissioning. These activities may be performed over multiple campaigns • Angel topside modifications estimated to be conducted over a 15-month period, commencing Q1 2021 until Q2 2022				
Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Subsea installation vessel • Light well intervention vessel • Support vessels, including anchor handling vessels, and activity support vessels				
Temporary exclusion zones:	• A temporary 500 m Petroleum Safety Zone will be in place around the MODU and installation vessel for the duration of activities.				
Temporary cautionary areas:	• A temporary 4000 m Operational Area around each well centre. This Operational Area allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel related petroleum activities and will apply for the duration of activities. • A temporary 1500 m Operational Area for each subsea installation location, defined as the area in which subsea installation, pipelay and pre-commissioning petroleum activities will take place. This Operational Area allows for the movement and positioning of large vessels during subsea installation and pipelay activities and will apply for the duration of activities.				

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Notification will be provided to relevant marine users closer to the time of the proposed activity.

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by 24 January 2020 to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards,

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.12 Email sent to PPA and DPIRD (14 December 2019)

Dear *[Redacted]*

Woodside is planning to undertake petroleum activities in in permit areas WA-5-L, WA-16-L and WA-3-L in Commonwealth waters to support ongoing production from the North West Shelf Project.

Activities are planned from Q1 2021, pending approvals, vessel availability and weather constraints.

We have identified and assessed potential risks and impacts to active commercial fishers and the marine environment that overlap the proposed Operational Area in the development of the proposed Environment Plan for this activity. These risks are summarised below.

Woodside has endeavoured to reduce these risks to an as low as reasonably practicable (ALARP) level. Please contact me if you believe we have overlooked any potential impacts to the commercial fishing industry or missed any points of importance so these can be addressed.

A Consultation Information Sheet (also available on our website) and a map of State Fisheries relevant to the proposed activities is also attached.

Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed activity area, as well as consideration of government fishing effort data from recent years, fishing methods and water depth. Individual licence holders or representative fishing organisations who have requested ongoing advice on Woodside's planned activities will also be advised.

Activity overview

Activity purpose:	• Support ongoing production from the North West Shelf Project				
Activity:	• Drilling of four production wells and installation of subsea infrastructure in permits areas WA-5-L, WA-16-L and WA-3-L. • Intervention, workover or re-drill of the GWF-3 and Lambert Deep production wells in permits area WA-5-L and WA-16-L, if required. • Modifications to topside infrastructure aboard the Angel Platform in permit area WA-3-L.				
Activity location:	• 126 km north-west of Dampier, Western Australia.				
Approximate locations:	**Structure**	**Water Depth m**	**Latitude**	**Longitude**	**Permit Area**

	LDA-01 production well	129	19° 26’07.220” S	116° 28’51.314” E	WA-16-L
	GDA-03 production well	125	19° 43’04.890” S	115° 51’58.911” E	WA-5-L
	GDA-04 production well	125	19° 42’35.697” S	115° 53’14.475” E	WA-5-L
	GDA-05 production well	125	19° 43’15.968” S	115° 51’10.743” E	WA-5-L
	LDA Manifold	129	19° 26’15.029” S	116° 29’28.721” E	WA-16-L
	Angel Platform	80	19° 29' 55.144" S	116° 35' 53.066" E	WA-3-L
Earliest commencement date:	• Activities are to commence from Q1 2021, subject to approvals, vessel availability and weather constraints				
Estimated duration:	• 70 days per well • 100 cumulative days to complete installation of subsea infrastructure and pre-commissioning. These activities may be performed over multiple campaigns • Angel topside modifications estimated to be conducted over a 15-month period, commencing Q1 2021 until Q2 2022				
Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Subsea installation vessel • Light well intervention vessel • Support vessels, including anchor handling vessels, and activity support vessels				
Temporary exclusion zones:	• A temporary 500 m Petroleum Safety Zone will be in place around the MODU and installation vessel for the duration of activities.				
Temporary cautionary areas:	• A temporary 4000 m Operational Area around each well centre. This Operational Area allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel related petroleum activities and will apply for the duration of activities. • A temporary 1500 m Operational Area for each subsea installation location, defined as the area in which subsea installation, pipelay and pre-commissioning petroleum activities will take place. This Operational Area allows for the movement and positioning of large vessels during subsea installation and pipelay activities and will apply for the duration of activities. • This is a cautionary area, commercial fishers are permitted to transit, anchor and or fish as long as it is safe to do so.				

Potential risks to commercial fishing

Potential risk	Risk description	Mitigation and/or management measures
Planned Activities		
Vessel interaction	The presence of the MODU, subsea installation vessel, intervention vessel and other support vessels may preclude	- Woodside will notify relevant fishery stakeholders and Government maritime safety agencies of specific start and end dates, specific vessel-on-location dates and any

	other marine users from access to the area.	exclusion zones prior to commencement of the activity.
Seabed disturbance	Disturbance to the seabed from mooring of the MODU, drilling and subsea installation of infrastructure.	Woodside will seek to minimise seabed disturbance for the drilling and installation activities, including: - Well location and site appraisal to identify and address well-specific hazards and drilling constraints. - MODU mooring analysis and anchor deployment in accordance with internal standards. - No anchoring of support and installation vessels during drilling, construction and installation activities, as well as logging/retrieval of wet-stored items.
Underwater noise	Noise will be generated by the MODU, subsea installation vessel, intervention vessel and other support vessels. Due to the low acoustic source levels associated with MODU and vessel operations there is not likely to be any interaction or potential impact to fish hearing, feeding or spawning.	- Acoustic impacts to marine fauna from the operation of MODU and vessels are considered not significant with no lasting effect. Therefore, the risks associated with implementation of additional management measures is considered disproportionate to the potential reduction in impact achieved.
Marine discharges	Discharges from drilling include water-based drill mud and cuttings, brines and cement. Discharges from the operation of the MODU include sewage, grey water, cooling water, desalination brine, deck drainage, ballast and bilge water These discharges may result in a localised short-term reduction in water quality however they will be rapidly diluted and dispersed in the water column.	- Implementation of chemical assessment and approval process.
Unplanned Risks		
Hydrocarbon release	Loss of hydrocarbons to the marine environment via loss of well control or from a vessel collision resulting a tank rupture.	- In the unlikely event of an oil spill or unplanned discharge into the environment, relevant agencies and organisations will be notified as appropriate to the nature and scale of the event, as soon as practicable following the occurrence. - Oil spill response strategies will be assessed based on potential impact to identified key receptor locations and sensitivities, which includes fish spawning and nursery areas.
Invasive Marine Species	Introduction or translocation and establishment of invasive marine species to the area via	- All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species.

	vessels ballast water or biofouling.	- Compliance with Australian biosecurity requirements and guidance.

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).

Notification will be provided to relevant marine users closer to the time of the proposed activity.

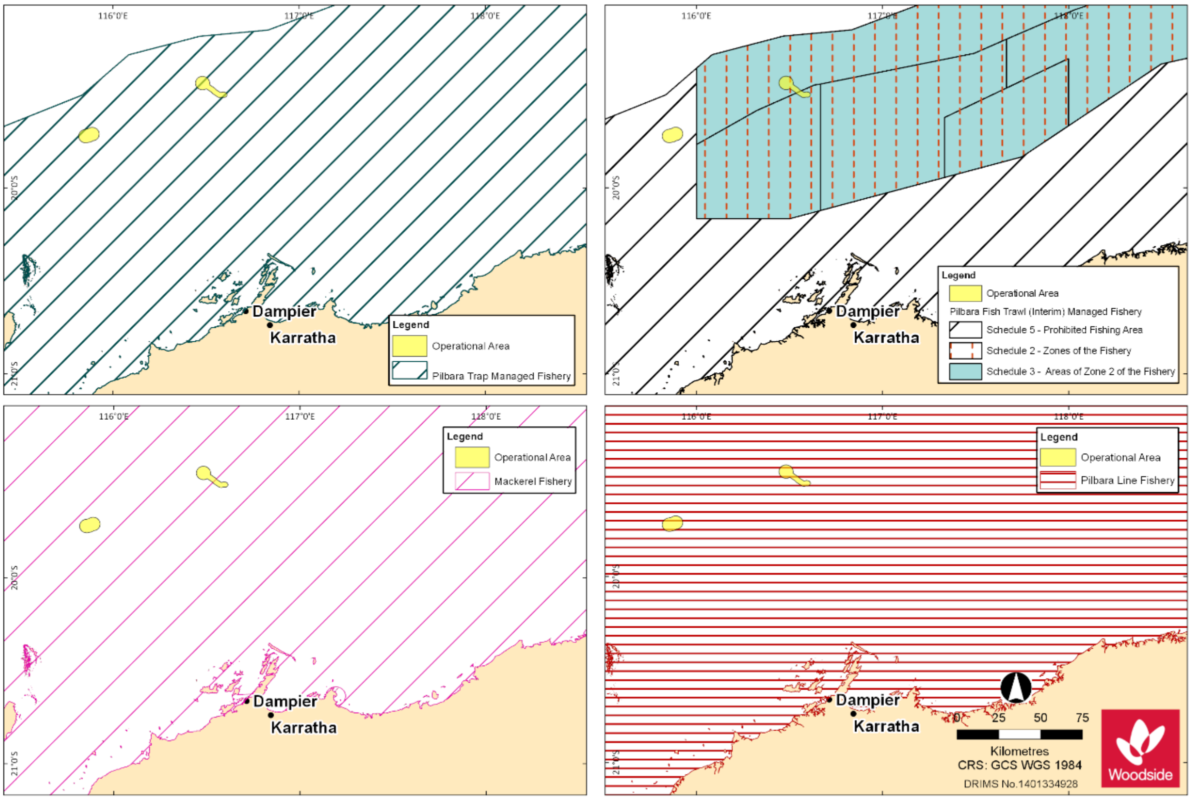
Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by 24 January 2020 to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

Regards

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.13 State Fisheries map sent to PPA, DPIRD, WAFIC, Mackerel Fishery, Pilbara Line Fishery, Pilbara Trap Fishery, Pilbara Trawl Fishery licence holders (14 December 2019)



1.14 Email sent to WAFIC (14 December 2019)

Dear *[Redacted]*

Woodside is planning to undertake petroleum activities in in permit areas WA-5-L, WA-16-L and WA-3-L in Commonwealth waters to support ongoing production from the North West Shelf Project.

Activities are planned from Q1 2021, pending approvals, vessel availability and weather constraints.

We have identified and assessed potential risks and impacts to active commercial fishers and the marine environment that overlap the proposed Operational Area in the development of the proposed Environment Plan for this activity. These risks are summarised below.

Woodside has endeavoured to reduce these risks to an as low as reasonably practicable (ALARP) level. Please contact me if you believe we have overlooked any potential impacts to the commercial fishing industry or missed any points of importance so these can be addressed.

A Consultation Information Sheet (also available on our website) and a map of State Fisheries relevant to the proposed activities is also attached.

Fisheries have been identified as being relevant on the basis of fishing licence overlap with the proposed activity area, as well as consideration of government fishing effort data from recent years, fishing methods and water depth. Individual licence holders will also be advised following your consideration of this information.

Activity overview

<table>
<tr><td>Activity purpose:</td><td colspan="5">Support ongoing production from the North West Shelf Project</td></tr>
<tr><td>Activity:</td><td colspan="5">Drilling of four production wells and installation of subsea infrastructure in permits areas WA-5-L, WA-16-L and WA-3-L.
Intervention, workover or re-drill of the GWF-3 and Lambert Deep production wells in permits area WA-5-L and WA-16-L, if required.
Modifications to topside infrastructure aboard the Angel Platform in permit area WA-3-L.</td></tr>
<tr><td>Activity location:</td><td colspan="5">126 km north-west of Dampier, Western Australia.</td></tr>
<tr><td rowspan="7">Approximate locations:</td><td>Structure</td><td>Water Depth m</td><td>Latitude</td><td>Longitude</td><td>Permit Area</td></tr>
<tr><td>LDA-01 production well</td><td>129</td><td>19° 26’07.220” S</td><td>116° 28’51.314” E</td><td>WA-16-L</td></tr>
<tr><td>GDA-03 production well</td><td>125</td><td>19° 43’04.890” S</td><td>115° 51’58.911” E</td><td>WA-5-L</td></tr>
<tr><td>GDA-04 production well</td><td>125</td><td>19° 42’35.697” S</td><td>115° 53’14.475” E</td><td>WA-5-L</td></tr>
<tr><td>GDA-05 production well</td><td>125</td><td>19° 43’15.968” S</td><td>115° 51’10.743” E</td><td>WA-5-L</td></tr>
<tr><td>LDA Manifold</td><td>129</td><td>19° 26’15.029” S</td><td>116° 29’28.721” E</td><td>WA-16-L</td></tr>
<tr><td>Angel Platform</td><td>80</td><td>19° 29' 55.144" S</td><td>116° 35' 53.066" E</td><td>WA-3-L</td></tr>
<tr><td>Earliest commencement date:</td><td colspan="5">Activities are to commence from Q1 2021, subject to approvals, vessel availability and weather constraints</td></tr>
<tr><td>Estimated duration:</td><td colspan="5">70 days per well
100 cumulative days to complete installation of subsea infrastructure and pre-commissioning. These activities may be performed over multiple campaigns
Angel topside modifications estimated to be conducted over a 15-month period, commencing Q1 2021 until Q2 2022</td></tr>
<tr><td>Vessels:</td><td colspan="5">Semi-submersible mobile offshore drilling unit (MODU)
Subsea installation vessel
Light well intervention vessel
Support vessels, including anchor handling vessels, and activity support vessels</td></tr>
<tr><td>Relevant fisheries consulted for this activity:</td><td colspan="5">State Fisheries
Mackerel – while we note that the Mackerel fishery Is active to a depth of 70 m, we have consulted them given the shallowest depth for this activity is 80 m
Pilbara Line
Pilbara Trap
Pilbara Trawl – a small part of the activity overlaps with Zone 2, Area 1 of the Pilbara Trawl fishery.</td></tr>
<tr><td>Temporary exclusion zones:</td><td colspan="5">A temporary 500 m Petroleum Safety Zone will be in place around the MODU and installation vessel for the duration of activities.</td></tr>
</table>

Temporary cautionary areas:	• A temporary 4000 m Operational Area around each well centre. This Operational Area allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel related petroleum activities and will apply for the duration of activities. • A temporary 1500 m Operational Area for each subsea installation location, defined as the area in which subsea installation, pipelay and pre-commissioning petroleum activities will take place. This Operational Area allows for the movement and positioning of large vessels during subsea installation and pipelay activities and will apply for the duration of activities. • This is a cautionary area, commercial fishers are permitted to transit, anchor and or fish as long as it is safe to do so.

Potential risks to commercial fishing and proposed mitigation methods

Potential risk	Risk description	Mitigation and/or management measures
Planned Activities		
Vessel interaction	The presence of the MODU, subsea installation vessel, intervention vessel and other support vessels may preclude other marine users from access to the area.	- Woodside will notify relevant fishery stakeholders and Government maritime safety agencies of specific start and end dates, specific vessel-on-location dates and any exclusion zones prior to commencement of the activity.
Seabed disturbance	Disturbance to the seabed from mooring of the MODU, drilling and subsea installation of infrastructure.	Woodside will seek to minimise seabed disturbance for the drilling and installation activities, including: - Well location and site appraisal to identify and address well-specific hazards and drilling constraints. - MODU mooring analysis and anchor deployment in accordance with internal standards. - No anchoring of support and installation vessels during drilling, construction and installation activities, as well as logging/retrieval of wet-stored items.
Underwater noise	Noise will be generated by the MODU, subsea installation vessel, intervention vessel and other support vessels. Due to the low acoustic source levels associated with MODU and vessel operations there is not likely to be any interaction or potential impact to fish hearing, feeding or spawning.	- Acoustic impacts to marine fauna from the operation of MODU and vessels are considered not significant with no lasting effect. Therefore, the risks associated with implementation of additional management measures is considered disproportionate to the potential reduction in impact achieved.
Marine discharges	Discharges from drilling include water-based drill mud and cuttings, brines and cement. Discharges from the operation of the MODU include sewage, grey water, cooling water, desalination brine, deck	- Implementation of chemical assessment and approval process.

	drainage, ballast and bilge water These discharges may result in a localised short-term reduction in water quality however they will be rapidly diluted and dispersed in the water column.	
Unplanned Risks		
Hydrocarbon release	Loss of hydrocarbons to the marine environment via loss of well control or from a vessel collision resulting a tank rupture.	- In the unlikely event of an oil spill or unplanned discharge into the environment, relevant agencies and organisations will be notified as appropriate to the nature and scale of the event, as soon as practicable following the occurrence. - Oil spill response strategies will be assessed based on potential impact to identified key receptor locations and sensitivities, which includes fish spawning and nursery areas.
Invasive Marine Species	Introduction or translocation and establishment of invasive marine species to the area via vessels ballast water or biofouling.	- All vessels will be assessed and managed as appropriate to prevent the introduction of invasive marine species. - Compliance with Australian biosecurity requirements and guidance.

Your feedback

Should you require further information as part of the WAFIC fee-for-service, as outlined in our letter of 12 September 2019, please let me know. We would appreciate any feedback by 20 December 2019 and subject to any comments, we would then consult individual Mackerel, Pilbara Line, Pilbara Trap and Pilbara Trawl Licence Holders.

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Regards

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.15 Email sent to relevant stakeholders: ACS, DIIS, DMIRS, APPEA, AHO, ACS, Santos, Lightmark Enterprises, Sapura Energy, BP, DAWR, DOT, AMSA – Marine Pollution, (16 December 2019)

Dear stakeholder,

See attached an updated Consultation Information Sheet for Woodside's planned Greater Western Flank Phase-3 and Lambert Deep drilling and subsea installation activities.

Please note that the approximate water depth for the Angel Platform has been revised from 70 m to 80 m.

Regards,

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.16 Email sent to DNP (14 January 2020)

Dear Director of National Parks,

Woodside is planning to undertake drilling, construction, installation, pre-commissioning and topside modification activities in permit areas WA-5-L, WA-16-L and WA-3-L in Commonwealth waters to support ongoing production from the North West Shelf Project. Activities are planned from Q1 2021, pending approvals, vessel availability and weather constraints. We note Australian Government Guidance on consultation activities with respect to the proposed activities and confirm that:

- The proposed activities are outside the boundaries of a proclaimed Commonwealth marine park, with the proposed activity being 31 km north west of Montebello Marine Park - Multiple Use Zone (Cwlth)).

- We have assessed potential risks to Commonwealth marine parks in the development of the proposed Environment Plan for this activity and believe that there are no credible risks as part of planned activities that have potential to impact marine park values.

- In the unlikely event of a loss of hydrocarbons, the worst case credible spill scenario assessed for this activity is a loss of well integrity. For this consequence to occur, there must be a failure of multiple physical and procedural barriers within the well relevant to the activity. Given the controls in place to prevent and control loss of well control events and mitigate their consequences, it is considered that the risk associated with a loss of well integrity is managed to as low as reasonably practical. In the unlikely event of a loss of well integrity there is a risk of condensate entering the:
    - Montebello Marine Park - Multiple Use Zone
    - Argo-Rowley Terrace AMP
    - Ningaloo AMP
    - Gascoyne AMP
    - Carnarvon Canyon AMP.

- A Commonwealth Government approved oil spill response plan will be in place for the duration of the activities, which includes notification to relevant agencies and organisations as to the nature and scale of the event, as soon as practicable following an occurrence. The Director of National Parks will be advised if an environmental incident occurs that may impact on the values of a marine parks.

For information, a Consultation Information Sheet about the planned activity is attached, which provides background on the activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

In line with Australian Government guidance on consultation with government agencies, can you please advise within 10 business days if you have any feedback on the proposed activity, noting that your feedback and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).

Comments can be made by email, letter or by phone.

Regards,

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.17 Email sent to adjacent titleholders: Santos; Lightmark Enterprises, Sapura Energy, BP (17 January 2020)

Dear stakeholder

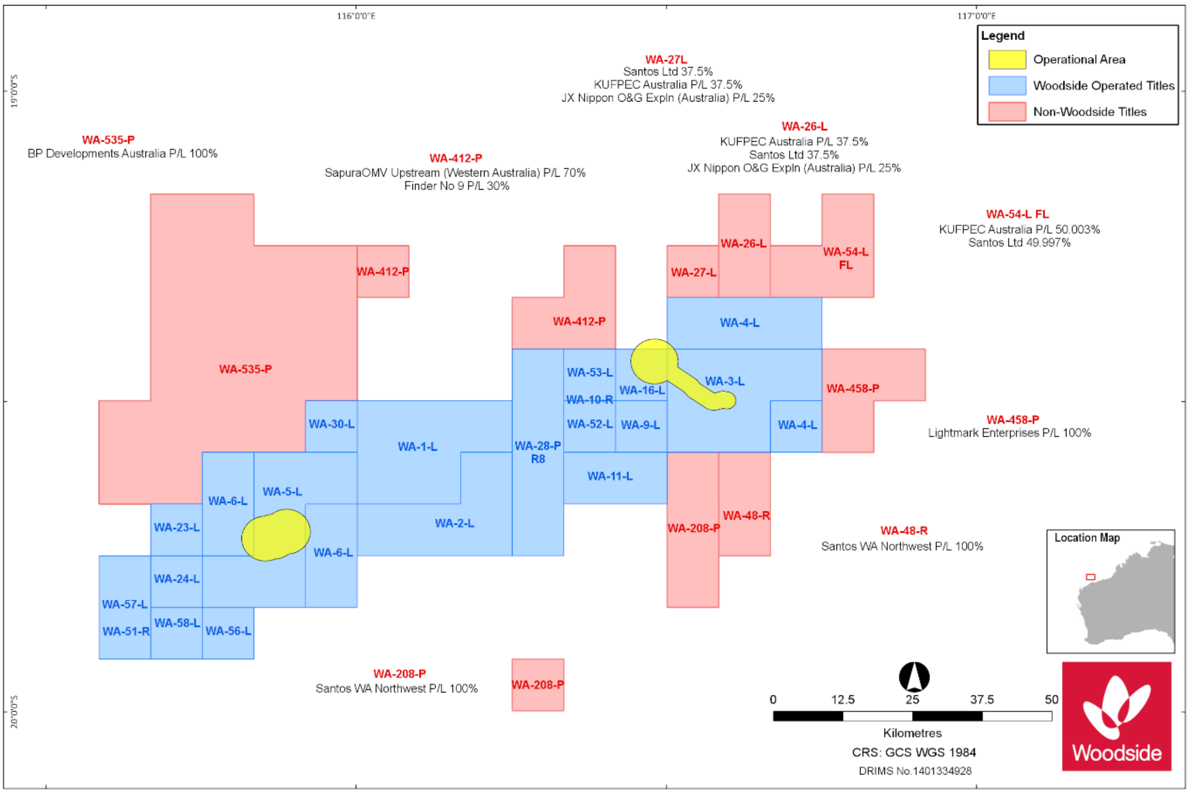
Please see attached an updated map of adjacent titles to Greater Western Flank Phase-3 and Lambert Deep activities.

Please note that the participants to titles WA-26-L and WA-27-L have been corrected.

Regards,

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.18 Titles map sent to adjacent titleholders: Santos, Lightmark Enterprises, Sapura Energy, BP, KUFPEC (17 January 2020), JX Nippon Oil and Gas (22 January 2020)



1.19 Email sent to DoT with first strike plan (14 January 2020)

Good morning *[Redacted]* and *[Redacted]*,

As part of Woodside's ongoing consultation for its current and planned activities, I would like to advise WA Department of Transport (DoT) that Woodside are preparing the *GWF-3 / Lambert Deep drilling and subsea installation Environment Plan* and would like to offer DoT the opportunity to review or provide comment on the activity.

Information is presented as follows:

A Consultation Information Sheet is available on our website here, providing information on the proposed petroleum activities program.

- The *GWF-3 / Lambert Deep drilling and subsea installation Oil Pollution First Strike Plan* is attached. This will form part of the approval submission in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

- In the table below, as requested in the *Offshore Petroleum Industry Guidance Note* (September 2018) and from recent engagement activities between DoT-Woodside, responses to the information requirements in a succinct summary and source of information.

Woodside propose to submit an EP 17th April to support these activities.

Should you require additional information or have a comment to make about the proposed activity, please contact myself by close of business 04th March 2020 to allow us sufficient time to inform our activity planning and EP development.

Comments can be made by email, letter or by phone.

Please be aware that your feedback will be communicated to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), as is required under legislation.

We look forward to hearing from you.

[Redacted]

Item Ref	Information Requested in the Offshore Petroleum Industry Guidance Note (September 2018)	Information Provided & Reference	FSP and OSPRMA Reference
1	Description of activity, including the intended schedule, location (including coordinates), distance to nearest landfall and map.	Included in the consultation information sheet	N/A
2	Worst case spill volumes.	Included in Appendix A of the First Strike Plan	FSP-Appendix A
3	Known or indicative oil type/properties.	Included in Appendix A of the First Strike Plan	FSP-Appendix A
4	Amenability of oil to dispersants and window of opportunity for dispersant efficacy.	NWS Condensate (analogue for the GWF3 Condensate – scenario MEE-01) is amenable to dispersant with an efficacy of 100% on oil weathered for 72 hours. Modelling predicts that this scenario will present some surface hydrocarbons at the appropriate threshold concentration (50 g/m^2) for dispersant to be applicable. This occurs within 9 km of the well with no hydrocarbons at threshold concentration entering any RPA. No floating hydrocarbon at threshold concentration is predicted for scenario MEE-02 and thus dispersant is not recommended for this scenario. Dispersant is not applicable for a spill of diesel (MEE-03).	OSPRMA: S5.4
5	Description of existing environment and protection priorities.	Included in section 4 of the First Strike Plan	FSP- S4

6	Details of the environmental risk assessment related to marine oil pollution - describe the process and key outcomes around risk identification, risk analysis, risk evaluation and risk treatment. For further information see the Oil Pollution Risk Management Information Paper (NOPSEMA 2017).	Unplanned loss of containment events from the Petroleum Activities Program have been identified during the risk assessment process (presented in Section 7 of the EP). Further descriptions of risk, impacts and mitigation measures (which are not related to hydrocarbon preparedness and response) are provided in Section 7 of the EP. Five unplanned events or credible spill scenarios for the Petroleum Activities Program have been selected as representative across types, sources and incident/response levels, up to and including the WCCS. Table 2-1 of the OSPRMA presents the credible scenarios for the Petroleum Activities Program. Two WCCS for the activity are then used for response planning purposes as all other scenarios are of a lesser scale and extent. By demonstrating capability to meet and manage an event of this size, Woodside assumes relevant scenarios that are smaller in nature and scale can also be managed by the same capability. Response performance outcomes have been defined based on a response to the WCCS.				OSPRMA- Table 2-1 EP- S7
7	Outcomes of oil spill trajectory modelling, including predicted times to enter State waters and contact shorelines.		**MEE-01: Hydrocarbon release caused by loss of well containment** (382,486 m^3 of GWF3 Condensate over 71 days)	**MEE-02: Hydrocarbon release caused by loss of well containment** (67,822 m^3 of Lambert Deep Condensate over 77 days)	**MEE-03: Hydrocarbon release caused by vessel collision** (instantaneous release of 1000 m^3 marine diesel)	
8		Minimum time to commencement of oil accumulation at any shoreline receptor (at a threshold of 100 g/m^2)	Model 21, Q2 22.6 days at Pilbara Islands – Southern Island Group (5 m^3)	Model 21, Q2 3.6 m^3 at Barrow Island (day 17)	*No contact at threshold*	OSPRMA- Executive Summary
9		Maximum cumulative oil volume accumulated at any individual shoreline receptor (at concentrations in excess of 100 g/m^2)	Model 10, Q1 65.1 m^3 at Pilbara Islands – Southern Island Group (day 76.5)	Model 20, Q1 86.7 m^3 at Montebello Islands (day 70.25)	*No contact at threshold*	OSPRMA- Executive Summary
10		Maximum cumulative oil volume accumulated across all shoreline receptors (at concentrations in excess of 100 g/m^2)	Model 7, Q2 72.2 m^3 at Pilbara Islands – Southern Island Group	Model 20, Q1 204.4 m^3 at Montebello Islands	*No contact at threshold*	OSPRMA- Executive Summary
11	Details on initial response actions	Included in Section 2 and 3 of the First Strike Plan				FSP- S2 & S3

	and key activation timeframes.		
12	Potential Incident Control Centre arrangements.	Included in S.4, Appendix E and F of the First Strike Plan	FSP-Appendix E and F
13	Potential staging areas / Forward Operating Base. Note FOB	A Forward Operating Base can be established at Exmouth and/ or Dampier.	TRP's-referenced in S.4
14	Details on response strategies.	Included in Section 2 and 3 of the First Strike Plan	FSP S2. And S3
15	Details and diagrams on proposed IMT structure including integration of DoT arrangements as per this IGN.	Included in Appendix E and F of the First Strike Plan	FSP appendix E&F
16	Details on testing of arrangements of OPEP/OSCP.	One Level 1 oil spill response exercise to be conducted within two weeks of commencing Anchor Hold test activities. The drill will test elements of the recommended response identified in the Gemtree Anchor Hold Test Oil Pollution First Strike Plan, in relation to the level of the incident. **Testing of Oil Spill Response Arrangements** There are a number of arrangements which in the event of a spill will underpin Woodside's ability to implement a response across its petroleum activities. In order to ensure each of these arrangements is adequately tested, the Hydrocarbon Spill Preparedness Capability and Competency Coordinator ensures tests are conducted in alignment with the Hydrocarbon Spill Arrangements Testing Schedule (Woodside Doc No. 10058092). Woodside's Hydrocarbon Spill Preparedness & Response Testing Schedule aligns with international good practice for spill preparedness & response management; the testing is compatible with the IPIECA Good Practice Guide and the Australian Emergency Management Institute Handbook. The Hydrocarbon Spill Arrangements Testing Schedule (Woodside Doc No. 10058092) identifies the type of test which will be conducted annually for each arrangement, and how this type will vary over a five year rolling schedule. Testing methods may include (but are not limited to): audits, drills, field exercises, functional workshops, assurance reporting, assurance monitoring and reviews of key external dependencies. Activity specific Oil Spill Pollution First Strike Plans are developed to meet the response needs of that particular activity's Worst Credible Spill Scenario (WCCS). The ability to implement these plans may rely on specific arrangements or those common to other Woodside activities. Regardless of their commonality each arrangement will be tested in at least one of the methods annually. This ensures that personnel are familiar with spill response procedures, reporting requirements, and roles/ responsibilities.	EP Section 7

		At the completion of testing a report is produced to demonstrate the outcomes achieved against the tested objectives. The report will include the lessons learned, any improvement actions and a list of the participants. Alternatively, an assurance report, assurance records, or audit report may be produced. These reports record findings and include any recommendations for improvement. Improvement actions and their close-out are actively recorded and managed. This is over and above the emergency management exercises conducted.	
17	Additional comments	Please note some of the links in the document are still being finalised, and as such may show a reference error in the attached version.	

[Redacted]
Hydrocarbon Spill Adviser | Security & Emergency Management
Woodside Energy Ltd

1.20 Email sent to JX Nippon Oil and Gas (22 January 2020)

Dear *[Redacted]*,
Woodside is planning to undertake petroleum activities in in permit areas WA-5-L, WA-16-L and WA-3-L in Commonwealth waters to support ongoing production from the North West Shelf Project. Activities are planned from Q1 2021, pending approvals, vessel availability and weather constraints.

A Consultation Information Sheet about the planned activity is attached, which provides background on the activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

A map of adjacent titles relevant to the proposed activity is also attached.

Activity overview

Activity purpose:	• Support ongoing production from the North West Shelf Project				
Activity:	• Drilling of four production wells and installation of subsea infrastructure in permits areas WA-5-L, WA-16-L and WA-3-L. • Intervention, workover or re-drill of the GWF-3 and Lambert Deep production wells in permits area WA-5-L and WA-16-L, if required. • Modifications to topside infrastructure aboard the Angel Platform in permit area WA-3-L.				
Activity location:	• 126 km north-west of Dampier, Western Australia.				
Approximate locations:	**Structure**	**Water Depth m**	**Latitude**	**Longitude**	**Permit Area**
	LDA-01 production well	129	19° 26’07.220” S	116° 28’51.314” E	WA-16-L
	GDA-03 production well	125	19° 43’04.890” S	115° 51’58.911” E	WA-5-L

	GDA-04 production well	125	19° 42'35.697" S	115° 53'14.475" E	WA-5-L
	GDA-05 production well	125	19° 43'15.968" S	115° 51'10.743" E	WA-5-L
	LDA Manifold	129	19° 26'15.029" S	116° 29'28.721" E	WA-16-L
	Angel Platform	80	19° 29' 55.144" S	116° 35' 53.066" E	WA-3-L
Earliest commencement date:	• Activities are to commence from Q1 2021, subject to approvals, vessel availability and weather constraints				
Estimated duration:	• 70 days per well • 100 cumulative days to complete installation of subsea infrastructure and pre-commissioning. These activities may be performed over multiple campaigns • Angel topside modifications estimated to be conducted over a 15-month period, commencing Q1 2021 until Q2 2022				
Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Subsea installation vessel • Light well intervention vessel • Support vessels, including anchor handling vessels, and activity support vessels				
Temporary exclusion zones:	• A temporary 500 m Petroleum Safety Zone will be in place around the MODU and installation vessel for the duration of activities.				
Temporary cautionary areas:	• A temporary 4000 m Operational Area around each well centre. This Operational Area allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel related petroleum activities and will apply for the duration of activities. • A temporary 1500 m Operational Area for each subsea installation location, defined as the area in which subsea installation, pipelay and pre-commissioning petroleum activities will take place. This Operational Area allows for the movement and positioning of large vessels during subsea installation and pipelay activities and will apply for the duration of activities.				

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by 7 February 2020 to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone

Regards,

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

1.21 Email sent to Finder Energy (26 February 2020)

Dear *[Redacted]*,

Woodside is planning to undertake petroleum activities in in permit areas WA-5-L, WA-16-L and WA-3-L in Commonwealth waters to support ongoing production from the North West Shelf Project. Activities are planned from Q1 2021, pending approvals, vessel availability and weather constraints.

A Consultation Information Sheet about the planned activity is attached, which provides background on the activity, including a summary of potential key risk and associated management measures. The Information Sheet is also available on our website.

A map of adjacent titles relevant to the proposed activity is also attached.

Activity overview

Activity purpose:	• Support ongoing production from the North West Shelf Project
Activity:	• Drilling of four production wells and installation of subsea infrastructure in permits areas WA-5-L, WA-16-L and WA-3-L. • Intervention, workover or re-drill of the GWF-3 and Lambert Deep production wells in permits area WA-5-L and WA-16-L, if required. • Modifications to topside infrastructure aboard the Angel Platform in permit area WA-3-L.
Activity location:	• 126 km north-west of Dampier, Western Australia.
Approximate locations:	(see table below)
Earliest commencement date:	• Activities are to commence from Q1 2021, subject to approvals, vessel availability and weather constraints
Estimated duration:	• 70 days per well • 100 cumulative days to complete installation of subsea infrastructure and pre-commissioning. These activities may be performed over multiple campaigns • Angel topside modifications estimated to be conducted over a 15-month period, commencing Q1 2021 until Q2 2022
Vessels:	• Semi-submersible mobile offshore drilling unit (MODU) • Subsea installation vessel • Light well intervention vessel

Approximate locations:

Structure	Water Depth m	Latitude	Longitude	Permit Area
LDA-01 production well	129	19° 26’07.220” S	116° 28’51.314” E	WA-16-L
GDA-03 production well	125	19° 43’04.890” S	115° 51’58.911” E	WA-5-L
GDA-04 production well	125	19° 42’35.697” S	115° 53’14.475” E	WA-5-L
GDA-05 production well	125	19° 43’15.968” S	115° 51’10.743” E	WA-5-L
LDA Manifold	129	19° 26’15.029” S	116° 29’28.721” E	WA-16-L
Angel Platform	80	19° 29' 55.144" S	116° 35' 53.066" E	WA-3-L

	• Support vessels, including anchor handling vessels, and activity support vessels
Temporary exclusion zones:	• A temporary 500 m Petroleum Safety Zone will be in place around the MODU and installation vessel for the duration of activities.
Temporary cautionary areas:	• A temporary 4000 m Operational Area around each well centre. This Operational Area allows for MODU mooring operations, including the possible installation of pre-laid moorings and vessel related petroleum activities and will apply for the duration of activities. • A temporary 1500 m Operational Area for each subsea installation location, defined as the area in which subsea installation, pipelay and pre-commissioning petroleum activities will take place. This Operational Area allows for the movement and positioning of large vessels during subsea installation and pipelay activities and will apply for the duration of activities.

Your feedback

Your feedback on the proposed activity and our response will be included in an Environment Plan for consideration by the National Offshore Petroleum Safety and Environmental Management Authority, as is required under the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth).

Please let us know if your feedback for this activity is sensitive and we will make this known to NOPSEMA upon submission of the Environment Plan in order for this information to remain confidential to NOPSEMA.

Please provide your views by 26 March 2020 to allow us sufficient time to inform our planning for the proposed activity. Comments can be made by email, letter or by phone.

[Redacted]
Graduate | Corporate Affairs
Woodside Energy Ltd

APPENDIX G DEPARTMENT OF PLANNING LAND, HERITAGE AND ABORIGINAL ENQUIRY SYSTEM RESULTS

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

Search Criteria

46 Registered Aboriginal Sites in Shapefile - EMBA_Smooth

Disclaimer

The *Aboriginal Heritage Act 1972* preserves all Aboriginal sites in Western Australia whether or not they are registered. Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist.

The information provided is made available in good faith and is predominately based on the information provided to the Department of Planning, Lands and Heritage by third parties. The information is provided solely on the basis that readers will be responsible for making their own assessment as to the accuracy of the information. If you find any errors or omissions in our records, including our maps, it would be appreciated if you email the details to the Department at heritageenquiries@dplh.wa.gov.au and we will make every effort to rectify it as soon as possible.

Copyright

Coordinate Accuracy

Coordinates (Easting/Northing metres) are based on the GDA 94 Datum. Accuracy is shown as a code in brackets following the coordinates.

Terminology (NB that some terminology has varied over the life of the legislation)

Place ID/Site ID: This a unique ID assigned by the Department of Planning, Lands and Heritage to the place.
Status:

- **Registered Site**: The place has been assessed as meeting Section 5 of the *Aboriginal Heritage Act 1972.*
- **Other Heritage Place which includes:**
  - **Stored Data / Not a Site:** The place has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972.*
  - **Lodged:** Information has been received in relation to the place, but an assessment has not been completed at this *stage* to determine if it meets Section 5 of the *Aboriginal Heritage Act 1972.*

Access and Restrictions:

- **File Restricted = No:** Availability of information that the Department of Planning, Lands and Heritage holds in relation to the place is not restricted in any way.
- **File Restricted = Yes:** Some of the information that the Department of Planning, Lands and Heritage holds in relation to the place is restricted if it is considered culturally sensitive. This information will only be made available if the Department of Planning, Lands and Heritage receives written approval from the informants who provided the information. To request access please contact heritageenquiries@dplh.wa.gov.au.
- **Boundary Restricted = No:** Place location is shown as accurately as the information lodged with the Registrar allows.
- **Boundary Restricted = Yes:** To preserve confidentiality the exact location and extent of the place is not displayed on the map. However, the shaded region (generally with an area of at least 4km²) provides a general indication of where the place is located. If you are a landowner and wish to find out more about the exact location of the place, please contact the Department of Planning, Lands and Heritage.
- **Restrictions:**
  - **No Restrictions:** *Anyone* can view the information.
  - **Male Access Only:** Only *males* can view restricted information.
  - **Female Access Only:** *Only* females can view restricted information.

Legacy ID: This is the former unique number that the former Department of Aboriginal Sites assigned to the place. This has been replaced by the Place ID / Site ID.

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
508	POINT MURAT 03	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	209042mE 7584688mN Zone 50 [Reliable]	P07503
509	POINT MURAT 04	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	208690mE 7584604mN Zone 50 [Reliable]	P07504
563	POINT MURAT 01	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	208716mE 7585665mN Zone 50 [Reliable]	P07501
564	POINT MURAT 02	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	209079mE 7585539mN Zone 50 [Reliable]	P07502
628	CAMP THIRTEEN BURIAL	No	No	No Gender Restrictions	Registered Site	Skeletal Material / Burial	*Registered Knowledge Holder names available from DAA	800392mE 7559449mN Zone 49 [Reliable]	P07434
756	WINPIKANYA	Yes	Yes	Female Access Only	Registered Site	Ceremonial, Engraving, Grinding Patches / Grooves, Mythological, Camp, Water Source	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	P07360
873	MONTEBELLO IS: NOALA CAVE.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Rockshelter, BP Dating: 27,220 +/- 640	*Registered Knowledge Holder names available from DAA	348188mE 7741053mN Zone 50 [Reliable]	P07287
926	MONTEBELLO IS: HAYNES CAVE.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Rockshelter, Arch Deposit	*Registered Knowledge Holder names available from DAA	348289mE 7741005mN Zone 50 [Reliable]	P07286
6017	YARDIE CREEK CARAVAN BURIAL	No	No	No Gender Restrictions	Registered Site	Skeletal Material / Burial	*Registered Knowledge Holder names available from DAA	191538mE 7576555mN Zone 50 [Unreliable]	P07115
6311	POINT MURAT.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Skeletal Material / Burial, Camp, Other: ?	*Registered Knowledge Holder names available from DAA	208538mE 7584405mN Zone 50 [Reliable]	P06628
6616	CORAL BAY ACCESS 2	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	784342mE 7438148mN Zone 49 [Unreliable]	P06361
6723	MULANDA 2	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	784742mE 7441148mN Zone 49 [Unreliable]	P06257

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
6724	MULANDA 3	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	784842mE 7441248mN Zone 49 [Unreliable]	P06258
6757	BLOODWOOD CREEK MIDDEN 1	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	794942mE 7544549mN Zone 49 [Reliable]	P06168
6758	BLOODWOOD CREEK MIDDEN 2	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	794942mE 7545049mN Zone 49 [Reliable]	P06169
6760	BLOODWOOD CREEK SHORELINE	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	794942mE 7545249mN Zone 49 [Reliable]	P06171
6761	LOW POINT MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	802992mE 7566299mN Zone 49 [Reliable]	P06172
6762	MILYERING MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	801342mE 7561449mN Zone 49 [Reliable]	P06173
6764	CAMP 17 SOUTH MIDDENS	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	799042mE 7555649mN Zone 49 [Unreliable]	P06175
6765	CAMP 17 NORTH MIDDENS	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	799042mE 7555849mN Zone 49 [Unreliable]	P06176
6769	MULANDA 1	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	784550mE 7441050mN Zone 49 [Reliable]	P06180
6782	28 MILE CREEK NORTH 1	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	795242mE 7545949mN Zone 49 [Unreliable]	P06140
6784	MANDU MANDU CREEK SOUTH	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	796642mE 7548649mN Zone 49 [Unreliable]	P06142
6785	MANDU MANDU CREEK NORTH	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	796642mE 7548649mN Zone 49 [Unreliable]	P06143

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
6790	YARDIE CREEK SOUTH 1	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	788942mE 7527749mN Zone 49 [Reliable]	P06148
6827	CORAL BAY SKELETON	No	No	No Gender Restrictions	Registered Site	Skeletal Material / Burial	*Registered Knowledge Holder names available from DAA	785143mE 7445149mN Zone 49 [Unreliable]	P06132
7126	MESA CAMP	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	798442mE 7554749mN Zone 49 [Unreliable]	P05792
7206	WEALJUGOO MIDDEN.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Camp, Hunting Place	*Registered Knowledge Holder names available from DAA	776584mE 7504740mN Zone 49 [Reliable]	P05710
7211	MAUD LANDING.	No	No	No Gender Restrictions	Registered Site	Skeletal Material / Burial, Camp, Meeting Place, Water Source	*Registered Knowledge Holder names available from DAA	784292mE 7441048mN Zone 49 [Unreliable]	P05715
7265	LAKE SIDE VIEW	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	800942mE 7560549mN Zone 49 [Reliable]	P05664
7300	MANDU MANDU CK ROCKSHELTERS	Yes	Yes	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	P05646
7303	TULKI WELL MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	798642mE 7554249mN Zone 49 [Reliable]	P05649
7305	MANGROVE BAY.	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter, Skeletal Material / Burial, Hunting Place	*Registered Knowledge Holder names available from DAA	804142mE 7568149mN Zone 49 [Reliable]	P05651
8301	NINGALOO STATION	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	775891mE 7493649mN Zone 49 [Unreliable]	P04353
8927	TEN MILE WELL BURIAL	No	No	No Gender Restrictions	Registered Site	Skeletal Material / Burial	*Registered Knowledge Holder names available from DAA	783642mE 7480649mN Zone 49 [Reliable]	P03570
10381	VLAMING HEAD	Yes	Yes	No Gender Restrictions	Registered Site	Ceremonial, Mythological	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	P01799

ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
11400	YARDIE CREEK STATION	No	No	No Gender Restrictions	Registered Site	Engraving	*Registered Knowledge Holder names available from DAA	191638mE 7576655mN Zone 50 [Unreliable]	P00750
11401	5 Mile Well (Cape Range)	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Engraving, Painting, Quarry, Arch Deposit	*Registered Knowledge Holder names available from DAA	198638mE 7583655mN Zone 50 [Unreliable]	P00751
11458	NINGALOO (near)	No	No	No Gender Restrictions	Registered Site	Painting	*Registered Knowledge Holder names available from DAA	781642mE 7511649mN Zone 49 [Unreliable]	P00701
11820	ENDERBY ISLAND 01	No	No	No Gender Restrictions	Registered Site	Engraving	*Registered Knowledge Holder names available from DAA	445137mE 7725156mN Zone 50 [Unreliable]	P00364
11885	PADJARI MANU CAVE (Formerly Bunbury Cave)	Yes	Yes	No Gender Restrictions	Registered Site	Artefacts / Scatter, Ceremonial, Engraving, Painting, Arch Deposit, Water Source	*Registered Knowledge Holder names available from DAA	Not available when location is restricted	P00267
15322	POINT MURAT/WHITE OPAL	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	209012mE 7585213mN Zone 50 [Reliable]	P07916
16596	Coral Bay to Yardie Creek 3	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	776901mE 7494189mN Zone 49 [Reliable]	
17193	Ningaloo Station	No	No	No Gender Restrictions	Registered Site	Skeletal Material / Burial	*Registered Knowledge Holder names available from DAA	775891mE 7489149mN Zone 49 [Unreliable]	
17447	PAP HILL OCHRE	No	No	No Gender Restrictions	Registered Site	Ceremonial, Grinding Patches / Grooves, Rockshelter, Ochre	*Registered Knowledge Holder names available from DAA	198327mE 7581741mN Zone 50 [Reliable]	
17448	CHUGORI ROCKHOLE	No	No	No Gender Restrictions	Registered Site	Ceremonial, Grinding Patches / Grooves, Man-Made Structure, Mythological, Water Source	*Registered Knowledge Holder names available from DAA	193492mE 7579323mN Zone 50 [Reliable]	

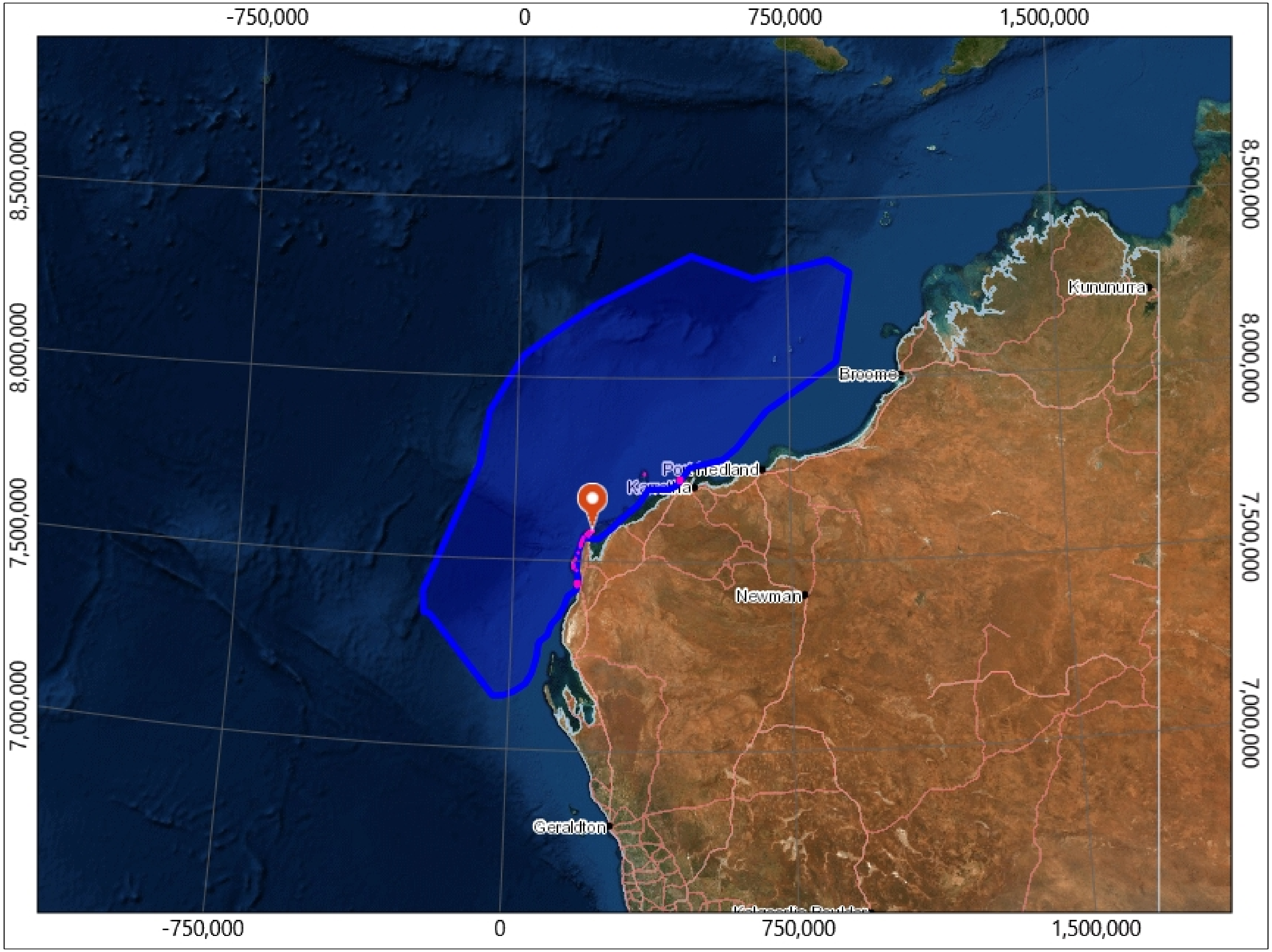
Department of Planning, Lands and Heritage

GOVERNMENT OF WESTERN AUSTRALIA

Aboriginal Heritage Inquiry System

Map of Registered Aboriginal Sites

For further important information on using this information please see the Department of Planning, Lands and Heritage's Disclaimer statement at https://www.dplh.wa.gov.au/about-this-website



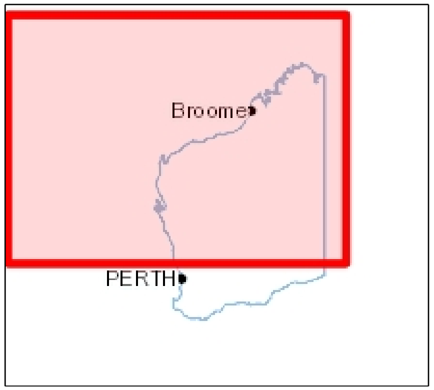
Legend

- Registered Aboriginal Site
- Search Area
- Town
- Road
- River
- Local Government Authority

556.30 kilometres

Map Scale 1 : 16,860,000

MGA Zone 50 (GDA94)



APPENDIX H GREATER WESTERN FLANK 3 AND LAMBERT DEEP DRILLING AND SUBSEA INSTALLATION – OIL POLLUTION FIRST STRIKE PLAN

Greater Western Flank 3 (GWF3) and Lambert Deep Drilling and Subsea Installation – Oil Pollution First Strike Plan

Security and Emergency Management
Hydrocarbon Spill Preparedness Unit

October 2020

Revision: 0b

TABLE OF CONTENTS

GWF3 AND LAMBERT DEEP DRILLING AND SUBSEA TIE-IN OIL POLLUTION FIRST STRIKE PLAN

SPILL FROM FACILITY INCLUDING SUBSEA INFRASTRUCTURE

(Note: Pipe laying and accommodation vessels are considered a "FACILITY" under Australian Regs).

LEVEL 1

CONTROL AGENCY:	**WOODSIDE**
INCIDENT CONTROLLER:	**Well Site Manager (WSM) with support from Onshore Drilling Superintendent**

LEVEL 2 and 3

CONTROL AGENCY:	**WOODSIDE**
INCIDENT CONTROLLER:	**Corporate Incident Coordination Centre (CICC) DUTY MANAGER**

SPILL FROM FACILITY ENTERING STATE WATERS

LEVEL 1

CONTROL AGENCY:	**WOODSIDE**
INCIDENT CONTROLLER:	**CICC DUTY MANAGER**

LEVEL 2 and 3

CONTROL AGENCY:	**Department of Transport (DoT)**
INCIDENT CONTROLLER:	**DoT Incident Controller (IC)**

SPILL FROM VESSEL

(Note: SOPEP should be implemented in conjunction with this document)

LEVEL 1

CONTROL AGENCY:	**AMSA**
INCIDENT CONTROLLER:	**VESSEL MASTER (with response assistance from Woodside)**

LEVEL 2 and 3

CONTROL AGENCY:	**AMSA**
INCIDENT CONTROLLER:	**AMSA (with response assistance from Woodside)**

Guidance to Oil Spill Incident Levels

The most significant characteristic of the below guidance should be considered when determining level or escalation potential.

Characteristic	Level 1 Indicators	Level 2 Indicators	Level 3 Indicators
General Description	Generally able to be resolved within 24-48 hours.	Generally response required beyond 48 hours.	Response may extend beyond weeks.
Woodside Emergency Management (EM)/ Crisis Management Team (CMT) Activation	Onsite Incident Controller (IC) activated. Use of ICC support may be required.	Handover of control from onsite IC to Corporate Incident Coordination Center (CICC) Duty Manager (DM) in Perth.	Includes Perth based CMT activation.
Number of Agencies	First-response agency and Incident Management Team (IMT)	Multi-agency response	Agencies from across government and industry.
Environment	Isolated impacts or with natural recovery expected within weeks.	Significant impacts and recovery may take months.	Significant area and recovery may take months. Remediation required.
Economy	Business level disruption (i.e. Woodside).	Business failure or 'Channel' impacts.	Disruption to a sector.
Public Affairs	Local and regional media coverage (Western Australia).	National media coverage.	International media coverage.

For guidance on credible spill scenarios and hydrocarbon characteristics refer to APPENDIX A – credible spill scenarios and hydrocarbon information

For Spills Entering State Waters

In the event of a spill where Woodside is the responsible party and the spill may impact State waters/shorelines, Woodside will notify the Western Australian Department of Transport Maritime Environmental Emergency Response unit (DoT).

If the spill impacts State waters/shorelines and is a Level 1, Woodside will remain the Control Agency. If the spill is a Level 2/3 then DoT will become the Control Agency for the response in State waters/shorelines only. DoT will appoint an Incident Controller and form a separate Incident Management Team to manage the State waters/shorelines response only. The coordination structure for a concurrent hydrocarbon spill in both Commonwealth and State waters/shorelines is shown in APPENDIX E – Coordination Structure for a Concurrent Hydrocarbon Spill in Both Commonwealth and State Waters/Shorelines.

Initially Woodside will be required to make available an appropriate number of suitably qualified persons to work in the DoT IMT (see APPENDIX G – Woodside liason officer resources to DoT). DoT's role as the Controlling Agency for Level 2 and 3 spills in State waters/shorelines does not negate the requirement for Woodside to have appropriate plans and resources in place to adequately respond to a Marine Hydrocarbon Spill incident in State waters/shorelines or to commence the initial response actions to a spill prior to DoT establishing incident control in line with DoT Offshore Petroleum Industry Guidance Note - Marine Oil Pollution: Response and Consultation Arrangements (July 2020):

https://www.transport.wa.gov.au/mediaFiles/marine/MAC_P_Westplan_MOP_OffshorePetroleumIndGuidance.pdf

Woodside's Incident Management Structure for a Hydrocarbon Spill, including Woodside Liaison Officer's command structure within DoT can be seen at APPENDIX F – Woodside incident management structure.

Response Process Overview

Use the below to determine actions required and which parts of this plan are relevant to the incident.		
For guidance on credible scenarios and hydrocarbon characteristics, refer to APPENDIX A – credible spill scenarios and hydrocarbon information		
ALL INCIDENTS	Notify the Woodside Communication Centre (WCC) on: [redacted]	
	Incident Controller or delegate to make relevant notifications in Table 1-1 of this document.	
LEVEL 1	**FACILITY INCIDENT**	**VESSEL INCIDENT**
	Coordinate pre-identified tactics in Table 2-1 of this document. Remember to download each Operational Plan.	**Upon agreement with AMSA:** Coordinate pre-identified tactics in Table 2-1 of this document. Remember to download each Operational Plan.
	If the spill escalates such that the site cannot manage the incident, inform the WCC on: [redacted] and escalate to a Level 2/3 incident.	
LEVEL 2/3	**FACILITY INCIDENT**	**VESSEL INCIDENT**
	Handover control to CICC for facility spill including from subsea infrastructure. **OR** Handover control to DoT for facility spill which has entered State waters.	Stand up CICC to assist AMSA.
	Undertake quick revalidation of the recommended strategies in Table 3-1 taking into consideration seasonal sensitivities and current situational awareness. Undertake validated strategies.	**If requested by AMSA:** Undertake quick revalidation of the recommended strategies in Table 3-1 taking into consideration seasonal sensitivities and current situational awareness. Undertake validated strategies.
	Create an Incident Action Plan (IAP) for all ongoing operational periods. **The content of the IAP should reflect the selected response strategies based on current situational awareness.** For the full detailed pre-operational Net Environmental Benefit Analysis (NEBA) see GWF3 and Lambert Deep Exploration Pre-operational NEBA.	**If requested by AMSA:** Create an IAP for all ongoing operational periods. **The content of the IAP should reflect the selected response strategies based on current situational awareness.** For the full detailed pre-operational Net Environmental Benefit Analysis (NEBA) see GWF3 and Lambert Deep Pre-operational NEBA.

1. NOTIFICATIONS (ALL LEVELS)

The Incident Controller or delegate must ensure the below notifications Table 1-1 are completed within the designated timeframes.

For other environmental notifications required refer to the *GWF3 and Lambert Deep Drilling and Subsea Installation Environment Plan*.

Table 1-1: Immediate Notifications

Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
Notifications to be made for ALL LEVELS of spill *(For spills from a vessel the following notifications must be undertaken by a WEL representative).*							
Immediately	Well Site Manager (WSM) or Vessel Master	Woodside Communication Centre (WCC)	Duty Manager	[redacted]	Verbally notify WCC of event and estimated volume and hydrocarbon type.	Verbal	
Within 2 hours	Drilling Superintendent	National Offshore Petroleum Safety Environmental Management Authority (NOPSEMA[1])	Incident notification office	1300 674 472	Verbally notify NOPSEMA for spills >80L. Record notification using Initial Verbal Notification Form or equivalent and send to NOPSEMA as soon as practicable (cc to National Offshore Petroleum Titles Administrator (NOPTA) and Department of Mines, Industry Regulation and Safety (DMIRS).	APPENDIX B – Form 1	
Within 3 days	Drilling Superintendent				Provide a written NOPSEMA Incident Report Form as soon as practicable (no later than 3 days after notification) (cc to NOPTA and DMIRS).	APPENDIX B – Form 2	

[1] Notification to NOPSEMA must be from a Woodside Representative.

Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					NOPSEMA: submissions@nopsema.gov.au NOPTA: resources@nopta.gov.au DMIRS: petreps@dmirs.wa.gov.au		
As soon as practicable	CICC DM or Delegate	Woodside	Environment Duty Manager	As per roster	Verbally notify Environment Duty Manager of event and seek advice on relevant performance tandards from EP.	Verbal	
As soon as practicable	CICC DM or Delegate	Department of Agriculture, Water and the Environment (Director of National Parks)	Marine Park Compliance Duty Officer	[redacted]	The Marine Park Compliance Duty Officer is notified in the event of oil pollution within a marine park, or where an oil spill response action must be taken within a marine park, so far as reasonably practicable, prior to response action being taken. The notification should include: • titleholder details • time and location of the incident • proposed response arrangements and locations as per the OPEP • contact details for the response coordinator.	Verbal	
Additional notifications to be made ONLY if spill is from a vessel							
Without delay as per protection of the Sea Act, part II, section 11(1)	Vessel Master	Australian Maritime Safety Authority (AMSA)	Response Coordination Centre (RCC)	[redacted]	Verbally notify AMSA RCC of the hydrocarbon spill. Follow up with a written Marine Pollution Report (POLREP) as	APPENDIX B – Form 3	

Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					soon as practicable following verbal notification.		
ADDITIONAL LEVEL 2/3 NOTIFICATIONS							
As soon as practicable	CICC DM or Delegate	AMOSC	AMOSC Duty Manager	[redacted]	Notify Australian Marine Oil Spill Centre (AMOSC) that a spill has occurred and follow-up with an email from the IC/CICC DM, CMT Leader or Oil Spill Preparedness Manager to formally activate AMOSC. Determine what resources are required consistent with the AMOSPlan and detail in a Service Contract that will be sent to Woodside from AMOSC upon activation.	APPENDIX B – Form 4	
As soon as practicable	CICC DM or Delegate	Oil Spill Response Limited (OSRL)	OSRL Duty Manager	[redacted]	Contact OSRL Duty Manager and request assistance from technical advisor in Perth. Send the notification form to OSRL as soon as practicable. For mobilisation of resources, send the Mobilisation Form to OSRL as soon as practicable.	Notification: APPENDIX B – Form 6a Mobilisation: APPENDIX B – Form 6b	
As soon as practicable or if spill is likely to extend into WA State waters.	CICC DM or Delegate	WA Department of Transport	DOT Duty Manager	[redacted]	Marine Duty Manager to verbally notify DoT that a spill has occurred and request use of equipment stored in the Exmouth supply shed at Harold E Holt. Follow up with a written POLREP as soon as practicable following verbal notification.	APPENDIX B – Form 5	

Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					Additionally DoT to be notified if spill is likely to extend into WA State waters. Request DoT to provide Liaison to WEL IMT.		
As soon as practicable if there is potential for oiled wildlife or the spill is expected to contact land or waters managed by WA Department of Biodiversity, Conservation and Attractions	CICC DM or Delegate	WA Department of Biodiversity, Conservation and Attractions (DBCA)	Duty Officer	[redacted]	Phone call notification.	Verbal	
As soon as practicable	CICC DM or Delegate	Marine Spill Response Corporation (MSRC)	MSRC Response Manager	[redacted]	Activate the contract with MSRC (in full) for the provision of up to 30 personnel depending on what skills are required. Please note that provision of these personnel from MSRC are on a best endeavours basis and are not guaranteed.	Verbal	

2. LEVEL 1 RESPONSE

2.1 Mobilisation of Response Techniques

For the relevant hydrocarbon type, undertake quick revalidation of the recommended techniques and pre-identified tactics indicated with a 'Yes' in Table 2-1. Undertake all validated pre-identified tactics immediately. These tactics should be carried out using the associated plan identified under Table 2-1 Operational Plan column.

All response techniques and pre-identified tactics have been identified from the pre-operational NEBA presented in the GWF3 and Lambert Deep Drilling and Subsea Installation Environment Plan Appendix D: Oil Spill Preparedness and Response Mitigation Assessment.

Table 2-1: Level 1 Response Summary

Response Techniques	Hydrocarbon Type: Marine Diesel	Hydrocarbon Type: GWF3 Condensate	Hydrocarbon Type: Lambert Deep Condensate	Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
Monitor and evaluate – tracking buoy (OM02)	Yes	Yes	Yes	If a vessel is on location, consider the need to deploy the oil spill tracking buoy. If no vessel is on location, consider the need to mobilise oil spill tracking buoys from the King Bay Supply Base (KBSB) Stockpile. If a surface sheen is visible from the facility, deploy the satellite tracking buoy within two hours.	Operations	**DAY 1:** Tracking buoy deployed within two hours.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02) of The Operational Monitoring Operational Plan. Deploy tracking buoy in accordance with APPENDIX D – Tracking buoy deployment instructions.
Please consider instructing the CICC DM to activate or implement any of the following Pre-Identified tactics. The following tactics will assist in answering the '7 Questions of Spill Assessment' identified in Appendix C to increase situational awareness.								
Monitor and evaluate – predictive modelling (OM01)	Yes	Yes	Yes	Undertake initial modelling using the Rapid assessment oil spill tool (Woodside Maps) and weathering fate analysis using ADIOS (or refer to the hydrocarbon information in APPENDIX A).	Intelligence or Environment	**DAY 1:** Initial modelling within six hours using the Rapid Assessment Tool.		Predictive Modelling of Hydrocarbons to Assess Resources at Risk (OM01 of the Operational Monitoring Operational Plan). *Planning to download immediately and follow steps*
	Yes	Yes	Yes	Send Oil Spill Trajectory Modelling (OSTM) form APPENDIX B, Form 7 to RPS APASA response team (email rpsresponse@rpsgroup.com) and call [redacted]	Intelligence	**DAY 1:** Detailed modelling within four hours of APASA receiving information from Woodside.		
Monitor and evaluate – aerial surveillance (OM02)	Yes	Yes	Yes	Instruct Aviation Duty Manager to commence aerial observations in daylight hours. Aerial surveillance observer to	Logistics – Aviation	**DAY 1:** Two trained aerial observers.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02 of The Operational Monitoring Operational Plan).

Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWF3 Condensate	Lambert Deep Condensate					
				complete log in APPENDIX B, Form 8		One aircraft available. Report made available to the IMT within two hours of landing after each sortie.		*Planning to download immediately and follow steps*
Monitor and evaluate – satellite tracking (OM02)	Yes	Yes	Yes	The Intelligence Duty Manager should be instructed to stand up KSAT to provide satellite imagery of the spill (email emergency@ksat.no and call [redacted]	Intelligence	**DAY 1:** Service provider will confirm availability of an initial acquisition within two hours. Data received to be uploaded into Woodside Common Operating Picture		
Monitor and evaluate – monitoring hydrocarbons in water (OM03)	Yes	Yes	Yes	Consider the need to mobilise resources to undertake water quality monitoring (OM03).	Planning or Environment	**DAY 3:** Water quality assessment access and capability. Daily fluorometry reports will be provided to IMT.		Detecting and Monitoring for the Presence and Properties of Hydrocarbons in the Marine Environment (OM03 of The Operational Monitoring Operational Plan).
Monitor and evaluate – pre-emptive assessment of receptors at risk (OM04)	Yes	Yes	Yes	Consider the need to mobilise resources to undertake pre-emptive assessment of sensitive receptors at risk (OM04).	Planning or Environment	In agreement with WA DoT, deployment of two specialists for each of the Response Protection Areas (RPA) within 10 days of predicted impacts.		Pre-emptive Assessment of Sensitive Receptors at Risk (OM04 of The Operational Monitoring Operational Plan).
Monitor and evaluate – shoreline	Yes	Yes	Yes	Consider the need to mobilise resources to undertake shoreline assessment surveys (OM05).	Planning or Environment	In agreement with WA DoT, deployment of one specialist in SCAT for each of the RPAs within		Monitoring of contaminated resources (OM05 of The Operational Monitoring Operational Plan).

Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWF3 Condensate	Lambert Deep Condensate					
assessment (OM05)						10 days of predicted impacts.		

3. LEVEL 2/3 RESPONSE

3.1 Mobilisation of Response Techniques

For the relevant hydrocarbon type, undertake quick revalidation of the recommended techniques and pre-identified tactics indicated with a 'Yes' in Table 3-1. Undertake all validated pre-identified tactics immediately. These tactics should be carried out using the associated plan identified under Table 3-1 Operational Plan column.

All response strategies and pre-identified tactics have been identified from the pre-operational NEBA presented in the GWF3 and Lambert Deep Drilling and Subsea Installation Environment Plan Appendix D: Oil Spill Preparedness and Response Mitigation Assessment.

Table 3-1: Level 2/3 Response Summary

Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWF3 Condensate	Lambert Deep Condensate					
Monitor and evaluate – tracking buoy (OM02)	Yes	Yes	Yes	If a vessel is on location, consider the need to deploy the oil spill tracking buoy. If no vessel is on location, consider the need to mobilise oil spill tracking buoys from the King Bay Supply Base (KBSB) Stockpile. If a surface sheen is visible from the facility, deploy the satellite tracking buoy within two hours.	Operations	**DAY 1:** Tracking buoy deployed within two hours.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02) of The Operational Monitoring Operational Plan. Deploy tracking buoy in accordance with APPENDIX D – Tracking buoy deployment instructions.
Monitor and evaluate – predictive modelling (OM01)	Yes	Yes	Yes	Undertake initial modelling using the Rapid assessment oil spill tool (Woodside Maps) and weathering fate analysis using ADIOS (or refer to the hydrocarbon information in APPENDIX A).	Intelligence or Environment	**DAY 1:** Initial modelling within six hours using the Rapid Assessment Tool.		Predictive Modelling of Hydrocarbons to Assess Resources at Risk (OM01 of The Operational Monitoring Operational Plan). *Planning to download immediately and follow steps*
	Yes	Yes	Yes	Send Oil Spill Trajectory Modelling (OSTM) form APPENDIX B, Form 7 to RPS APASA response team (email rpsresponse@rpsgroup.com) and call [redacted]	Intelligence	**DAY 1:** Detailed modelling within 4 hours of APASA receiving information from Woodside.		

Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWF3 Condensate	Lambert Deep Condensate					
Monitor and evaluate – aerial surveillance (OM02)	Yes	Yes	Yes	Instruct Aviation Duty Manager to commence aerial observations in daylight hours. Aerial surveillance observer to complete log in APPENDIX B, Form 8	Logistics - Aviation	**DAY 1:** Two trained aerial observers. One aircraft available. Report made available to the IMT within two hours of landing after each sortie.		Surveillance and Reconnaissance to Detect Hydrocarbons and Resources at Risk (OM02 of The Operational Monitoring Operational Plan). *Planning to download immediately and follow steps*
Monitor and evaluate – satellite tracking (OM02)	Yes	Yes	Yes	The Intelligence Duty Manager should be instructed to stand up KSAT to provide satellite imagery of the spill (email emergency@ksat.no and cal [redacted]	Intelligence	**DAY 1:** Service provider will confirm availability of an initial acquisition within two hours. Data received to be uploaded into Woodside Common Operating Picture.		
Monitor and evaluate – monitoring hydrocarbons in water (OM03)	Yes	Yes	Yes	Consider the need to mobilise resources to undertake water quality monitoring (OM03).	Planning or Environment	**DAY 3:** Water quality assessment access and capability Daily fluorometry reports will be provided to IMT.		Detecting and Monitoring for the Presence and Properties of Hydrocarbons in the Marine Environment (OM03 of The Operational Monitoring Operational Plan).
Monitor and evaluate – pre-emptive assessment of receptors at risk (OM04)	Yes	Yes	Yes	Consider the need to mobilise resources to undertake pre-emptive assessment of sensitive receptors at risk (OM04).	Planning or Environment	**DAY 2:** In agreement with WA DoT, deployment of two specialists for each of the Response Protection Areas (RPA) with predicted impacts.		Pre-emptive Assessment of Sensitive Receptors (OM04) of The Operational Monitoring Operational Plan.
Monitor and evaluate – shoreline assessment (OM05)	Yes	Yes	Yes	Consider the need to mobilise resources to undertake shoreline	Planning or Environment	**DAY 2:** In agreement with WA DoT, deployment of one specialist in		Shoreline Assessment (OM05) of The Operational Monitoring Operational Plan.

Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWF3 Condensate	Lambert Deep Condensate					
				assessment surveys (OM05).		SCAT for each of the RPAs with predicted impacts.		
Surface Dispersant	No	Yes	No	Mobilise Karratha and Exmouth stockpiles.	Logistics, Marine and Planning	**DAY 1:** One aircraft with minimum payload of 1,850 litre mobilised to site within 4 hours of activation. One additional aircraft mobilised to site within another 20 hours of activation. Access to 5000 m³ of dispersant on activation of OSRL Global Dispersant Stockpile (GDS) membership within 24-48 hours.		Surface Dispersants Operational Plan
				Consider need to mobilise vessels for surface dispersant application, including: • Woodside drilling support and offtake • support vessels on / off location • Woodside Exmouth pilot vessel Regional mutual aid vessel		**DAY 2:** Four additional aircraft mobilised to site within 48 hours of activation. One high capacity aircraft with minimum payload of 10 m³ available to spray on day 2. Two offtake support vessels from integrated fleet will undertake dispersant trials within 48 hours of the release as per first strike plan.		
				Consider need to mobilise fixed wing aerial dispersant platforms				

Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWF3 Condensate	Lambert Deep Condensate					
				Consider need to mobilise OSRL Hercules C130 This technique is not recommended for marine diesel or the Lambert Deep condensate scenario as modelling predicts that floating oil will not reach dispersant response thresholds at any RPA.				
Mechanical Dispersion	No	No	No	This technique is not recommended. Although feasible, highly volatile hydrocarbons are likely to weather, spread and evaporate quickly and lead to unsafe conditions in the vicinity of fresh hydrocarbon. Additionally, vessels used for mechanical dispersion would be contaminated by the hydrocarbon and could cause secondary contamination of unimpacted areas.				
Containment and Recovery	No	Yes	No	Equipment from Woodside, AMOSC, DoT and AMSA Western Australian Stockpiles and relevant personnel mobilised. Mobilisation of rapid sweep systems (NOFI Buster	Logistics and Planning	**DAY 2:** Two vessel-based containment and recovery operations would be deployed by day 2.		Containment and Recovery Operational Plan

Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWF3 Condensate	Lambert Deep Condensate					
				Series, DESMI Speed Sweep etc should be prioritised to increase encounter rates)		Deployment of two containment and recovery teams would be available by day 2, and four containment and recovery teams available by day 5.		
				Consideration of mobilisation of interstate/international containment and recovery equipment and relevant personnel (i.e. OSRL). Mobilisation of rapid sweep systems (NOFI Buster Series, DESMI Speed Sweep etc should be prioritised to increase encounter rates)				
				This technique is not recommended for marine diesel or the Lambert Deep condensate scenario as modelling predicts that floating oil will not reach containment and recovery response thresholds at any RPA.				
In Situ Burning	No	No	No	This technique is not recommended. It requires calm sea state conditions which limits its feasibility in the region. Furthermore, modelling predicts that floating oil will not reach response thresholds or slick				

Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWF3 Condensate	Lambert Deep Condensate					
				thickness to required for effective in situ burning operations. There are health and safety risks for response personnel associated with the containment and subsequent burning of hydrocarbons and the residue from attempts to burn would sink, posing a risk to the environment.				
Shoreline Protection and Deflection	No	Yes	Yes	Shoreline protection and deflection may be deployed if Operational Monitoring activities detect surface hydrocarbons moving towards shorelines. Undertaken in agreement with WA DoT (for Level 2/3 spills). Woodside will mobilise and begin the shoreline protection and deflection response to reduce the volume of oil at shorelines by deploying protection and deflection equipment at selected RPA shorelines 5 days prior to predicted impact. Equipment from Woodside, AMOSC and AMSA Western Australian	Operations and Planning	In agreement with WA DoT, activate relevant Tactical Response Plans (TRPs) 5 days prior to impact. In agreement with WA DoT, mobilise teams to RPAs 5 days prior to impact. In agreement with WA DoT, equipment mobilised from closest stockpile 5 days prior to impact. Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles 5 days prior to impact.		Protection and Deflection Operational Plan *Logistics to download immediately and follow steps* Tactical Response Plans available from: *Oil Spill Portal – Tactical Response Plans* Relevant TRPs: Barrow and Lowendal Islands TRP Montebello Island – Stephenson Channel Nth TRP Montebello Island Champagne Bay and Chippendale Channel TRP Montebello Island – Claret Bay TRP Montebello Island – Hermite/Delta Island Channel TRP

Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWF3 Condensate	Lambert Deep Condensate					
				Stockpiles mobilised. Consideration of mobilisation of interstate/international shoreline protection equipment (i.e. OSRL).				Montebello Island – Hock Bay TRP Montebello Island – North and Kelvin Channel TRP Montebello Island – Sherry Lagoon Entrance TRP Pilbara Islands – Southern Island Group TRP Rankin Bank and Glomar Shoals Muiron Islands TRP
				Mobilise security provider as per security support plan.				Land Based Security Support Plan
Shoreline Clean Up	No	Yes	Yes	Shoreline clean-up operations may be deployed if Operational Monitoring activities detect surface hydrocarbons moving towards shorelines. Undertaken in agreement with WA DoT (for Level 2/3 spills). Equipment from Woodside, AMOSC and AMSA Western Australian Stockpiles and relevant personnel mobilised. Consideration of mobilisation of interstate/international shoreline cleanup	Logistics and Planning	One shoreline clean-up team to each contaminated RPA 5 days prior to impact. TRPs available for at risk shorelines 5 days prior to impact. Access to at least 675 m^3 of solid and liquid waste storage available by day 4 upon activation of third party contract.		Shoreline Clean-up Operational Plan *Logistics to download immediately and follow steps*

Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWF3 Condensate	Lambert Deep Condensate					
				equipment and relevant personnel (i.e. OSRL).				
				Mobilise security provider as per security support plan.				Land Based Security Support Plan
Oiled Wildlife Response	Yes	Yes	Yes	If oiled wildlife is a potential impact, request AMOSC to mobilise containerised oiled wildlife first strike kits and relevant personnel. Refer to relevant Tactical Response Plan for potential wildlife at risk. Mobilise AMOSC Oiled Wildlife Containers. Consider whether additional equipment is required from local suppliers.	Logistics and Planning	**DAY 5:** Contracted capability to treat up to an additional 250 individual fauna within a five-day period. Facilities for oiled wildlife rehabilitation are operational 24/7		Oiled Wildlife Response Operational Plan
Scientific Monitoring (Type II)	Yes	Yes	Yes	Notify Woodside science team of spill event.	Environment			Oil Spill Scientific Monitoring Programme – Operational Plan
For well integrity event the following strategies apply:								
Well Intervention – SFRT	No	Yes	Yes	Debris clearance equipment to be mobilised prior to deployment of capping stack.	Operations, Logistics and Drilling and Completions (source control)	**DAY 2:** Remotely Operated Vehicle (ROV) on Mobile Offshore Drilling Unit (MODU) ready for deployment within 48 hours		Source Control and Well Intervention Operational Plan
Subsea Dispersant	No	Yes	Yes	Consider the need to mobilise suitable support	Operations (Source Control Unit)	**DAY 1:** Equipment to be mobilised within 24 hours if required.		Subsea First Response Toolkit (SFRT) and Capping Stack Operational Plan

Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWF3 Condensate	Lambert Deep Condensate					
				vessel and reeled injection unit.		SSDI operations to be deployed to the field within 12 days if required. Access to 5000 m^3 of dispersant on activation of GDS membership within 24-48 hours.		
Capping Stack	No	Yes	Yes	As per GWF-3 LD Blowout Contingency Plan. Conventional/vertical capping stack deployment with a heavy lift vessel will be attempted at the discretion of the vessel master on the day, giving due regard to the safety of the vessel and crew and consideration to the factors that may influence a safe deployment such as: a plume radius ~25 m and acceptable environmental conditions (e.g. wind speed, wave height, current and plume radius).	Drilling and Completions (source control)	**DAY 1:** Identify source control vessel availability within 24 hours. Capping stack on suitable vessel mobilised to site within 16 days.		Source Control Emergency Response Planning Guideline
Relief Well	No	Yes	Yes	As per GWF-3 LD Blowout Contingency Plan.	Operations, Logistics and Drilling and Completions (source control)	**DAY 1:** Identify source control vessel availability within 24 hours. ROV on MODU ready for deployment within 48 hours. MODU mobilised to location		Source Control Emergency Response Planning Guideline

4. PRIORITY RECEPTORS

Note: DoT are the Control Agency to respond to all the sites listed below in a Level 2/3 spill into State waters/shorelines.

Action: Provide DoT with all relevant Tactical Response Plans for these locations.

Based on hydrocarbon spill risk modelling results no response protection areas have the potential to be contacted by hydrocarbon at or above impact threshold levels within 48 hours of a spill. Open ocean surrounding the GDA05 well site (Credible Scenario-01) is predicted to have surface hydrocabons at response threshold (Table 4-2).

Please note that impact thresholds (10 g/m^2 surface hydrocarbon concentration, 100 g/m^2 shoreline accumulation, and 500 ppb entrained hydrocarbon concentration) used to determine the 'environment that may be affected' (EMBA) identified in the Environment Plan are lower than the response thresholds (Table 4-1).

Table 4-1: Response Thresholds

Surface Hydrocarbon (g/m^2)	Description
>10	Predicted minimum threshold for commencing operational monitoring[2]
50	Predicted minimum floating oil threshold for effective containment and recovery and surface dispersant application [3]
100	Predicted optimum floating oil threshold for effective containment and recovery and surface dispersant application
250	Predicted minimum threshold for effective shoreline clean-up operations

Table 4-2: Receptors for Priority Protection (Credible Scenario-01)

Receptor	Distance and Direction from GDA05 well	Threshold triggered and recommended strategy	Tactical Response Plans (also available within the Data Directory)
Open ocean	9 km around the GDA05 well	Surface hydrocarbons at >50 g/m^2 Recommended strategies: surface dispersant application and/or containment and recovery if operational monitoring detects surface oil at appropriate threshold concentrations.	N/A – open ocean

Hydrocarbon spill modelling results indicate the sensitive receptors listed below have the potential to be contacted by hydrocarbons beyond 48 hours of a spill:

- Barrow Island
- Lowendal Islands
- Montebello Islands and State Marine Park
- Muiron Islands Marine Management Area and World Heritage Area

[2] Operational monitoring will be undertaken from the outset of a spill whether or not this threshold has been reached. Monitoring is needed throughout the response to assess the nature of the spill, track its location and inform the need for any additional monitoring and/or response techniques. It also informs when the spill has entered State Waters and/or control of the incident passes to statutory authorities e.g. WA DoT or AMSA.

[3] At 50g/m^2 containment and recovery and surface dispersant application operations are not expected to be particularly effective. This threshold represents a conservative approach to planning response capability and displaying the spread of surface oil.

- Pilbara Islands – Southern Island Group
- Pilbara – Northern Pilbara – Islands & Shoreline
- Dampier Archipelago

Tactical Response plans for these locations can be accessed via the Oil Spill Portal - Tactical Response Plans[4].

Oil spill trajectory modelling specific to the spill event will be required to determine the regional sensitive receptors to be contacted beyond 48 hours of a spill.

Figure 4-1 illustrates the location of regional sensitive receptors in relation to the GWF3 and Lambert Deep PAP.

Consideration should be given to other stakeholders (including mariners) in the vicinity of the spill location. Table 4-3 indicates the assets within the vicinity of the GWF3 and Lambert Deep PAP.

Table 4-3: Assets in the vicinity of the GWF3 and Lambert Deep operational areas

Asset	Distance and direction from GWF3 operational area	Distance and direction from Lambert Deep operational area	Operator
Angel	74 km NE	Overlapping	Woodside
Goodwyn Alpha (GWA)	4 km NE	59 km SW	Woodside
Okha FPSO	56 km NE	13 km SW	Woodside
North Rankin Complex	27 km NE	36 km SW	Woodside
Wheatstone Platform	51 km SW	124 km SW	Chevron
Reindeer	52 km SE	62 km SW	Quadrant/Santos
Pluto	55 km SW	128 km SW	Woodside
Stag	71 km SE	92 km SW	Quadrant/Santos

[4] The Tactical Response Plans for the RPA's idenitifed contain the details of potential forward operating bases and staging areas. Incident Command Centre: For Level 1 incidents the in-field team and asset operator will lead the response on-scene.For level 2/3 Incident the Incident control centre will be located in Perth at Woodside's building. The Woodside CICC is fully equipped with communications equipment and technology to ensure the coordination of response activities for the overall response.

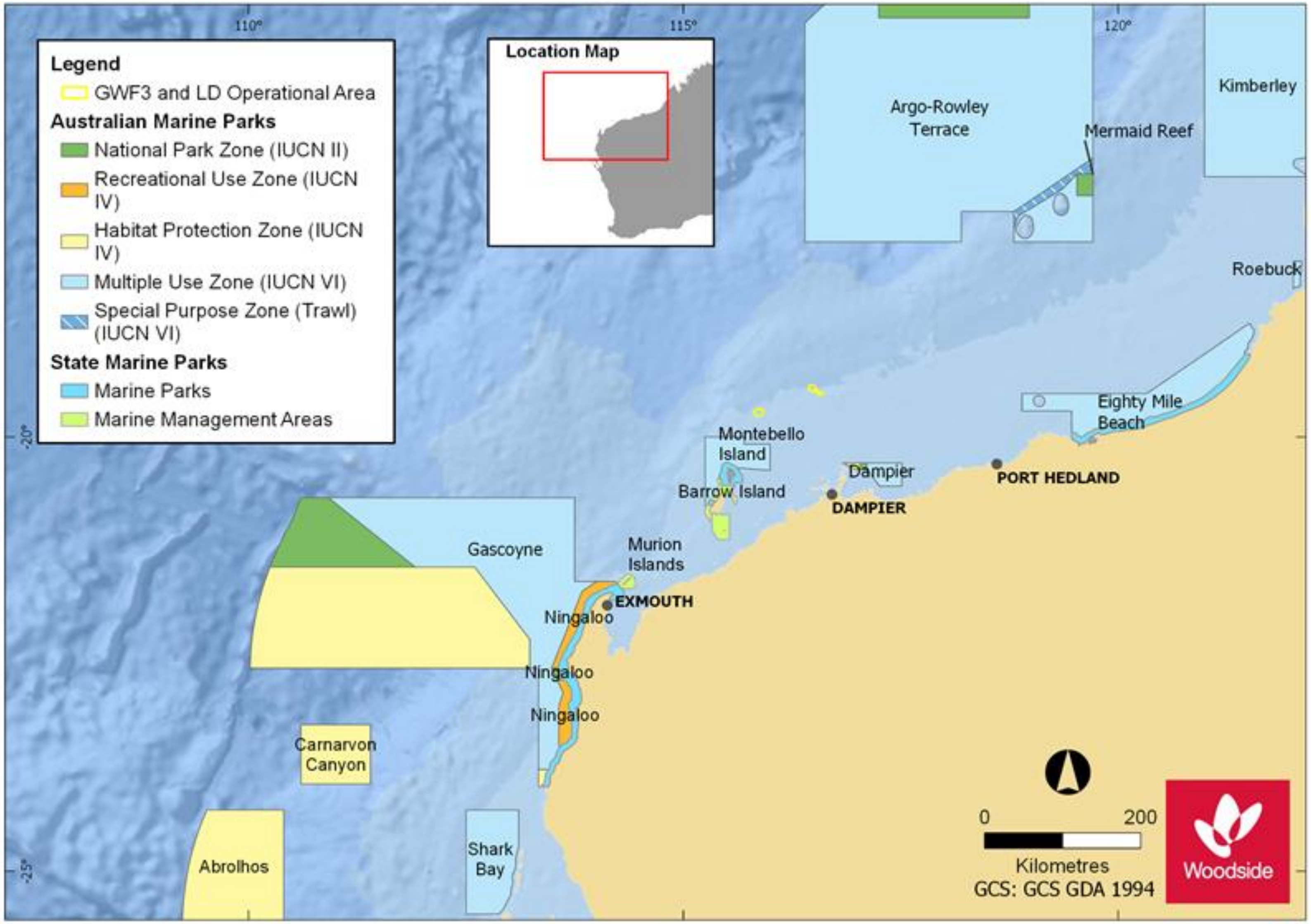


Figure 4-1: Regional sensitive receptors – GWF3 and Lambert Deep operational area

5. DISPERSANT APPLICATION

Dispersant may be suitable for use if operational monitoring detects surface hydrocarbons at appropriate concentrations (>50 g/m^2).

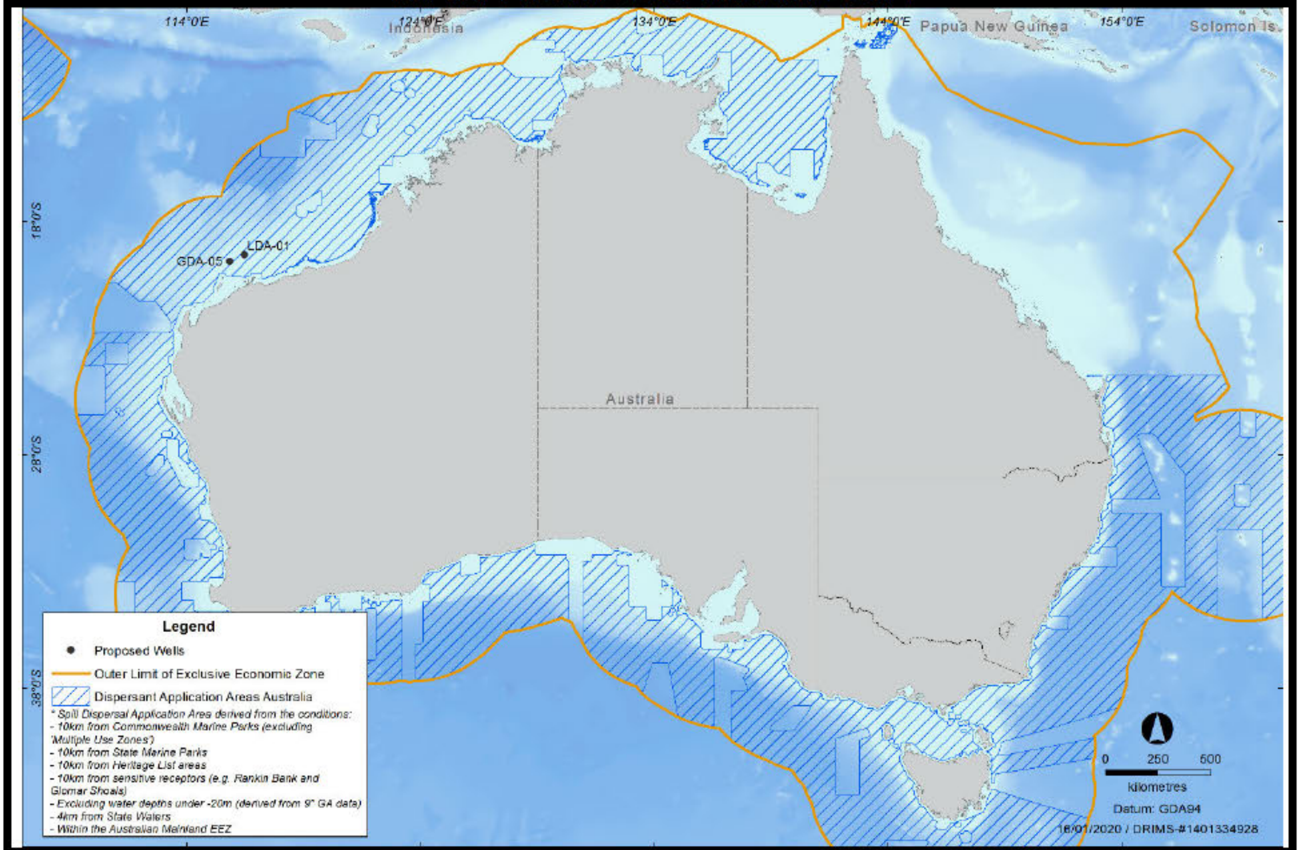
INSTRUCTIONS

DISPERSANTS ARE PRE-APPROVED UNDER THE ENVIRONMENT PLAN FOR USE IN THE PURPLE STRIPED ZONE ONLY. OSCA APPROVED OR TRANSISTIONAL DISPERSANTS ARE PRE-APPROVED FOR USE.

The shape file for the approved dispersant zone is saved in Woodside's Corporate Geodatabase by GTO.

The **SURFACE DISPERSANT OPERATIONAL PLAN** should be used to mobilise dispersant operations immediately – Surface Dispersants Operational Plan

PRE APPROVED DISPERSANT ZONE



DISPERSANT VOLUMES

Current dispersant volumes available should be checked in the following document:
Oil Spill Preparedness - Dispersant Stockpiles Datasheet

APPENDIX A – CREDIBLE SPILL SCENARIOS AND HYDROCARBON INFORMATION

For more detailed hydrocarbon information see the
Hydrocarbon Data Directory

Credible Spill Scenarios

Scenario	Product	Maximum Volumes	Suggested ADIOS2 Analogue*
Credible Scenario-01: Hydrocarbon release caused by loss of well containment	GWF3 Condensate (API 57.6°)	382,486 m^3 (0.8% residue of 3059.9 m^3)	NWS Condensate
Credible Scenario-02: Hydrocarbon release caused by loss of well containment	Lambert Deep Condensate (API 47.5°)	67,822 m^3 (8.2% residue of 5561.4 m^3)	NWS Condensate
Credible Scenario-03: Hydrocarbon release due to vessel collision (instantaneous surface release)	Marine diesel (API 37.2°)	1000 m^3 (5% residue of 50 m^3)	Diesel Fuel Oil – Southern USA 1 (API 37.2°)

**Initial screening of possible ADIOS2 analogues was done by considering hydrocarbons with similar APIs. Suggested selection was based on the closest distillation cut to Woodside's hydrocarbon. Only hydrocarbons with distillation cuts that showed results for >380°C were included in selection process*

GWF3 Condensate

GWF-3 Condensate is a mixture of volatile and persistent hydrocarbons with high proportions of highly volatile and low proportions of residual components. In general, about 65.9% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 22.5% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 10.8% should evaporate over several days (265 °C < BP < 380 °C). Approximately 0.8% of the oil is shown to be persistent. The aromatic content of the oil is approximately 16.3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 88% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves, but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

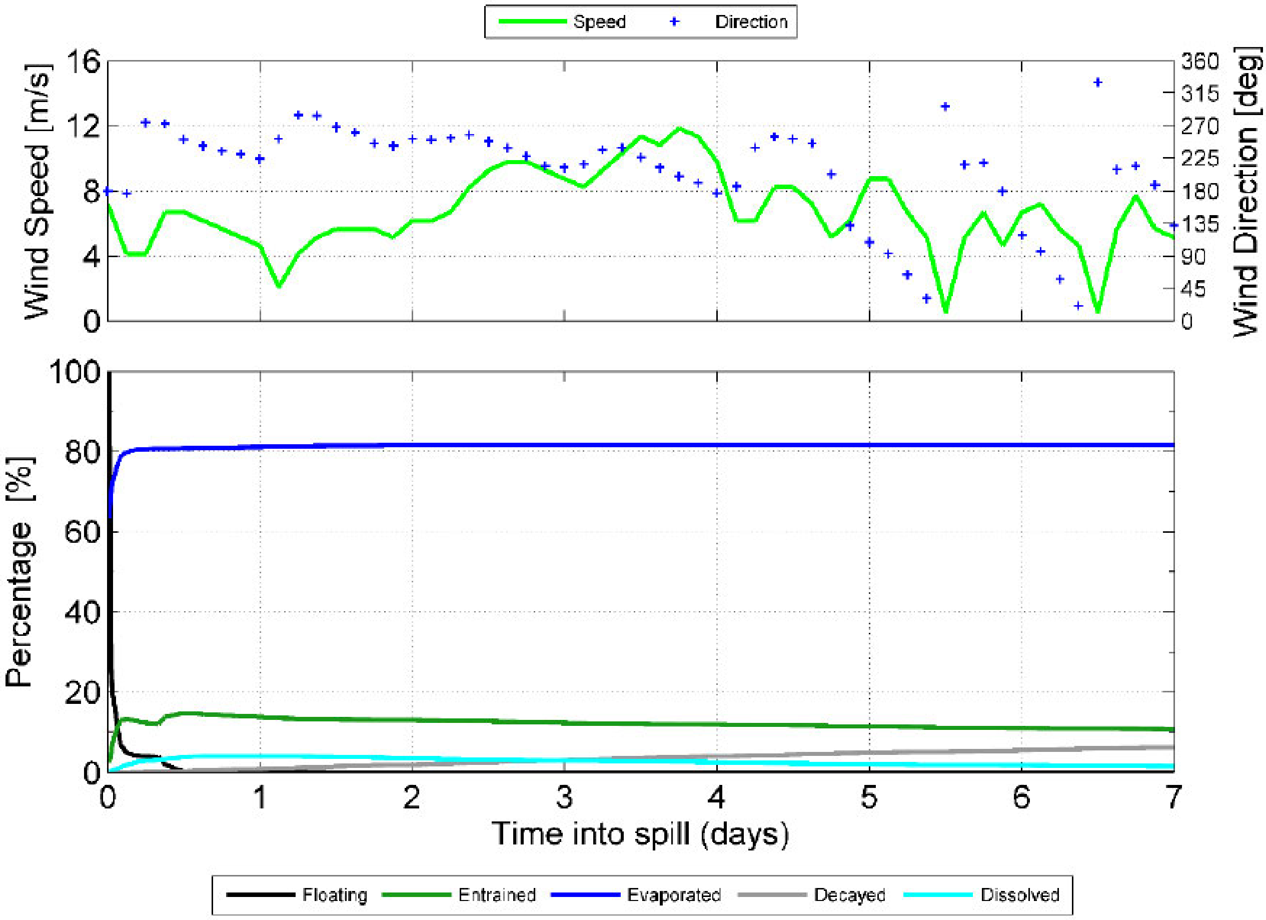


Figure A-1: Mass balance plot representing, as proportion (middle panel) and volume (bottom panel), the weathering of GWF-3 Condensate spilled onto the water surface as a one-off release (50 m^3 over 1 hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

Lambert Deep Condensate

Lambert Deep Condensate is a mixture of volatile and persistent hydrocarbons with moderate proportions of both highly volatile and residual components. In general, about 18.8% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 56.1% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 16.9% should evaporate over several days

(265 °C < BP < 380 °C). Approximately 8.2% of the oil is shown to be persistent. The aromatic content of the oil is approximately 16.3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 75% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves, but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

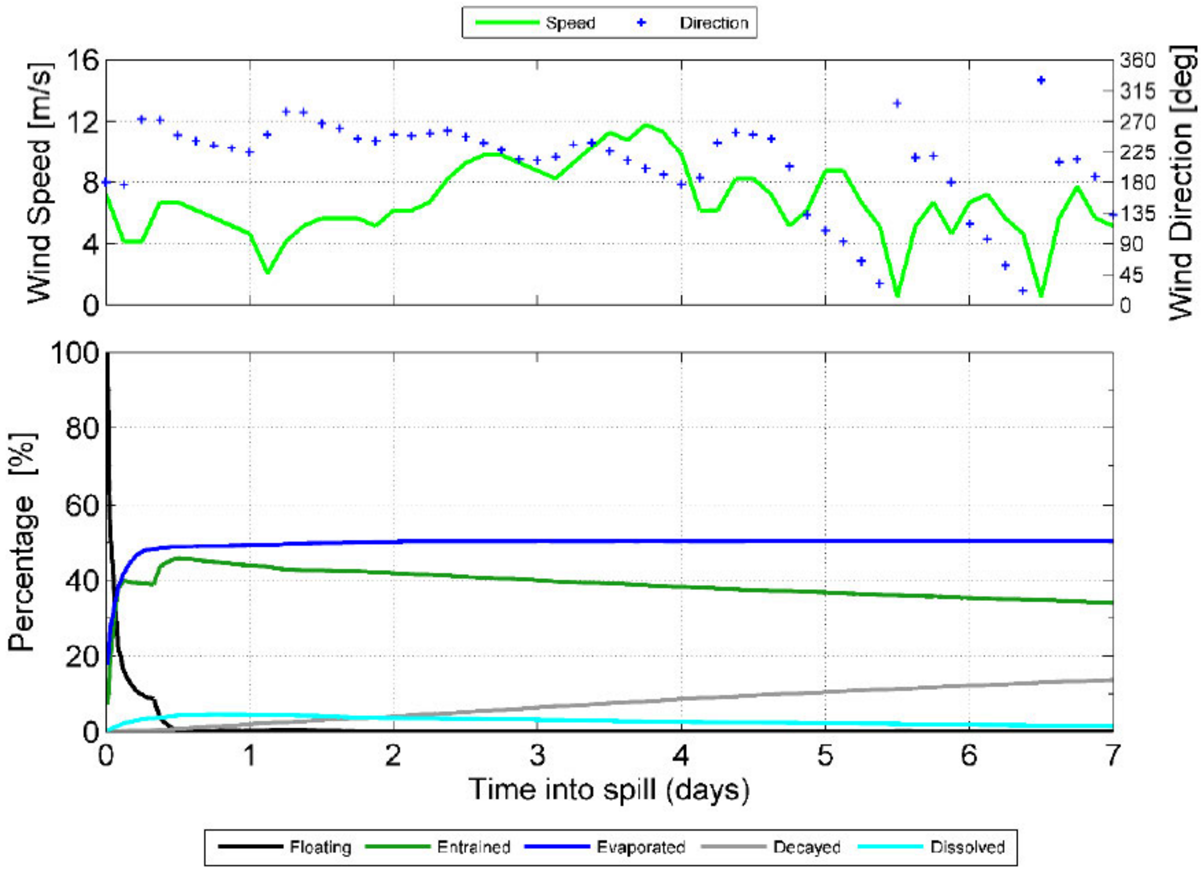


Figure A-2: Mass balance plot representing, as proportion (middle panel) and volume (bottom panel), the weathering of Lambert Deep Condensate spilled onto the water surface as a one-off release (50 m^3 over 1 hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

The results of the OILMAP simulation predict that the discharges will generate a cone of rising gas that will entrain the oil droplets and ambient sea water up to the water surface. This outcome was calculated by the model for both scenarios at all discharge rates specified throughout the blowout period. The mixed plume is initially forecast to jet towards the water surface with a vertical velocity of between 15 m/s and 17 m/s, gradually slowing and increasing in plume diameter as more ambient water is entrained. The diameter of the central cone of rising water and oil at the point of surfacing is predicted to be approximately 16 m for both scenarios.

The ongoing nature of the release combined with the potential for the plume to breach the water surface may present other hazards, including conditions that may lead to high local concentrations of atmospheric volatiles. These issues should be considered when evaluating the practicality of response operations at or near the blowout site. The results suggest that beyond the immediate vicinity of the blowout the majority of the released hydrocarbons will be present in the upper layers of the ocean, with the potential for oil to form floating slicks under sufficiently calm local wind conditions.

Marine diesel

Marine Diesel Oil is typically classed as an International Tanker Owners Pollution Federation (ITOPF) Group I/II oil. Marine diesel is a mixture of volatile and persistent hydrocarbons with low proportions of highly volatile and residual components. In general, about 6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 35% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 54% should evaporate over several days (265 °C < BP < 380 °C). Approximately 5% of the oil is shown to be persistent. The aromatic content of the oil is approximately 3%.

If released in the marine environment and in contact with the atmosphere (i.e. surface spill), approximately 41% by mass of this oil is predicted to evaporate over the first couple of days depending upon the prevailing conditions, with further evaporation slowing over time. The heavier (low volatility) components of the oil have a tendency to entrain into the upper water column due to wind-generated waves but can subsequently resurface if wind-waves abate. Therefore, the heavier components of this oil can remain entrained or on the sea surface for an extended period, with associated potential for dissolution of the soluble aromatic fraction.

Under the variable-wind case, where the winds are of greater strength, entrainment of marine diesel into the water column is indicated to be significant. Approximately 24 hours after the spill, around 72% of the oil mass is forecast to have entrained and a further 24% is forecast to have evaporated, leaving only a small proportion of the oil floating on the water surface (<1%). The residual compounds will tend to remain entrained beneath the surface under conditions that generate wind waves (approximately >6 m/s).

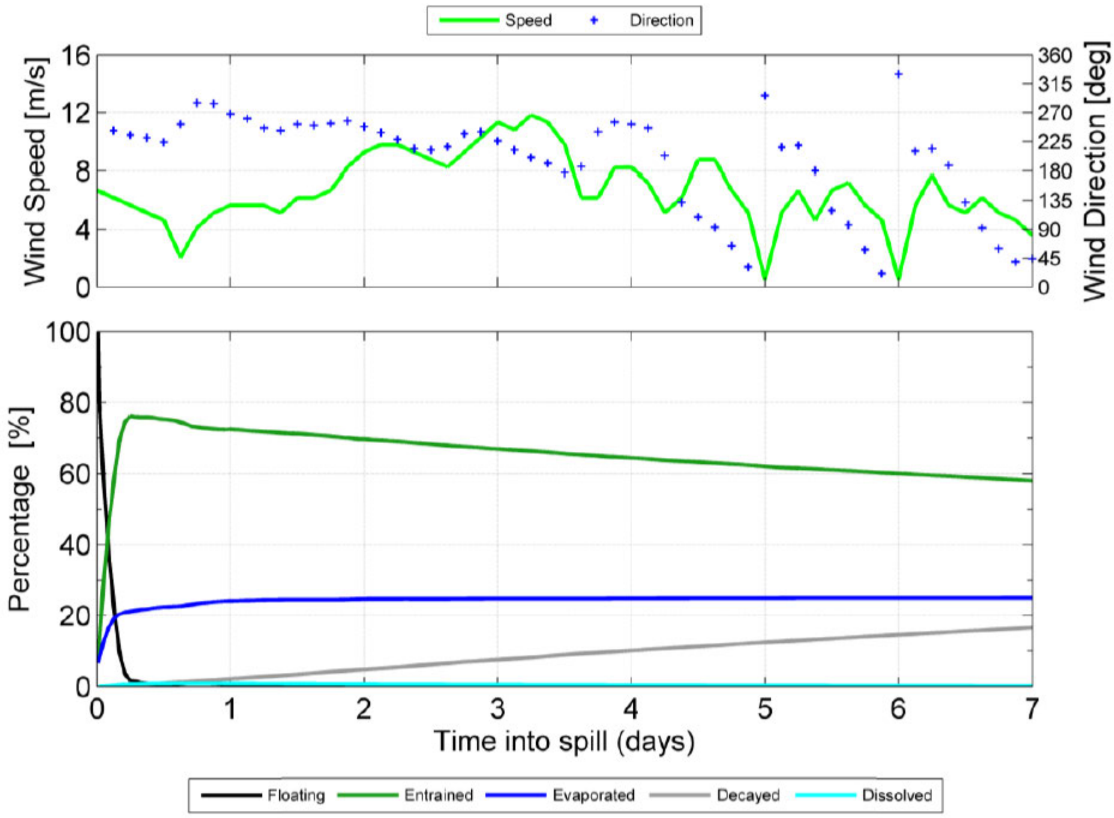


Figure A-3: Proportional mass balance plot representing the weathering of marine diesel spilled onto the water surface as a one-off release (50 m^3 over 1 hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

APPENDIX B – FORMS

Form No.	Form Name	Link
1	Record of Initial Verbal Notification to NOPSEMA Template	Link
2	NOPSEMA Incident Report Form	Link
3	Marine Pollution Report (POLREP – AMSA)	Link
4	AMOSC Service Contract Note	Link
5	Marine Pollution Report (POLREP – DoT)	Link
6a	OSRL Initial Notification Form	Link
6b	OSRL Mobilisation Activation Form	Link
7	RPS APASA Oil Spill Trajectory Modelling Request	Link
8	Aerial Surveillance Observer Log	Link

FORM 1

Record of initial verbal notification to NOPSEMA

(NOPSEMA ph: 1300 674 472)

Date of call	
Time of call	
Call made by	
Call made to	

Information to be provided to NOPSEMA:

Date and Time of incident/time caller became aware of incident	
Details of incident	1. **Location** ________ 2. **Title** ________ 3. **Hydrocarbon source** □ **Platform** ________ □ **Pipeline** ________ □ **FPSO** ________ □ **Exploration drilling** ________ □ **Well** ________ □ **Other (please specify)** ________ 4. **Hydrocarbon type** ________ 5. **Estimated volume of hydrocarbon** ________ 6. **Has the discharge ceased?** ________ 7. **Fire, explosion or collision?** ________ 8. **Environment Plan(s)** ________ 9. **Other Details** ________

Actions taken to avoid or mitigate environmental impacts	
Corrective actions taken or proposed to stop, control or remedy the incident	

After the initial call is made to NOPSEMA, please send this record as soon as practicable to:

1. **NOPSEMA** **submissions@nopsema.gov.au**
2. **NOPTA** **resources@nopta.gov.au**
3. **DMIRS** **petreps@dmirs.wa.gov.au**

FORM 2

[for exploration/development activities]
[insert NOPSEMA Incident Report Form when printing]
Link

FORM 3

[insert Marine Pollution Report (POLREP – AMSA) when printing]

Link

FORM 4

[insert AMOSC Service Contract note when printing]
Link

FORM 5

[insert Marine Pollution Report (POLREP – DoT) when printing]

Link

FORM 6a

[insert OSRL Initial Notification Form when printing]
Link

FORM 6b

[insert OSRL Mobilisation Activation Form when printing]
Link

FORM 7

[insert RPS APASA Oil Spill Trajectory Modelling Request form when printing]
Link

FORM 8

[insert Aerial Surveillance Observer Log when printing]

Link

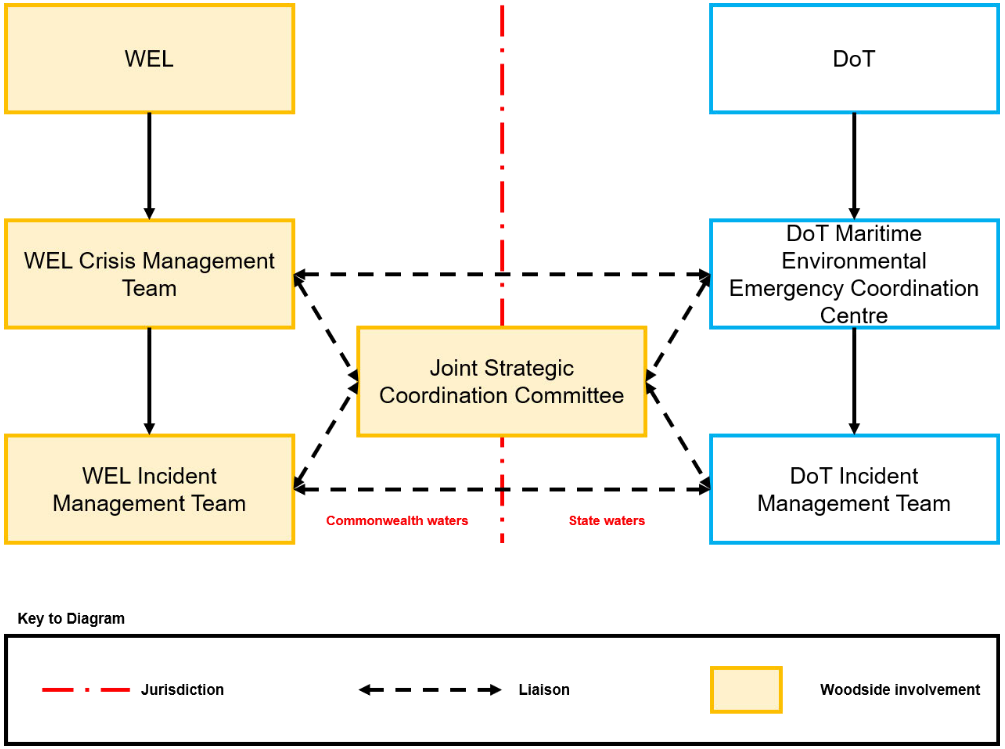
APPENDIX C – 7 QUESTIONS OF SPILL ASSESSMENT

WHAT IS IT? **Oil Type/name** **Oil properties** **Specific gravity / viscosity / pour point / asphphaltines / wax content / boiling point**	
WHERE IS IT? Lat/Long Distance and bearing	
HOW BIG IS IT? Area Volume	
WHERE IT IS GOING? Weather conditions Currents and tides	
WHAT IS IN THE WAY? Resources at risk	
WHEN WILL IT GET THERE? Weather conditions Currents and tides	
WHAT'S HAPPENING TO IT? Weathering processes	

APPENDIX D – TRACKING BUOY DEPLOYMENT INSTRUCTIONS

(Insert Link when printing)

APPENDIX E – COORDINATION STRUCTURE FOR A CONCURRENT HYDROCARBON SPILL IN BOTH COMMONWEALTH AND STATE WATERS/SHORELINES[5]

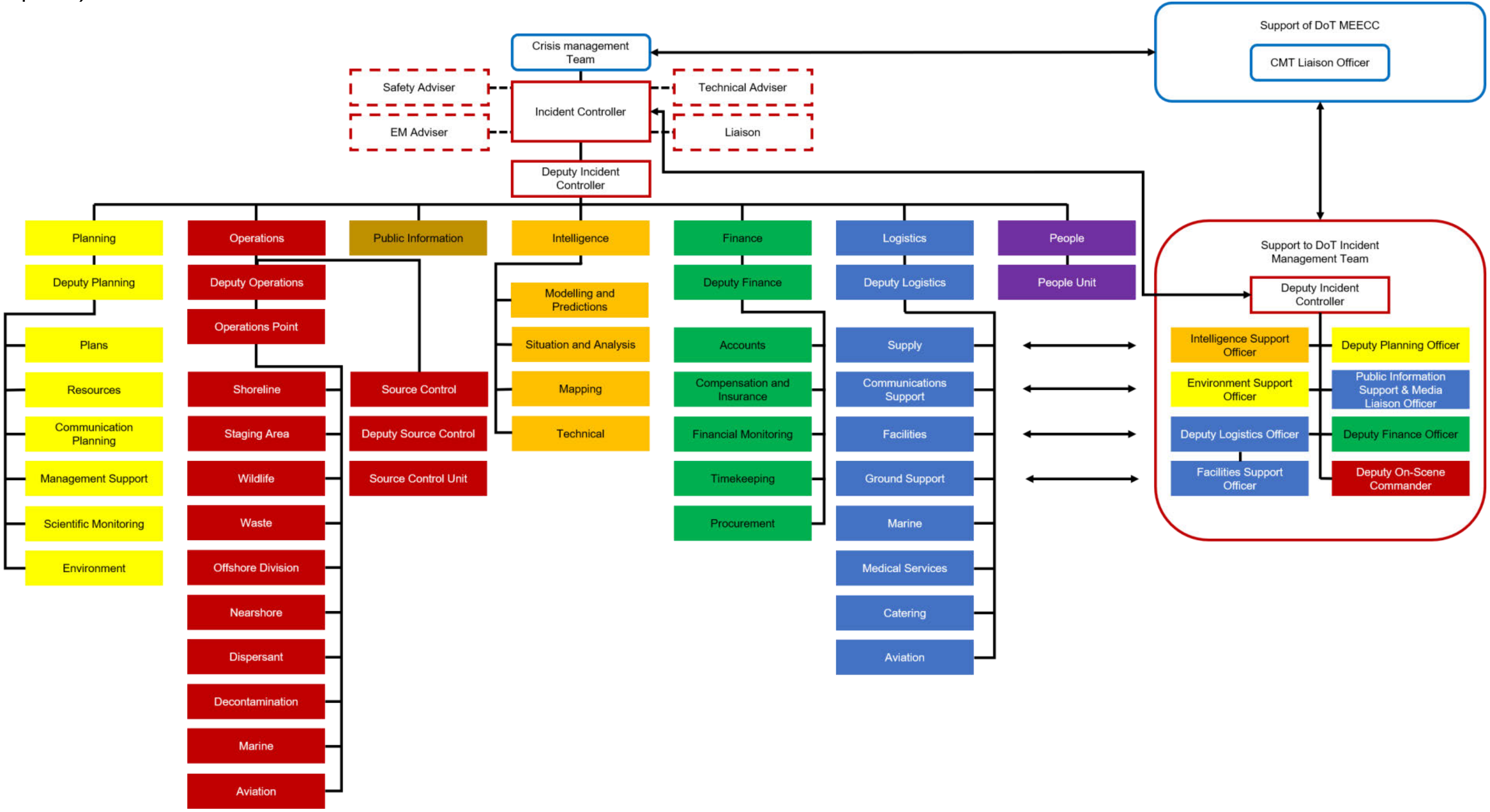


The Control Agency for a hydrocarbon spill in Commonwealth waters/shorelines resulting from an offshore petroleum activity is Woodside (the Petroleum Titleholder). The Control Agency for a hydrocarbon spill in State waters/shorelines resulting from an offshore petroleum activity is DoT. DoT will appoint an Incident Controller and form a separate IMT to only manage the spill within State waters/shorelines.

[5] Adapted from DoT Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangements July 2020. Note: For full structure up to Commonwealth Cabinet/Minister refer to Marine Oil Pollution: Response and Consultation Arrangements Section 6.5, Figure 3.

APPENDIX F – WOODSIDE INCIDENT MANAGEMENT STRUCTURE

Woodside Incident Management Structure for Hydrocarbon Spill (including Woodside Liaison Officers Command Structure within DoT IMT if required).



APPENDIX G – WOODSIDE LIASON OFFICER RESOURCES TO DOT

Once DoT activates a State waters/shorelines IMT, Woodside will make available the following roles to DoT.

Area	WEL Liaison Role	Personnel Sourced from[6]:	Key Duties	#
DoT MEECC	CMT Liaison Officer	CMT Duty Managers Roster	• Provide a direct liaison between the CMT and the MEECC. • Facilitate effective communications and coordination between the CMT Leader and SMEEC. • Offer advice to SMEEC on matters pertaining to PT crisis management policies and procedures.	1
DoT IMT Incident Control	WEL Deputy Incident Controller	CICC Duty Managers Reserve List Roster	• Provide a direct liaison between the PT IMT and DoT IMT. • Facilitate effective communications and coordination between the PT IC and the DoT IC. • Offer advice to the DoT IC on matters pertaining to PT incident response policies and procedures. • Offer advice to the Safety Coordinator on matters pertaining to PT safety policies and procedures, particularly as they relate to PT employees or contractors operating under the control of the DoT IMT.	1
DoT IMT Intelligence	Intelligence Support Officer/ Deputy Intelligence Officer	AMOSC Staff Member or AMOSC Core Group	• As part of the Intelligence Team, assist the Intelligence Officer in the performance of their duties in relation to situation and awareness. • Facilitate the provision of relevant modelling and predications from the PT IMT. • Assist in the interpretation of modelling and predictions originating from the PT IMT. • Facilitate the provision of relevant situation and awareness information originating from the DoT IMT to the PT IMT. • Facilitate the provision of relevant mapping from the PT IMT. • Assist in the interpretation of mapping originating from the PT IMT. • Facilitate the provision of relevant mapping originating from the DoT IMT to the PT IMT.	1
DoT IMT Intelligence – Environment	Environment Support Officer	CMT Environmental FST Duty Managers Roster	• As part of the Intelligence Team, assist the Environment Coordinator in the performance of their duties in relation to the provision of environmental support into the planning process. • Assist in the interpretation of the PT OPEP and relevant TRP plans. • Facilitate in requesting, obtaining and interpreting environmental monitoring data originating from the PT IMT. • Facilitate the provision of relevant environmental information and advice originating from the DoT IMT to the PT IMT.	1
DoT IMT Planning-Plans/ Resources	Deputy Planning Officer	AMOSC Core Group/CICC Planning Coordinator Reserve List and Planning Group 3	• As part of the Planning Team, assist the Planning Officer in the performance of their duties in relation to the interpretation of existing response plans and the development of incident action plans and related sub plans. • Facilitate the provision of relevant IAP and sub plans from the PT IMT. • Assist in the interpretation of the PT OPEP from the PT.	1

[6] See Combined CICC, KICC, CMT roster and Preparedness Schedule Link / AMOSC Service Contract Link

Area	WEL Liaison Role	Personnel Sourced from[6]:	Key Duties	#
			• Assist in the interpretation of the PT IAP and sub plans from the PT IMT. • Facilitate the provision of relevant IAP and sub plans originating from the DoT IMT to the PT IMT. • Assist in the interpretation of the PT existing resource plans. • Facilitate the provision of relevant components of the resource sub plan originating from the DoT IMT to the PT IMT. **(Note this individual must have intimate knowledge of the relevant PT OPEP and planning processes)**	
DoT IMT Public Information- Media/ Community Engagement	Public Information Support and Media Liaison Officer/ Deputy Public Information Officer	CMT Reputation {Media} FST Duty Manager Roster	• As part of the Public Information Team, provide a direct liaison between the PT Media team and DoT IMT Media team. • Facilitate effective communications and coordination between the PT and DoT media teams. • Assist in the release of joint media statements and conduct of joint media briefings. • Assist in the release of joint information and warnings through the DoT Information and Warnings team. • Offer advice to the DoT Media Coordinator on matters pertaining to PT media policies and procedures. • Facilitate effective communications and coordination between the PT and DoT Community Liaison teams. • Assist in the conduct of joint community briefings and events. • Offer advice to the DoT Community Liaison Coordinator on matters pertaining to the PT community liaison policies and procedures. • Facilitate the effective transfer of relevant information obtained from through the Contact Centre to the PT IMT.	1
DoT IMT Logistics	Deputy Logistic Officer	CMT Services FST Logistics Team 2 Roster	• As part of the Logistics Team, assist the Logistics Officer in the performance of their duties in relation to the provision of supplies to sustain the response effort. • Facilitate the acquisition of appropriate supplies through the PTs existing OSRL, AMOSC and private contract arrangements. • Collects Request Forms from DoT to action via PT IMT. **(Note this individual must have intimate knowledge of the relevant PT logistics processes and contracts)**	1
DoT IMT Finance- Accounts/	Deputy Finance Officer	CICC Finance Coordinator Roster	• As part of the Finance Team, assist the Finance Officer in the performance of their duties in relation to the setting up and payment of accounts for those services acquired through the PTs existing OSRL, AMOSC and private contract arrangements. • Facilitate the communication of financial monitoring information to the PT to allow them to track the overall cost of the response.	1

Area	WEL Liaison Role	Personnel Sourced from[6]:	Key Duties	#
Financial Monitoring			• Assist the Finance Officer in the tracking of financial commitments through the response, including the supply contracts commissioned directly by DoT and to be charged back to the PT.	
DoT IMT Operations	Deputy Operations Officer	CICC Operations Coordinator Roster	• As part of the Operations Team, assist the Operations Officer in the performance of their duties in relation to the implementation and management of operational activities undertaken to resolve an incident. • Facilitate effective communications and coordination between the PT Operations Section and the DoT Operations Section. • Offer advice to the DoT Operations Officer on matters pertaining to PT incident response procedures and requirements. • Identify efficiencies and assist to resolve potential conflicts around resource allocation and simultaneous operations of PT and DoT response efforts.	1
DoT IMT Operations – Waste Management	Facilities Support Officer/ Deputy Waste Management Coordinator	CMT Services FST Logistics Team 2 and WEL Waste Contractor Roster	• As part of the Operations Team, assist the Waste Management Coordinator in the performance of their duties in relation to the provision of the management and disposal of waste collected in State waters. • Facilitate the disposal of waste through the PT's existing private contract arrangements related to waste management and in line with legislative and regulatory requirements. • Collects Request Forms from DoT to action via PT IMT.	1
DoT FOB Operations Command	Deputy On-Scene Commander/ Deputy Division Commander	AMOSC Core Group	• As part of the Field Operations Team, assist the Division Commander in the performance of their duties in relation to the oversight and coordination of field operational activities undertaken in line with the IMT Operations Section's direction. • Provide a direct liaison between the PT FOB and DoT FOB. • Facilitate effective communications and coordination between the PT Division Commander and the DoT Division Commander. • Offer advice to the DoT Division Commander on matters pertaining to PT incident response policies and procedures. • Assist the Safety Coordinator deployed in the FOB in the performance of their duties, particularly as they relate to PT employees or contractors. • Offer advice to the Safety Coordinator deployed in the FOB on matters pertaining to PT safety policies and procedures.	1
			Total Woodside personnel initially required in DoT IMT	11

DOT LIAISON OFFICER RESOURCES TO WOODSIDE

Once DoT activates a State waters/shorelines IMT, Woodside will request DoT make available the following roles:

Area	DoT Liaison Role	Personnel Sourced from:	Key Duties	#
WEL CMT	DoT Liaison Officer (prior to DoT assuming Controlling Agency) / Deputy Incident Controller – State waters (after DoT assumes Controlling Agency)	DoT	• Facilitate effective communications between DoT's SMEEC / Incident Controller and the Petroleum Titleholder's appointed CMT Leader / Incident Controller. • Provide enhanced situational awareness to DoT of the incident and the potential impact on State waters. • Assist in the provision of support from DoT to the Petroleum Titleholder. • Facilitate the provision technical advice from DoT to the Petroleum Titleholder Incident Controller as required.	1
WEL Reputation FST (Media Room)/ Public Information – Media	DoT Media Liaison Officer	DoT	• Provide a direct liaison between the PT Media team and DoT IMT Media team. • Facilitate effective communications and coordination between the PT and DoT media teams. • Assist in the release of joint media statements and conduct of joint media briefings. Assist in the release of joint information and warnings through the DoT Information and Warnings team. • Offer advice to the PT Media Coordinator on matters pertaining to DoT and wider Government media policies and procedures.	1
			Total DoT Personnel Initial Requirement to Woodside	2