Goodwyn Alpha (GWA) Facility Operations Environment Plan

Production Division

August 2021

Revision 10

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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 1.6**, is operator of the Goodwyn Alpha (GWA) facility. The GWA facility commenced operation in 1995. Well fluids are recovered from a series of fields via wells, pipelines and subsea infrastructure, which are processed by the GWA facility. The following activities are proposed to occur within Permit Area WA-23-L, WA-5-L, WA-57-L, WA-6-L, WA-1-L, WA-24-L, WA-2-PL, WA-9-PL, WA-13-PL, WA-27-PL and WA-24-PL:

- routine production and associated activities
- routine inspection, monitoring, maintenance and repair (IMMR) of the platform and associated subsea infrastructure
- well clean up and commissioning
- platform well intervention, unloading, workovers and well kill activities.

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 the 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). In accordance with the requirements of Regulation 17 (5) of the Environment Regulations, Woodside has revised the GWA Operations EP to incorporate the operation of the Greater Western Flank-3 subsea infrastructure as a new stage.

1.2 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 (as defined in Section 3A of the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (Cth) (*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 (EPOs), standards (EPSs), and measurement criteria (MC). 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.

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1.3 Scope of the Environment Plan

The scope of this EP covers the activities that define the Petroleum Activities Program, as described in Section 3, for a period of up to five years. The Operational Area, as defined in **Section 3.3**, defines the spatial boundary of the Petroleum Activities Program.

This EP addresses potential environmental impacts from planned activities and potential unplanned risks that originate from within the Operational Area. Transit to and from the Operational Area by 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 applicable maritime regulations and other requirements and are not managed by this EP.

1.4 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**
A description of the receiving environment	**Section 4**
A description of the activity	**Section 3**
Details of the environmental impacts and risks	**Section 6**
The control measures for the activity	**Section 6**
The arrangements for ongoing monitoring of the titleholder's environmental performance	**Section 7.6**
Response arrangements in the oil pollution emergency plan (OPEP)	**Section 7.9**
Consultation already undertaken and plans for ongoing consultation	**Section 5**
Details of the titleholder's nominated liaison person for the activity	**Section 1.7.2**

1.5 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 relevant section of 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**

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Criteria for acceptance	Content Requirements/Relevant Regulations	Elements	Section of EP
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	EPOs EPSs 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 • 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 part of a declared World Heritage property within the meaning of the EPBC Act	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: (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	No activity, or part of the activity, undertaken in any part of a declared World Heritage property	**Section 3** **Section 4** **Section 6**

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Criteria for acceptance	Content Requirements/Relevant Regulations	Elements	Section of EP
	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 7.8**

1.6 Description of the Titleholder

Woodside is the Titleholder for this activity, on behalf of a Joint Venture including Woodside Energy Ltd, BP Developments Australia Pty Ltd, BHP 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 is Australia's leading natural gas producer. Woodside's operations are characterised by strong safety and environmental performance in remote and challenging locations. Wherever Woodside works, it is committed to living its values of integrity, respect, working together, ownership, sustainability and courage.

Since 1984 the company has been operating, on behalf of the Joint Venture, the landmark Australian project, the North West Shelf (NWS), which is one of the world's premier liquefied natural gas (LNG) 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. Further information about Woodside can be found at http://www.woodside.com.au.

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1.7 Details of Titleholder, Liaison Person and Public Affairs Contact

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

1.7.1 Titleholder

Woodside Energy Limited

11 Mount Street

Perth, Western Australia

T: 08 9348 4000

ACN: 63 005 482 986

1.7.2 Nominated Liaison Person

Shannen Wilkinson

Senior Corporate Affairs Adviser

11 Mount Street

Perth, Western Australia

T: 08 9348 4000

E: feedback@woodside.com.au

1.7.3 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.

1.8 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.

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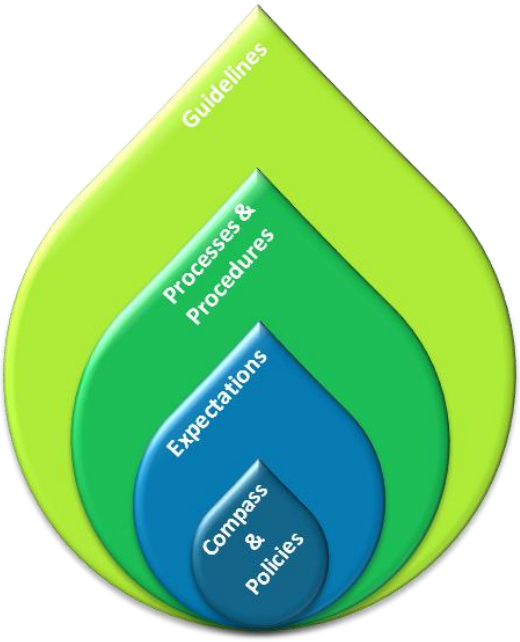

Figure 1-1: The four major elements of the WMS Seed

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.

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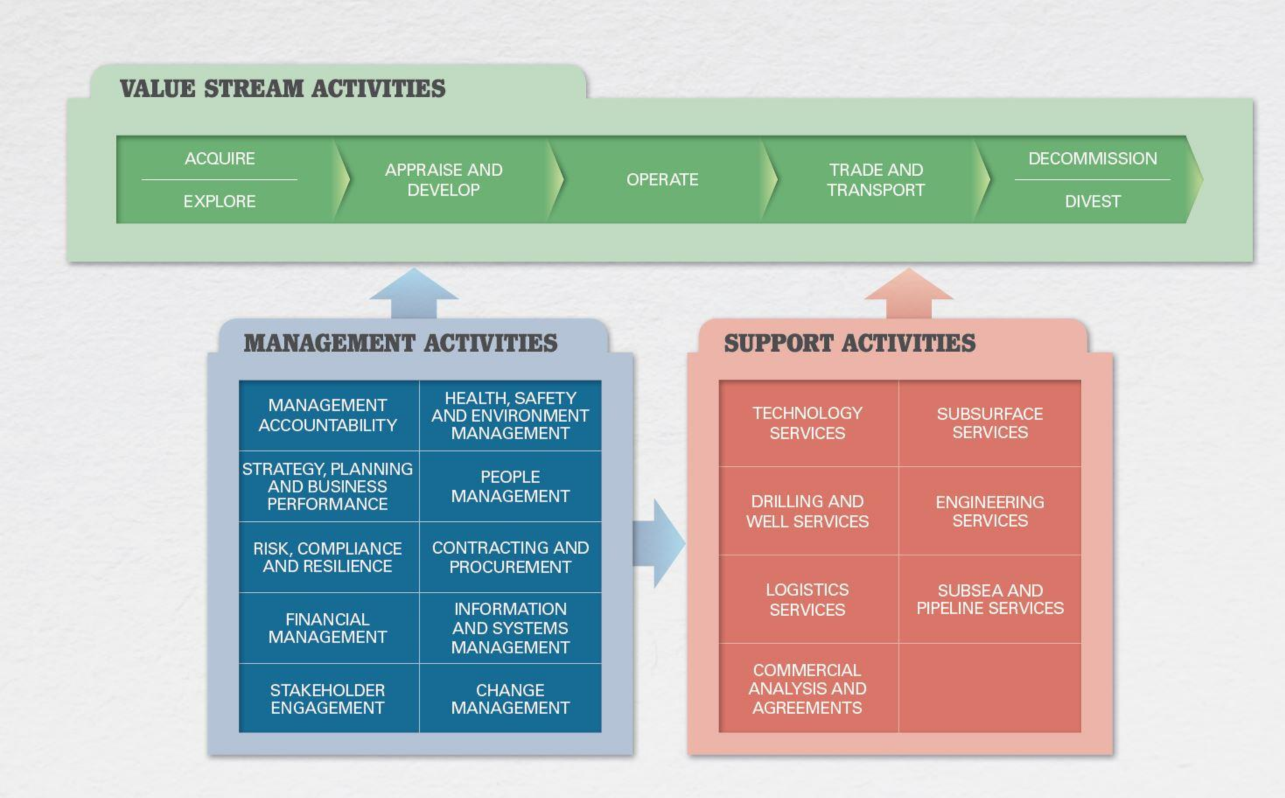

Figure 1-2: The WMS business process hierarchy

1.8.1 Health, Safety and Environment Policy

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

1.9 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 Western Australia (WA) *Environment Protection Act 1986* as the activity does not occur on State land or within State Waters.

1.9.1 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 at 200 nm.

The relevant requirements in Section 572 of the OPGGS Act are detailed in **Table 1-3**.

Table 1-3: Relevant requirements of the OPGGS Act 2006

Section Number	Relevant Requirement	Relevant Section of the EP
Section 572 - Maintenance and removal of property etc. by titleholder		
2	A titleholder must maintain in good condition and repair all structures that are, and all equipment and other property that is: (a) in the title area; and	**Section 3.10**

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Section Number	Relevant Requirement	Relevant Section of the EP
	(b) used in connection with the operations authorised by the permit, lease, licence or authority.	
3	A titleholder must remove from the title area all structures that are, and all equipment and other property that is, neither used nor to be used in connection with the operations: (a) in the title area; and (b) used in connection with the operations authorised by the permit, lease, licence or authority.	**Section 3.5 and 7**

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 ecological sustainable development
- 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.

1.9.2 Environment Protection and Biodiversity Conservation Act 1999 (Cth)

One of the objectives EPBC Act is to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places in Australia. These are defined under Part 3 of the Act as “Matters of National Environmental Significance” (MNES). The EPBC Act sets a regime which aims to ensure actions taken on (or impacting upon) Commonwealth land or waters are consistent with the principles of ecological sustainable development. 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.

In relation to offshore petroleum activities in Commonwealth waters, in accordance with the “Streamlining Offshore Petroleum Approvals Program” (the Program), requirements under the EPBC Act are now administered by NOPSEMA, commencing February 2014. The Program requires any offshore petroleum activities, authorised by the OPGGS Act to be conducted in accordance with an accepted EP. The definition of ‘environment’ in the Program covers all matters protected under Part 3 of the EPBC Act.

1.9.2.1 Offshore Project

The GWA facility commenced operations in 1995 and subsequent tie-ins have been referred for assessment under the EPBC Act. These include the following:

- Echo Yodel Development (2000/11), the decision by the Environment Minister approved the action with conditions.
- Perseus over Goodwyn Development (2004/1326), the decision by the Environment Minister determined the action is not a controlled action.
- Greater Western Flank (GWF) Phase 1 Gas Development (2011/5980) the decision by the Environment Minister determined the action is not a controlled action if undertaken in a particular manner.
- Greater Western Flank 2 and 3 were included in the Greater Western Flank Gas Development (2005/2464), the decision by the Environment Minister determined the action is not a controlled action.

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1.9.2.2 Recovery Plans and Threat Abatement Plans

Under s139(1)(b) of the EPBC Act, the Environment Minister must not act inconsistently with a recovery plan for a listed threatened species or ecological community or a threat abatement plan for a species or community protected under the Act. Similarly, under s268 of the EPBC Act:

“A Commonwealth agency must not take any action that contravenes a recovery plan or a threat abatement plan.”

In relation to offshore petroleum activities in Commonwealth waters, these requirements are now administered by NOPSEMA in accordance with commitments set out in the Programs. Relevant recovery plans or threat abatement plans relevant to the scope of this EP have been identified as described in **Section 2.9** and assessed in **Section 6.9.**

1.9.2.3 Australian Marine Parks

Under the EPBC Act, Australian Marine Parks (AMPs), formally known as Commonwealth Marine Reserves, 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), and is required to publish management plans for them. Other parts of the Commonwealth Government must not perform functions or exercise powers in relation to these parks that are inconsistent with management plans (s362 of the EPBC Act). Relevant AMPs are listed in **Section 4.8** and described in **Appendix C, Section 10.5**. The North-west Marine Parks Network Management Plan describes the requirements for management.

1.9.2.4 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**.

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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: • identify the World Heritage values of the property that are likely to be affected by the action; and • examine how the World Heritage values of the property might be affected; and • 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.

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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 EPOs and 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 EP to include details of the environmental impacts and risks for the Petroleum Activities Program, and an evaluation of all the impacts and risks, appropriate to the nature and scale of each impact and risk. The objective of the risk assessment process described in this section is to identify risks and associated impacts of an activity, so they can 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 inherent potential to cause environmental impacts
- **Environmental risks** are unplanned events with the potential for environmental impact (termed risk 'consequence').

In this section, potential impacts from planned activities are termed 'impacts', and 'risks' are associated with unplanned events with the potential for environmental impact (should the risk be realised), with such impacts 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 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 Organization for Standardization (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 (PSM) 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

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in **Figure 2-1**. A description of each step and how it is applied to the scopes of this activity is provided in **Section 2.2** to **Section 2.11**.

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.

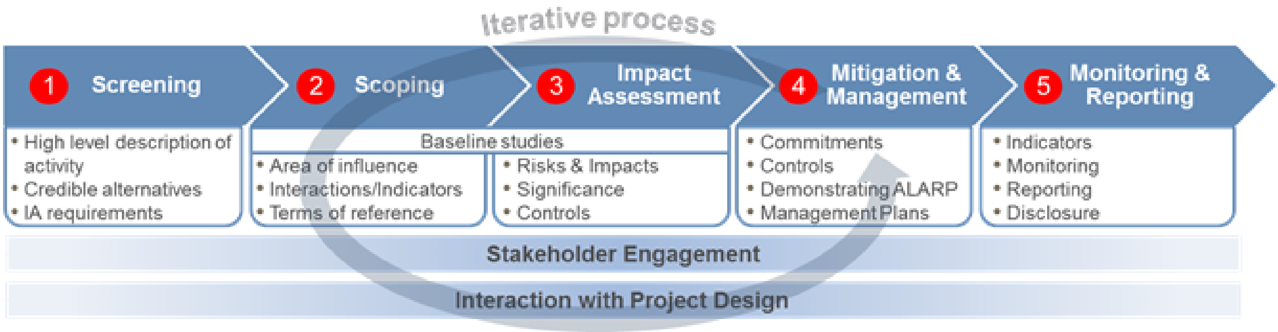

Figure 2-2: Woodside's impact assessment process

2.2.4 Process Safety Management Procedure and Process Safety Risk Assessment Procedure

Due to the nature and scale of petroleum activities, Woodside's PSM Procedure establishes Woodside's framework for PSM (**Section 7.1.2**). This framework includes the Process Safety Risk Assessment Procedure (PSRA). The PSRA is a key part of Woodside's PSM framework for

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managing the integrity of systems and processes that handle hazardous substances over the exploration and production lifecycle. The PSRA sets out methods to ensure that process safety risks are understood and controlled, including that all process safety hazards are systematically identified, assessed and treated so that the associated risks are reduced to a level that is tolerable and ALARP.

2.3 Environment Plan Development Process

The EP development process is illustrated in **Figure 2-3**. Each element of this process is discussed further in **Section 2.5** to **Section 2.10**.

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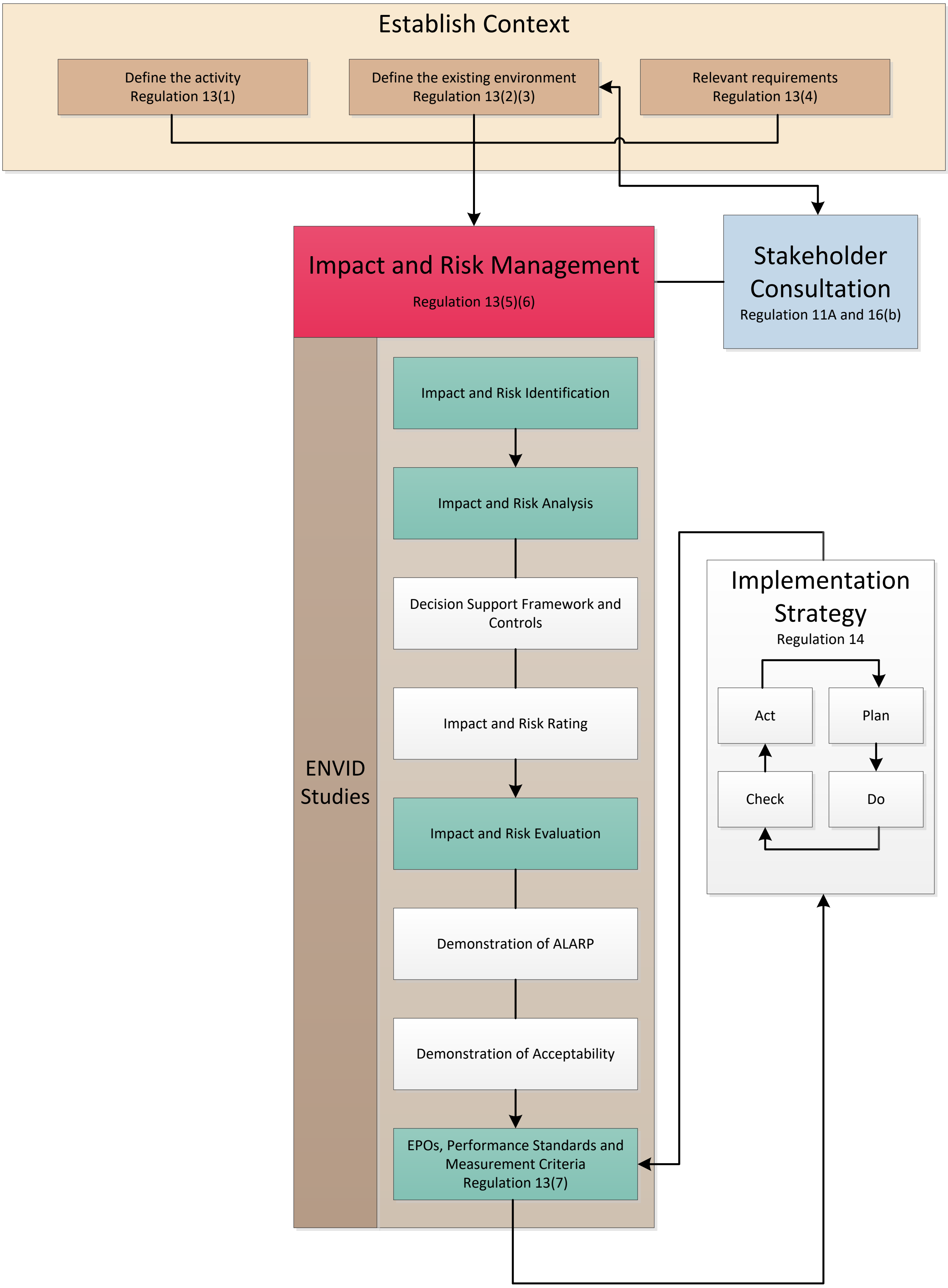

Figure 2-3: Environment Plan Development Process

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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'[1] 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[2] events.

The Existing Environment (Section 4) is structured into subsections defining the physical, biological, socio-economic 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 6.8**. MNES, as defined under 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

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

[2] *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 and in turn provides context to the 'nature and scale' of the existing environment.*

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consistently applied to the risk evaluation section to provide a robust approach to the overall environmental risk evaluation and its documentation in the EP.

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	Socio-economic

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 and reviewed and are presented in **Appendix B**.

The Corporate Health, Safety and Environment 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 environmental risk identification studies (e.g. HAZID/ENVID), consequence modelling studies for high consequence, low probability environmental risks, bowtie risk assessments for Major Environmental Events (MEEs) as required by Woodside's PSRA processes, desktop reviews and 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.

An environmental impacts and risks identification and assessment workshop was undertaken by multidisciplinary teams comprising relevant 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 workshop, 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.

Impacts and risks were evaluated and tabulated for each planned activity and unplanned events respectively. Environmental impacts and risks were recorded in an environmental impacts and risk register. The output of the workshop is used to present the risk assessment and form the basis of EPOs, EPSs, and MC. This information is presented in **Section 6**, following the format presented in **Table 2-2**.

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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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
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 2.8.2**), 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 is integrated into the environmental impacts and risks identification and assessment workshop 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 impact and risk register 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.

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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 utilise 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.

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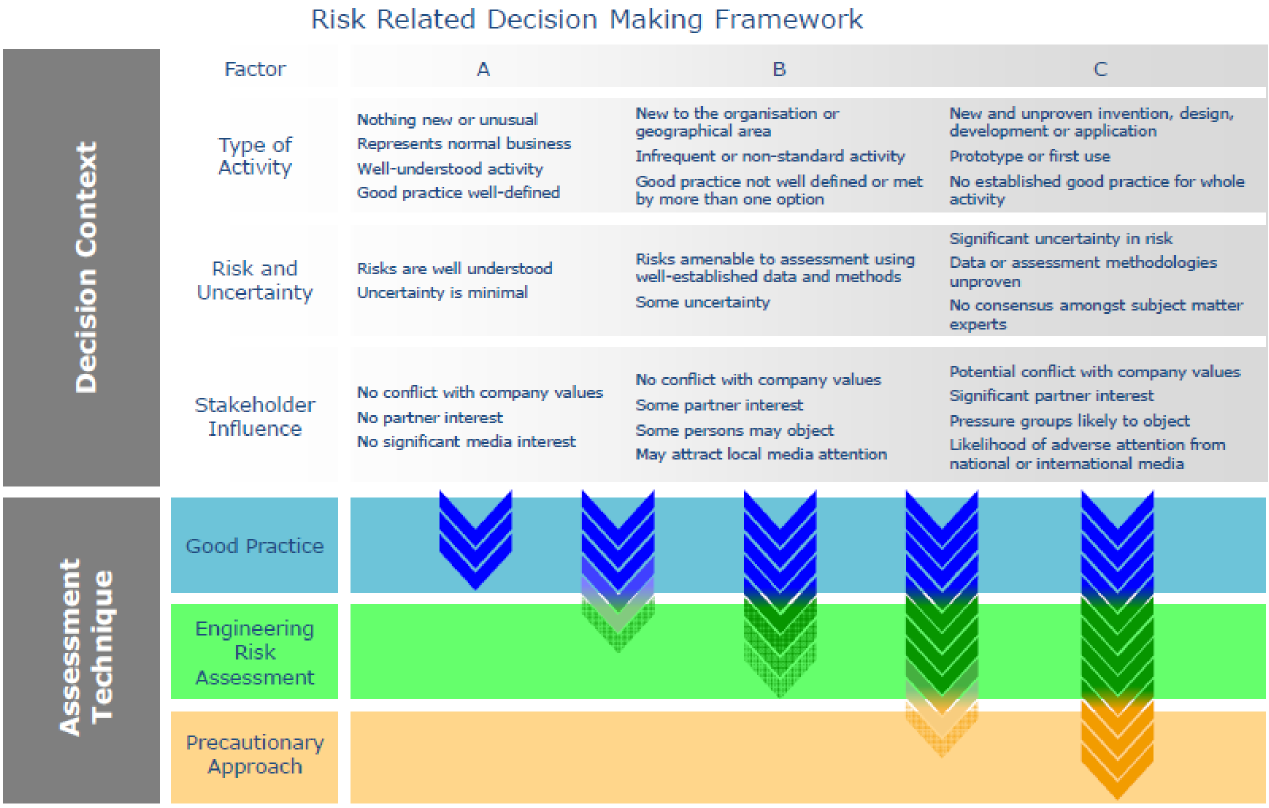

Figure 2-4: Risk-related Decision-making Framework (Oil and Gas UK, 2014)

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.

2.6.1.4.1 Decision Calibration

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

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- **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 (**Figure 2-5**).

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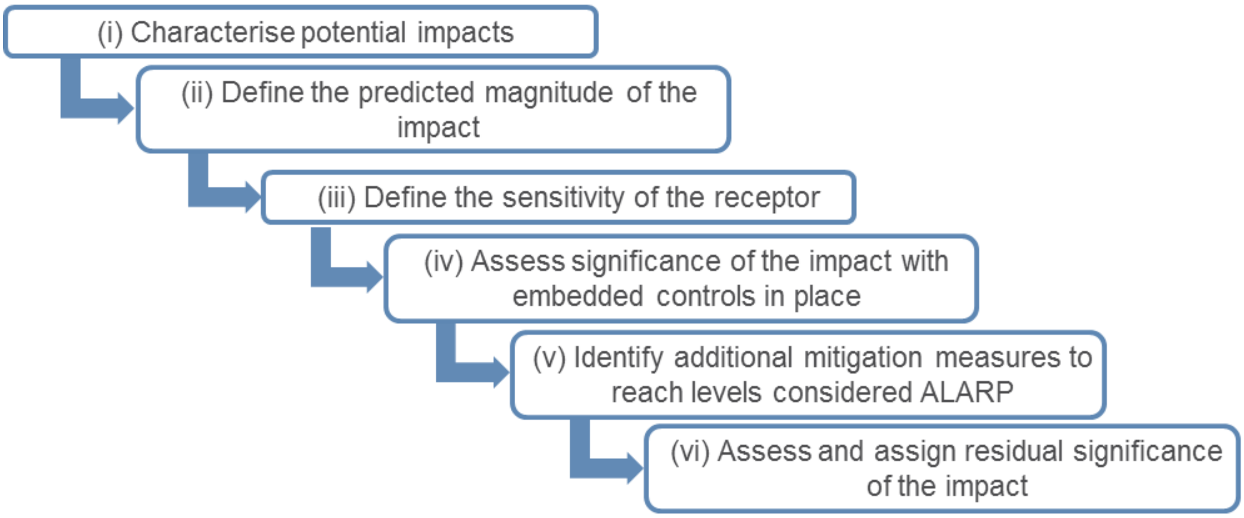

Figure 2-5: Environmental Risk and Impact Analysis

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.

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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 undertaken using the steps described in the subsections below.

2.6.3.1.1 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.

2.6.3.1.2 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 1,000–10,000 years	1 in 100–1,000 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**

2.6.3.1.3 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.

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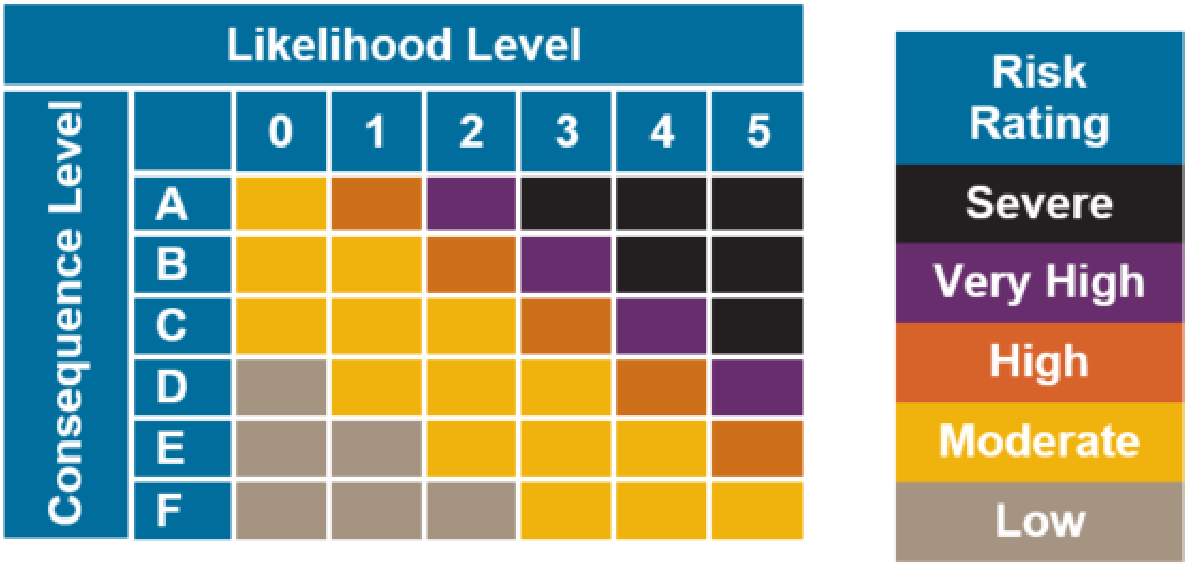

Figure 2-6 : Woodside Risk Matrix – Risk Level

To support ongoing risk management (as a key component of Woodside's PSM 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 ensure the continual management of risk to ALARP by identifying risk reduction measures and assessing acceptability.

2.7 Classification and Analysis of Major Environment Events

For Woodside's production facilities, a further level of analysis is undertaken to identify, classify and analyse MEEs. This extra level of rigour is applied to ensure sufficient controls are in place for risks with potential Level B and above consequences. In the health and safety area, Major Accident Events (MAEs) are identified using a similar process, which supports consistency in managing key risks within Woodside in accordance with Process Safety Risk Management Procedures.

Woodside defines a MEE as an event with potential environment, reputation (pertaining to environment events), social or cultural consequences of level B or higher as per Woodside's Risk Matrix (**Figure 2-6**). MEEs are evaluated against credible worst-case scenarios that may occur when all controls are absent or have failed.

2.7.1 Major Environment Event Identification

The ENVID process identifies numerous sources of risk with differing consequence levels. These risks are screened for those risk events that meet the MEE criteria, and MEE risks are analysed further through detailed consequence modelling and probability/ frequency studies and examined for 'appropriateness' of controls in a bowtie risk assessment.

Risks that do not meet the MEE definition, although screened out of the MEE process, are still evaluated for ALARP and risk acceptability using the methodology described in **Section 2.8**. Some high consequence/low probability events which do not meet the MEE consequence threshold may still undergo additional consequence and probability assessment where they could have a high adverse impact on the company's reputation or relationships with stakeholders, beyond requirement to demonstrate ALARP and acceptable risk levels following application of controls.

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2.7.2 MEE Classification

A standard naming convention has been established for MEEs which is based around ensuring the MEE titles reflect the cause of the event (e.g. 'subsea system loss of containment') rather than the event itself (e.g. significant hydrocarbon spill to the marine environment). The MEEs are assigned a unique identification code (e.g. MEE-01, MEE-02, etc).

2.7.3 Bowtie Analysis

MEEs are subject to more detailed analysis using the bowtie risk assessment technique, which illustrates cause outcome pathways for each MEE and controls in place to prevent the 'top event' or mitigate the consequences (outcomes). The key drivers for adopting the bowtie technique for MEEs are that it:

- identifies the controls (prevention and mitigation barriers) necessary to ensure the risk is acceptable and ALARP
- supports the process of demonstrating ALARP (described in **Section 2.8.1**)
- enables verification of and linking to the relevant sections of the WMS that supports barriers
- improves the capacity for lessons learnt and incident prevention by being able to directly relate causes of an incident to those controls that failed
- ensures greater visibility and granularity in the assessment process and enables complex risk scenarios to be presented in an easy to understand format.

The bowtie technique (an example bowtie diagram is shown in **Figure 2-7**) shows the relationships between the 'Causes' that may lead to a particular unwanted event ('Top Event'), together with the range of potential escalation paths that can lead to a variety of 'Outcomes' (or consequences). A bowtie also shows the preventive barriers that may prevent a Top Event from occurring specific to each Cause, and the mitigation barriers in place to limit the potential effects once the Top Event has been realised, specific to each credible MEE Outcome.

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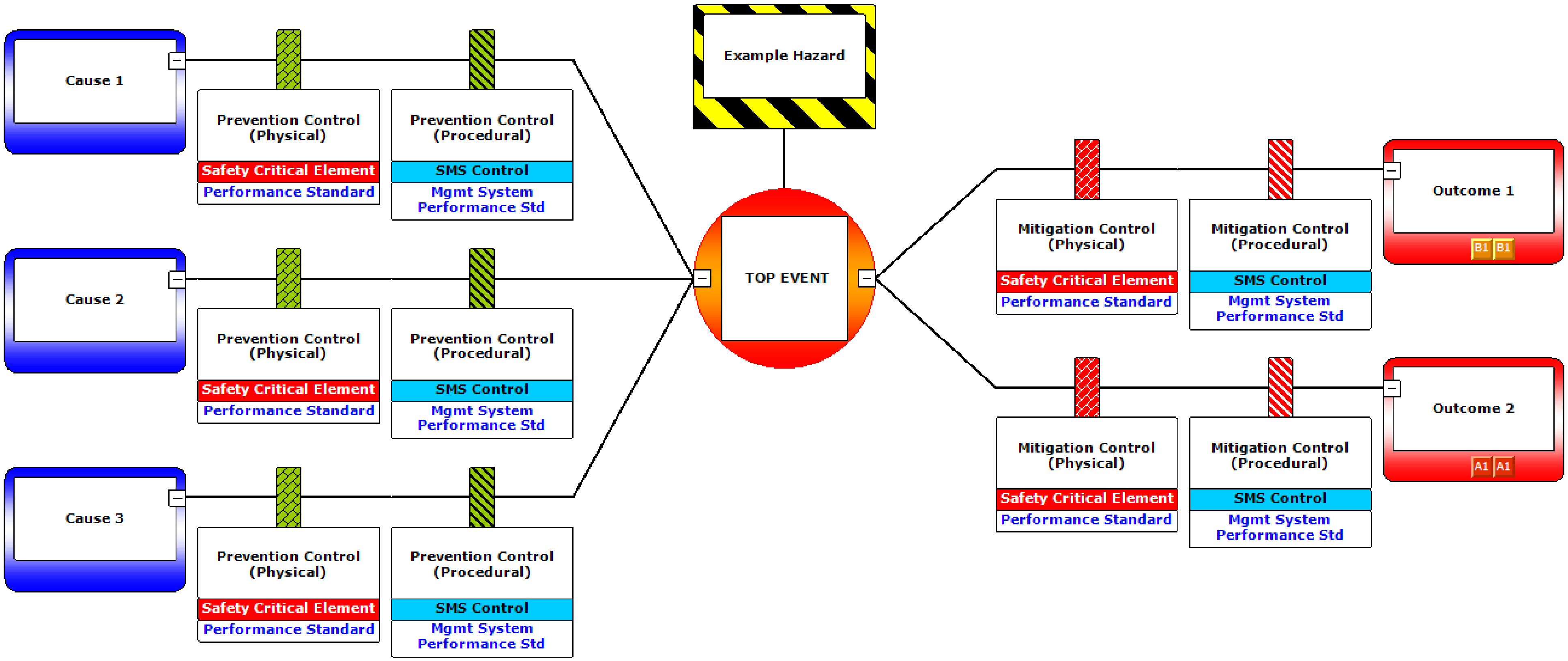

Figure 2-7: Example of Bowtie Diagram Structure

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2.7.4 MEE Register

A MEE Register is prepared for each production facility after completing the bowtie diagrams. The purpose of the MEE Register is to record the MEE identification process, groupings, bowtie diagrams and datasheets in a consolidated format. Datasheets are prepared for each MEE, which summarise the hazard description, hazard management, emergency response, ALARP summary and a list of critical barriers identified on the bowties (known as Safety and Environment Critical Elements (SCEs)).

Potential common causes that contribute to MAEs/MEEs, or that can result in failure or degradation of the controls in place to protect against MAEs/MEEs, include some generic mechanisms of SCE failure and generic human error. These are represented in bowties applicable to multiple MEEs and identified in the MEEs applicable to this EP.

2.7.5 Safety and Environment Critical Elements and Technical Performance Standards

Woodside identifies and manages Safety and Environment Critical Element (SCE) technical and management system performance standards (MSPS) in accordance with PSM Procedures, Risk Management Procedures and Change Management Procedures (further described in the implementation strategy in **Section 7**). SCEs are identified for MAEs and MEEs. An SCE is a hardware control, the failure of which could cause or contribute substantially to, or the purpose of which is to prevent or limit the effect of a MAE, MEE or Process Safety Event. In addition, Woodside defines Safety and Environment Critical Component (SCC) as an item of equipment or structure forming part of a hardware SCE that supports the SCE in achieving the safety function[3].

Once an SCE is identified as an MEE barrier for the operated facility, technical performance requirements are developed for the facility SCE in accordance with the Global SCE Performance Standards and process described in the SCE Management Procedure and form the SCE Facility Performance Standard. Each SCE Performance Standard represents a statement of the performance required of an SCE (e.g. functionality, availability, reliability, survivability). SCE Performance Standard requirements are used to establish agreed assurance tasks for each SCE, support the management of operations within acceptable safety and/or environment risk levels, and ensure continuous management of risk to ALARP. An assurance task is an activity carried out by the operator to confirm that the SCE meets, or will meet, its SCE Performance Standard. Examples of assurance tasks include inspection routines, maintenance activities, test routines, instrumentation calibration, and reliability monitoring.

SCE Facility Performance Standards do not always align directly with EPSs. They are used in conjunction with the WMS to identify and treat potential step-outs from expected controls performance or integrity envelopes and ensure SCE performance can be optimised. Woodside's HSE Event Reporting Guideline describes the process for identifying 'Failure to meet Facility Performance Standard', which is when the SCE does not meet the goal as stated in the relevant Performance Standard. (see **Section 7.1.5**). Situations where SCEs fail to meet Facility Performance Standards represent a potential increase in risk that, if not addressed immediately, have the potential to result in a process safety event, or worsen the consequences of one. Recording SCE Failure to Meet Performance Standard Events into the Event Reporting Database is important to highlight risk, investigate causes, ensure risks are managed and meet potentially applicable external reporting requirements. For applicable SCEs, 'Failure to meet Facility Performance Standard' represent scenarios that may fail to achieve an EPS presented in this EP.

The results of the MEE classification and analysis for GWA operations are presented in **Section 6.8** of this EP. More detail on the SCE and Performance Standards process, and the interrelationships to other parts of the SCE Management Procedures, is described in **Section 7.1.5**.

[3] *Note: Not all individual equipment items that comprise a SCE are safety-critical.*

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2.7.6 Safety-critical Management System Barriers

For each MEE, Safety-critical Management System specific measures are also identified. These are management system components (generally WMS processes) that are key barriers to, or measures for, managing MEEs.

2.8 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 ecological sustainable development – 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.

2.8.1 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 (C, D, E or F 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 (A or B level consequence)	**Moderate and above (C, B or A)**	**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.		

2.8.2 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.

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Table 2-6: Summary of Woodside's Criteria for Acceptability

Risk	Impact	Decision Type
Low and Moderate	**Negligible, Slight, or Minor (D, E or F)**	**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 (C, B or A)**	**B and C**
Woodside demonstrates these higher order Risks, Impacts and Decision Types are 'Acceptable if ALARP' if it can be demonstrated using good industry practice and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained. In undertaking this process for Moderate and High risks, Woodside evaluates: • 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). 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 increasing involvement of senior management in accordance with Woodside's Risk Management Procedure to accept the risk. This includes due consideration of regulatory requirements.		

2.9 Recovery Plan and Threat Abatement Plan Assessment

To support the demonstration of acceptability, a separate assessment is undertaken to demonstrate that the EP is not inconsistent with any relevant recovery plans or threat abatement plans (refer **Section 1.9.2.2**). The steps in this process are:

- Identify relevant listed threatened species and ecological communities (**Section 4.6**).
- Identify relevant recovery plans and threat abatement plans (**Section 6.9**).
- List all objectives and (where relevant) the action areas of these plans, and assess whether these objectives/action areas apply to government, the Titleholder, and the Petroleum Activities Program (**Section 6.9**).
- For those objectives/action areas applicable to the Petroleum Activities Program, identify the relevant actions of each plan, and evaluate whether impacts and risks resulting from the activity are clearly not inconsistent with that action (**Section 6.9**).

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

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

2.11 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

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principles of Australian Standard/New Zealand Standard (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**.

2.12 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 a 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 D**.

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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. It includes the location of the activity, general details of the facility's layout, the operational details of the activity, and additional information relevant to consideration of environmental risks and impacts.

GWA produces dry gas and condensate from a series of reservoirs and associated subsea infrastructure. These fluids are processed before being exported to the interfield line (IFL) and to the Karratha Gas Plant (KGP) for processing. The facility was commissioned as an integrated drilling, production, utilities and accommodation platform. However, the GWA facility no longer has drilling capability and drilling does not form part of the scope of this EP. An overview of the Petroleum Activities Program is provided in **Table 3-1**.

Table 3-1: Petroleum Activities Program overview

Item	Description
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL
Platform Location	Latitude: 19° 39' 07" South Longitude: 115° 55' 47" East
Water Depth (Lowest Astronomical Tide (LAT)) at GWA topsides location	131 m
End of Field Life	2036-2040
Key components of platform facilities	Fixed platform, processing equipment, wells and utilities
Key components of subsea infrastructure	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals
Exploration Wells with Wellheads[1]	Exploration wells Temporary Abandoned (ETA) with wellheads Abandoned wells with Wellhead (AW)
Vessels	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities.
Key activities	• routine production; • routine inspection, maintenance and repair (IMR) of the platform and associated subsea infrastructure; • well clean-up and commissioning; • platform well intervention, workovers and well kill activities; and • non-routine and unplanned activities and incidents associated with the above

[1]ETA wells are managed as per WOMP requirements. Woodside is conducting a detailed review of the subsurface and well barrier status to determine adequacy as permanent barriers. AW wells are accepted to have adequate permanent barriers and do not require management under a WOMP. All wellheads are being maintained.

3.2 Location

The GWA facility is located in Commonwealth waters on the NWS of WA within licence areas WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L, WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL and WA-27-PL. The GWA platform is situated approximately 138 km north-west of Dampier and 23 km south west of North Rankin Complex (NRC) (**Figure 3-1**).

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The GWA facility and associated infrastructure is marked on nautical maps and is surrounded by a 500 metre petroleum safety zone (PSZ). The coordinates and permit areas of the GWA facility and associated infrastructure are presented in **Table 3-2**.

Table 3-2: GWA and associated infrastructure approx. locations and Petroleum Titles

Infrastructure	Water Depth (approx. m LAT)	Latitude (WGS84)	Longitude (WGS84)	Petroleum Titles
GWA Platform	131 m	19° 39’ 07.936” S	115° 55’ 47.028” E	WA-5-L
Existing Subsea Infrastructure				
IFL - GWA	130 m	19° 39' 07.332" S	115° 55' 48.509" E	WA-2-PL
IFL - NRA SSIV	124 m	19° 35’ 06.290” S	116° 08’ 15.023” E	WA-2-PL
Echo Yodel (EY) Pipeline – GWA Platform [1]	130 m	19° 39’ 06.644” S	115° 55’ 47.670” E	WA-9-PL
EY Pipeline – Wellhead [1]	133 m	19° 44’ 43.310” S	115° 44’ 11.401” E	WA-9-PL
Echo Yodel subsea infrastructure	133 m	19° 44’ 43.310” S	115° 44’ 11.401” E	WA-23-L
PoG Pipeline – GWA Platform	130 m	19° 39’ 06.831” S	115° 55’ 47.875” E	WA-13-PL
PoG Pipeline – Wellhead	127 m	19° 31’ 11.736” S	116° 06’ 39.297” E	WA-13-PL
GWF Phase-1 Pipeline – GWA Platform	130 m	19° 39’ 06.933” S	115° 55’ 48.327” E	WA-24-PL
GWF Phase-1 Pipeline – Manifold	111 m	19° 45’ 44.068” S	115° 53’ 24.368” E	WA-24-PL
GWF Phase-2 Pipeline – GWA Platform	130 m	19° 39’ 06.933” S	115° 55’ 48.327” E	WA-27-PL
New Production Wells				
GDA03 well	125 m	19° 43' 04.890" S	115° 51' 58.911"E	WA-5-L
GDA04 well	125 m	19° 42' 35.697" S	115° 53' 14.475"E	WA-5-L
GDA05 well	125 m	19° 43' 15.968" S	115° 51' 10.743"E	WA-5-L
Production Wells				
PER 01 Well	131 m	19° 33’ 22.460” S	116° 02’ 06.799” E	WA-1-L
PER 03 Well	130 m	19° 35’ 29.270” S	116° 02’ 33.259” E	WA-1-L
GDA01 Well	125 m	19° 42’ 24.097” S	115° 52’ 33.203” E	WA-5-L
GDA02 Well	125 m	19° 42’ 24.097” S	115° 52’ 33.203” E	WA-5-L
TPA01 Well	200 m	19° 45' 44.652" S	115° 53' 25.253" E	WA-5-L
TPA02 Well	200 m	19° 45’ 44.996” S	115° 53’ 23.982” E	WA-5-L
TPA03 Well	113 m	19° 45’ 43.618” S	115° 53’ 23.986” E	WA-5-L
LPA-01 well	77 m	19° 49' 46.337" S	115° 39' 29.415" E	WA-57-L
LPA-02 well	77 m	19° 49' 46.453" S	115° 39' 27.558" E	WA-57-L
LPA-03 well	77 m	19° 49' 45.485" S	115° 39' 28.597" E	WA-57-L
SRA-01 well	93 m	19° 47' 38.715" S	115° 46' 25.485" E	WA-24-L

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Infrastructure	Water Depth (approx. m LAT)	Latitude (WGS84)	Longitude (WGS84)	Petroleum Titles
SRA-02 well	93 m	19° 47' 39.845" S	115° 43' 24.273" E	WA-24-L
KDA-01 well	122 m	19° 45' 27.547" S	115° 47' 07.026" E	WA-5-L
KDA-02 well	122 m	19° 45' 27.547" S	115° 45' 08.228" E	WA-5-L
DOA-01 well	130 m	19° 43' 00.124" S	115° 48' 55.179" E	WA-6-L
Production Wells (shut in)				
PER 02 Well[2]	127 m	19° 31' 11.700" S	116° 06' 39.350" E	WA-1-L
PER 04 Well[2]	128 m	19° 31' 06.500" S	116° 05' 53.639" E	WA-1-L
Production Wells Permanently Plugged				
Yodel 03 Well[3]	136 m	19° 44' 21.841" S	115° 44' 49.063" E	WA-23-L
Yodel 04 Well[3]	133 m	19° 44' 48.040" S	115° 44' 06.603" E	WA-23-L
Exploration Wells Temporary Abandoned (ETA)				
Dockrell-1	112 m	19°47'11.791" S	115°46'51.527" E	WA-5-L
Goodwyn-3	122 m	19°44'5.487" S	115°52'47.425" E	WA-5-L
Goodwyn-6[4]	126 m	19°43'19.078" S	115°51'16.964" E	WA-5-L
North Rankin-2	128 m	19°33'51.925" S	116°8'51.518" E	WA-1-L
North Rankin-3	128 m	19°31'45.977" S	116°10'27.159" E	WA-1-L
North Rankin-6	126 m	19°32'40.035" S	116°8'31.167" E	WA-1-L
Rankin-1	95 m	19°47'53.086" S	115°44'39.313" E	WA-24-L
Abandoned Wells with Wellhead (AW)				
Goodwyn-1	127 m	19°41'33.489" S	115°53'49.169" E	WA-5-L
Goodwyn-2	135 m	19°39'47.736" S	115°51'56.302" E	WA-5-L
Goodwyn-4	132 m	19°41'33.147" S	115°50'58.763" E	WA-5-L
Goodwyn-5	130 m	19°40'37.089" S	115°53'49.806" E	WA-5-L
Lady Nora-2	77 m	19°49'59.820" S	115°37'14.440" E	WA-57-L
Lowendal-1	87 m	19°52'43.558" S	115°38'6.461" E	WA-57-L
North Rankin-1	124 m	19°35'51.910" S	116°7'35.520" E	WA-1-L
North Rankin-4	129 m	19°35'3.577" S	116°6'47.028" E	WA-1-L
North Rankin-5	125 m	19°34'12.455" S	116°9'33.688" E	WA-1-L
Tidepole-1	112 m	19°46'3.442" S	115°53'12.382" E	WA-5-L

NOTES:

1 – Echo Yodel (EY) Pipeline is suspended and isolated. Activities associated with decommissioning are provided for under the approval of the EY Decommissioning EP (NOPSEMA Doc ID A728912). Maintenance continues under this EP until decommissioning activity commences.

2 –PER 02 and 04 wells are production wells no longer in use (i.e. shut in and designated redundant). PER 02 and PER 04 will continue to be subject to subsea inspection until final abandonment, currently scheduled for permanent plugging in 2024-2025.

3 – Yodel 03 and 04 wells have been permanently plugged. All activities associated with final abandonment are provided for under the approval of the EY and Capella Plugging for Abandonment EP (NOPSEMA Doc ID A772288). Maintenance continues under this EP until they are removed.

4 - Goodwyn-6 well is currently in the approved Okha Operations EP (NOPSEMA Doc ID A739486), and will move to be managed under this EP.

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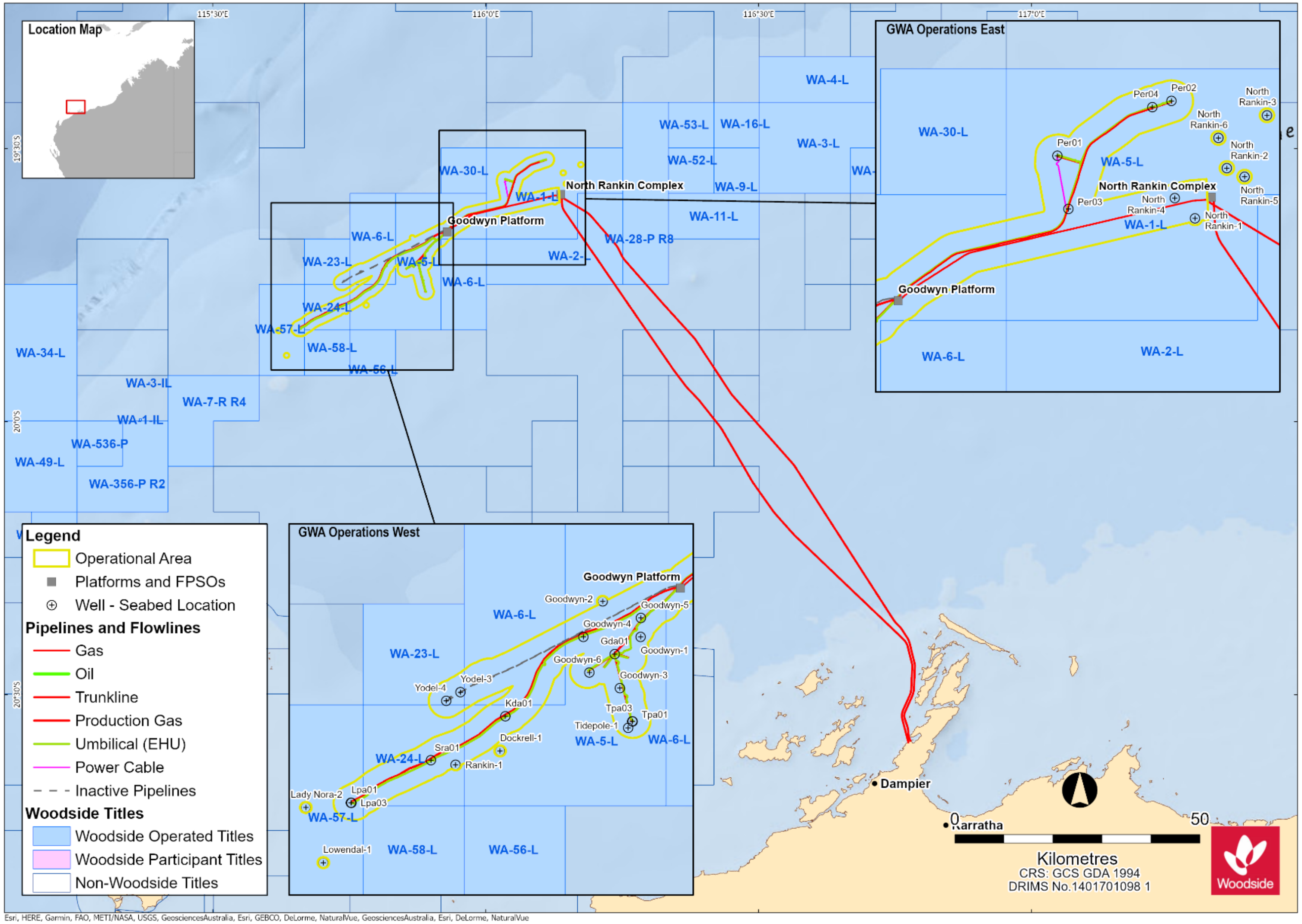

Figure 3-1: GWA facility and Operational Area

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3.3 Operational Area

The Operational Area 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. The area includes (**Figure 3-1**):

- GWA platform and the area within a 500 m PSZ around the facility;
- the IFL from GWA to NRC (NRA SSIV) covered by Pipeline Licence WA-2-PL and an area encompassing 1500 m around the infrastructure;
- EY subsea infrastructure, including the Yodel 03 and 04 wells, the EY pipeline and Electric-hydraulic umbilicals (EHU) covered by Pipeline Licence WA-9-PL, Umbilical Termination Assemblies (ETA), Umbilical Termination Basket (UTB) and jumpers and an area within 1500 m around the infrastructure;
- PoG subsea infrastructure, including the PoG pipeline covered by Pipeline Licence WA-13-PL, four wells (PER-01, PER-02, PER-03, PER-04), umbilicals, jumpers, spools and an area within 1500 m around the infrastructure;
- GWF-1 subsea infrastructure, including the GWF-1 pipeline covered by Pipeline Licence WA-24-PL back to GWA, five wells (GDA01, GDA02, TPA01, TPA02, TPA03), umbilicals, jumpers, spools and an area within 1500 m around the infrastructure;
- GWF-2 subsea infrastructure, including the GWF-2 pipeline covered by Pipeline Licence WA-27-PL, eight wells (LPA-01, LPA-02, LPA-03, SRA-01, SRA-02, KDA-01, KDA-02, DOA-01), umbilicals, jumpers, spools and an area within 1500 m around the infrastructure;
- GWF-3 subsea infrastructure, utilising the GWF-1 pipeline covered by Pipeline Licence WA-24-PL back to GWA, three wells (GDA-03, GDA-04, GDA-05), flowlines, umbilicals and an area within 1500 m around the infrastructure; and
- Exploration wells with wellheads (**Table 3-2**) and an area of 500 m around each well.
- Vessel-related activities within the Operational Area will comply with this EP. Vessels supporting the Petroleum Activities Program operating outside of the Operational Area (e.g. transiting to and from port) are subject to applicable maritime regulations and other requirements which are not managed under this EP.

3.4 Timing

The GWA facility commenced production in 1995. The facility operates 24 hours a day, 365 days a year.

Commissioning (initial start-up) of the GWF3 infrastructure is planned to commence in 2022. The end of life of the GWA facility is not predicted during the life of this EP. Tie-back opportunities are continuously being reviewed for Woodside’s offshore facilities, which have the potential to extend the life of the facility. Any future decommissioning, well plug and abandonment or drilling will be the subject to a separate EP.

This EP is intended to remain in force for up to five years from EP acceptance by the regulator.

3.5 Facility Layout and Description

This section provides an overview of the GWA facility and associated infrastructure, as relevant to consideration of the environmental risks and impacts of the Petroleum Activities Program.

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3.5.1 GWA Topsides

The GWA topsides structure consists of 11 modules (**Figure 3-2**). The plan view area of GWA is 4,000 m^2, extending 120 m from north to south and 55 m from east to west. The production deck is 25 m above sea level and the platform extends to approximately 175 m above sea level, to the top of the flare tower. The accommodation module (Module D, designated temporary refuge) is at the southern end of the platform and is segregated from the production systems by the utilities and drilling support modules.

The product export pipeline riser is located at the northern end of the platform. Two ‘A’ frame pedestal cranes are used to service the platform and dropped object protection is provided at critical topsides and subsea locations.

The drilling derrick on the GWA Facility has been removed, however, the drilling package maintenance is in place to maintain equipment and structural safety and to ensure required function and integrity are maintained until fully removed from the facility. Redundant equipment may be removed from GWA using a heavy lift vessel.

The following topside module designations have been used for the GWA facility as shown in **Figure 3-2**:

- Module A: Utilities area (located under drilling support module)
- Module B: Process area with module L stripping columns to the west face
- Module C: Wellheads (located under module G)
- Module D: Temporary Refuge, including Accommodation (located under helideck)
- Module E: Compression and flare tower area (located under module H)
- Module F: Drilling utilities/pipe deck
- Module G: Drilling facilities (located under Module K) (planned to be removed)
- Module H: Flare tower (on top of Module E)
- Module K: Drilling derrick (now fully removed)
- Module L: Stripping columns to the west of Module B
- Module M: Amenities building/store
- Module X: Module support frame.

3.5.1.1 Platform Wells

There are 19 platform wells on the GWA platform, accessing the Goodwyn field. Tubing retrievable sub-sea safety valves (SSSV) and wireline retrievable SSSVs are installed on GWA wells as the primary down-hole safety system. These valves are controlled from the surface via a single control line or independent control lines located approximately 550 m below the wellhead.

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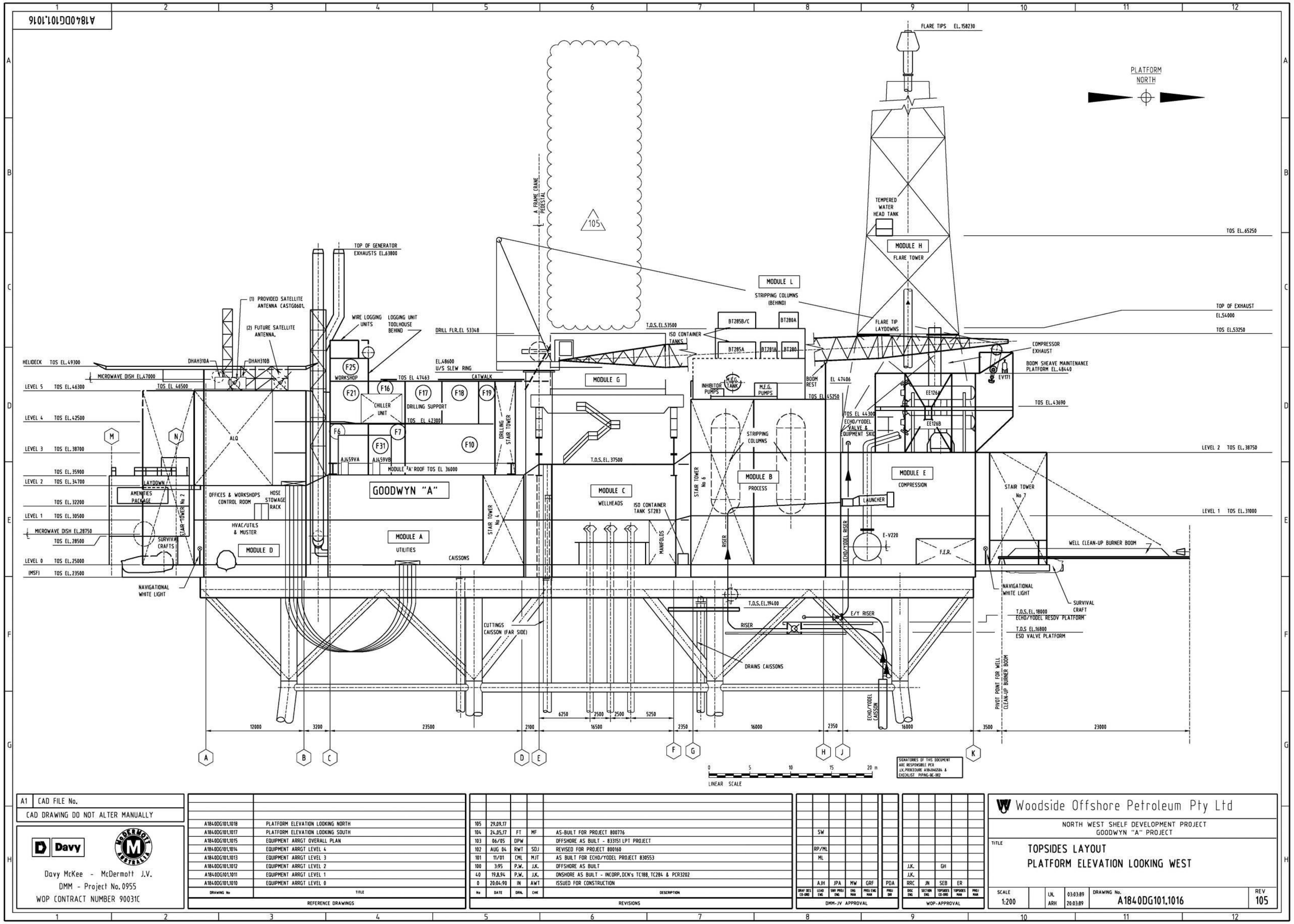

Figure 3-2: GWA facility topside module layout

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3.5.2 Subsea Infrastructure

3.5.2.1 Field Inventory

The layout of the GWA subsea infrastructure, including location of the fields, is shown in **Figure 3-3** and detailed in **Table 3-3**.

The subsea infrastructure in the petroleum titles is recorded and tracked using a database. This database is updated as equipment is brought into title, which may include new or replacement equipment (**Section 3.5.2.1**; **Section 6.6.2**). Remotely Operated Vehicle (ROV) as found and as left surveys are undertaken to identify the location of items placed on the seabed. At the completion of the IMR campaign this data is used to update the inventory for the title. Material items dropped to the marine environment and not recovered (See **Section 6.7.2**) are added to the inventory for the title.

Table 3-3: Inventory of subsea wells and infrastructure, including status

Infrastructure	Status[1]
IFL: 24 km 30” pipeline	Maintained for production
IFL: 1 Umbilical jumper to SSIV	Maintained for decommissioning
EY: 23 km 12” pipeline, 23 km 5” umbilical, 2 x wells (Yodel 03 & Yodel 04), 2 x UTAs, I x UTB, 1 x pig launcher, control jumpers	Maintained for decommissioning
PoG: 24 km 16” flowline, 6 km 10” flowline, 2 x wells (PER-01, PER-03), 3 x SDUs/EDU, 1 x Pipeline End Manifold, infield umbilicals, rigid spools and control jumpers, 1 x SSIV	Maintained for production
PoG: 2 x wells (PER-02, PER-04), 3 x SDUs/CHTU, infield umbilicals, rigid spools and control jumpers	Maintained for decommissioning
PoG: 6 electrical jumpers	Maintained for decommissioning
GWF-1: 14 km 16” flowline, 5 x wells, 2 x manifolds, 1 x Tie in Skid, infield umbilicals, 9 x UTAs, rigid spools and control jumpers, 1 x SSIV	Maintained for production
GWF-2: 35 km 16” flowline, 8 x wells, 4 x manifolds, 12 X PLETs, 1 X MCS, infield umbilicals, 8 x UTAs, rigid spools and control jumpers	Maintained for production
GWF-3: 3 x 8” flexible flowline (approximately 1.2 km, 1.6 km and 2.9 km long), 3 x wells, 1 x manifold, infield umbilicals and control jumpers	Maintained for production
17 exploration wells with wellheads	Maintained for decommissioning

[1]Status at time of submission of this EP

The GWA subsea system has been designed, fabricated and installed in accordance with best practice and international standards. The pipelines, flowlines and wells are marked on nautical charts.

3.5.2.2 Subsea Components

The subsea system is controlled from the GWA platform through the following components:

- Jumpers and umbilicals which provide hydraulic and electric power, communications and chemical supplies between the platform and subsea components through a number of cables and tubes. Umbilicals run between the platform and the Subsea Distribution Units (SDU) and Umbilical Termination Assemblies (UTA), Umbilical Termination Baskets (UTBs) and jumpers run between SDUs/UTAs/UTBs and the manifold;

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- Valves which control subsea operations and processes;
- Chokes which control pressure and flow rates of hydrocarbons; and
- Subsea Control Modules (SCM) and electrical distribution unit (EDU) which are sealed and pressure compensated electro-hydraulic units (found on manifold and/or Xmas trees) and link the surface and subsea controls.

A number of subsea valves may also be overridden manually from either an ROV or divers.

The layout of the GWA facility subsea infrastructure is shown in **Figure 3-3**.

3.5.2.3 Interfield Line (IFL)

Gas and condensate is exported via the 23 km IFL from GWA platform, which joins the second trunkline (2TL) near NRC. A pig launcher is provided for servicing the IFL. The launcher is designed for single launchings of spheres and for launching of pipeline inspection tools. The pipeline/riser includes two key isolation valves. The Riser Emergency Shutdown Valve (RESDV) is located in the splash zone and the sub-sea isolation valve (SSIV) is located on the jacket mudmat.

Concrete mattresses are provided to protect the IFL from dropped objects in the vicinity of the GWA platform. Protection frames are provided around the riser and SSIV.

3.5.2.4 Echo/Yodel Field

EY subsea infrastructure includes the Yodel 03 and Yodel 04 wells, EY pipeline with pig launcher connected and a main electrohydraulic umbilical (EHU) both covered by Pipeline Licence WA-9-PL; two UTAs, one UTB and two infield jumpers in WA-23-L. Production from the EY field ceased in 2012. The two EY production wells have been permanently plugged for abandonment and will be decommissioned in accordance with the accepted EY and Capella Permanent Plugging for Abandonment EP (NOPSEMA Doc ID A772288).

The EY pipework downstream of the RESDV was disconnected and reconfigured to connect the RESDV to the test header to provide a double block and bleed isolation, topsides pressure monitoring and access to flare. The EY pipeline was subject to a pigging campaign in 2016 to clean and remove hydrocarbons from the pipeline, via flushing with inhibited seawater to the GWA facility. Following completion of the pigging campaign a foam pig was launched from GWA. Nitrogen was used to propel the pig to a distance of approximately 400 m from the GWA Facility where it remains.

A section of the EY pipeline was removed in 2018 from between the foam pig and the GWA platform meaning the pipeline is suspended and isolated from the GWA platform.

Integrity of the EY riser is maintained through regular inspection and maintenance until future re-use or decommissioning plans are finalised. Activities associated with EY pipeline and associated EY subsea infrastructure, re-use or decommissioning are the subject of the EY Decommissioning EP (NOPSEMA Doc ID A728912). Decommissioning planning is further described in **Section 7.2**.

3.5.2.5 Perseus/Searipple Field

PoG subsea infrastructure includes the PoG pipeline covered by Pipeline Licence WA-13-PL, four wells (PER-01, PER-02, PER-03, PER-04), and associated umbilicals, jumpers, spools. Control and monitoring of the subsea wells is through an EHU from GWA. Configuration of the subsea architecture allows for future extension of the PoG pipeline system through drilling of additional wells. Two wells (PER-02 and PER-04) are shut in and are designated redundant. Integrity of the wells continues to be maintained through regular inspection until decommissioning plans are finalised and executed. See **Section 7.2** for decommissioning planning activities.

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3.5.2.6 Greater Western Flank

GWF-1 subsea infrastructure comprises five gas production wells within the Goodwyn (GDA01 and GDA02) and Tidepole reservoirs (TPA01, TPA02 and TPA03). These wells are tied back to the GWA facility via a 16”, 16.3 km pipeline which terminates at the GWF-1 SSIV. The SSIV is connected via a series of spools to the GWF riser located in the centre of the platform and is therefore protected from ship impact by the GWA jacket structure from a depth below that which it is vulnerable to ship impact (approximately -12 m). In an emergency, this pipeline can be isolated from the riser using the SSIV located on the seabed approximately 40 m from the platform.

GWF-2 subsea infrastructure comprises eight wells (LPA-01, LPA-02, LPA-03, SRA-01, SRA-02, KDA-01, KDA-02, DOA-01) across six reservoirs Keast/Dockrell, Sculptor, Rankin and Lady Nora/Pemberton. Wells are tied back to the GWA facility via a 35 km pipeline which is tied into the existing GWF-1 SSIV. Hydrocarbons from GWF-2 are comingled with GWF-1 and routed through the common GWF spools and riser for further processing topside.

The GWF-3 Development accesses incremental volumes from the Goodwyn GH reservoir via existing GWF-1 infrastructure. GWF-3 infrastructure comprises three wells (GDA03, GDA04, GDA05), tied in via the existing GDA manifold. Each well connects to the GDA manifold by a nominal eight-inch internal diameter flexible flowline and by an EHU which provides monoethylene glycol (MEG) and subsea control. The production of these wells is provided for in this EP.

Activities associated with drilling, installation of subsea infrastructure and pre-commissioning of GWF-3 are provided for under the accepted Greater Western Flank 3 and Lambert Deep Drilling and Subsea Installation EP.

3.5.3 GWF-3 Commissioning (initial start-up) Activities

The commissioning (initial start-up) activities of the GWF3 wells and associated subsea infrastructure are planned to commence in 2022. All activities may be subject to rescheduling, including delay, based on operational requirements of the GWA platform or other production scheduling reasons.

The Operations EP scope starts once hydrocarbons are introduced into the system (commissioning (initial start-up)). Once hydrocarbons have been introduced into the system, preservation fluids are displaced to the GWA platform, where they are processed and wells are cleaned-up to maximum rates.

3.5.4 Exploration Wells with Wellheads

There are ETA and AW wells with wellheads identified in **Table 3-2** that are not tied back to the GWA facility and have no associated infrastructure (i.e. no Xmas tree). The ETA wells are managed under NOPSEMA accepted Well Operations Management Plans (WOMPs). Wellheads are being inspected in accordance with the WOMPs based on the assessed risk for each well (**Section 3.10**).

In line with the WOMP commitment relating to ETA wells, Woodside is continuing to undertake detailed subsurface/technical assessments of these ETA wells. This is to ensure that the wells are abandoned to the relevant regulatory requirements, including permanent downhole barriers. WOMPs to enable final NOPSEMA assessment and subsequent abandonment applications are being continually progressed, with some wells having been accepted as permanently abandoned and having been removed from their respective WOMPs (AW wells).

Decommissioning of the ETA wellheads cannot progress until the wells have been accepted as permanently abandoned. However, planning for ETA and AW wellhead decommissioning is premised upon removal as the base case, with consideration of the principles of ALARP and acceptability. Once wells have been accepted as permanently abandoned and the decommissioning activity is defined, an EP will be submitted for the wellhead decommissioning

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activity. The anticipated submission date for the wellhead decommissioning EP is 2022. These wells with wellheads are continuing to be maintained until decommissioned.

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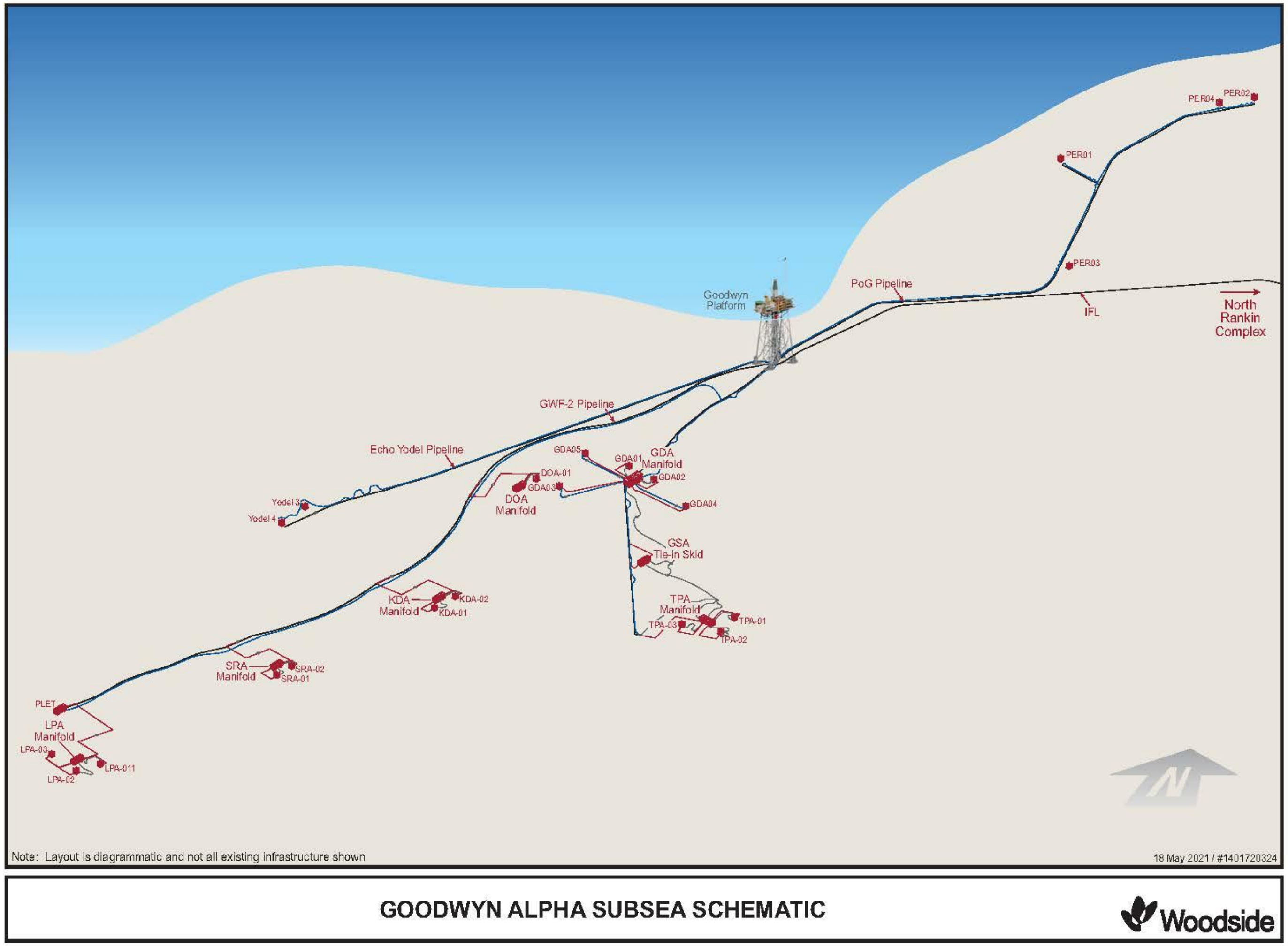

Figure 3-3: Schematic of the GWA facility subsea infrastructure

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3.6 Operational Details

3.6.1 Manning and Modes of Operation

Total overnight personnel onboard (PoB) capacity for the GWA facility is 137 people. The Central Control Room (CCR) is manned 24 hours per day. Other activities which affect manning levels, are:

- crew change;
- engineering projects;
- campaign maintenance;
- inspections/audits; and
- planned facility shutdowns.

Normal operations at GWA fall under any one of the following modes of operation:

- production and maintenance, including IMR activities;
- production and platform well maintenance;
- production, restarts and GWF-3 commissioning activities;
- production and major projects; and
- remote operations.

These modes of operation are described below. Production, maintenance and project activities may occur concurrently.

3.6.1.1 Production and Maintenance

Production and maintenance covers hydrocarbon receipt, processing, export and supporting operations. Inspection, maintenance and repair, including those undertaken subsea, are undertaken to maintain production within the platform and subsea infrastructure design constraints.

3.6.1.2 Production and Platform Well Maintenance

Production and platform well maintenance involves well workover or interventions concurrent with production activities. Workover/well intervention may take place utilising an hydraulic workover unit (refer **Section 3.11**).

3.6.1.3 Production, Restarts and GWF-3 Well Commissioning Activities

The GWF-3 commissioning (initial start-up) activities and performance testing program is likely to be executed in one campaign encompassing all three wells, however, is not bound to a single campaign. Gas produced as part of GWF3 well commissioning activities is treated as normal production gas and routed through separation systems to export. Therefore there is no additional planned flaring associated with commissioning (initial start-up) activities.

Commissioning and performance testing activities to be carried out includes (amongst other activities):

- Subsea valve leak-off testing and function testing;
- Flowline preservation fluid displacement into the GWF1 pipeline and through GWA production process;
- Final well clean-up;
- Simulated emergency shutdown (ESD) test;

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- Flowmeter calibration;
- Internal control valve functionality;
- System performance testing.

There is the potential for the GWA facility to experience short duration high OIW during GWF3 commissioning (initial start-up) activities, due to the large volume of preservation fluids remaining in spools and flowlines on start up of each well (MEG: water and dye/biocide mixture). A temporary OIW polishing skid will be utilised to assist with risk of high OIW during GWF3 commissioning.

During production restart after planned shutdown, there is also the potential for the GWA facility to experience high OIW, due to mobilisation of emulsions observed in the produced water system. The temporary high OIW associated with production restarts may be experienced for up to three days.

3.6.1.4 Major Projects

Major projects involve refurbishment, modification or major maintenance on the facility. The Projects function is responsible for undertaking these projects. Potential environmental impacts related to projects are managed through the process outlined in **Section 7.1.3.3**.

3.6.1.5 Remote Operations

While the GWA facility is typically operated as a manned facility, Woodside may de-man GWA (e.g. as a precautionary safety measure during severe cyclones). Operation of the GWA facility may be maintained during de-manning via a Remote Operation Station at the Mia Yellagonga office or the KGP.

Whilst remotely operated, the GWA facility continues to produce at stable rates established prior to de-manning the facility. Operating at stable rates means production remains steady with no major process changes. This minimises the potential for process upsets while operating in remote mode.

3.6.2 Process Description

3.6.2.1 Production Process

The GWA facility receives well fluids (gas, condensate and associated produced water (PW)) from the production wells for topside processing via gas dehydration and condensate dewatering. The facility then exports the processed gas and condensate onshore to the KGP.

The GWA facility has two processing trains (T100 and T200). T100 has an operating limit of 19.3 kt dry gas per day (kt/d), plus associated condensate whilst T200, in low pressure mode, has been proven to 15.0 kt/d export gas, plus associated condensate.

GWF and PoG field production is processed and dehydrated on GWA using existing processing capacity, with both PoG and GWA currently flowing into T200, while GWA flows to T100.

The gas export compressor takes suction at the lower operating pressures and returns the gas to export pressure allowing it to be routed onshore via the pressurised pipeline. The export compression package (compressor, power generation turbine and associated equipment) includes the following equipment:

- Export compressor and aftercooler;
- Gas generator;
- Power turbine;
- Reduction gearbox;
- Lube oil systems;

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- Dry gas seal system;
- Suction Scrubber.

3.6.2.2 Flare Systems

The GWA platform has two flare systems, the High Pressure (HP) Flare and the Low Pressure (LP) Flare. The main purpose of the flare systems is to safely discharge gas streams during an emergency depressurisation. However, there are also a number of process streams which continuously pass gas to the flare, such as gas flashed from the PW, and stripping gas used in the glycol regeneration process. Other streams intermittently flow to the flare, such as during maintenance activities, and when vessels are depressurised and purged.

The flow of gas through each of the HP and LP flare networks is measured using separate ultrasonic flow meters with pressure and temperature compensation. A small portion of the fuel gas stream is used for the flare purges to exclude air.

High Pressure System

The HP flare system collects vented hydrocarbons from process and utility systems, with design pressures of 2,000 kPa or greater. Hydrocarbons are vented to the HP flare from pressure safety valves (PSV), manual blowdowns and automatic blowdowns. The main HP flare header is routed to the HP flare drum, which is designed to separate all liquid droplets by gravity. Liquids collected in the drum are pumped away to the oily water treatment system. Vapours from the flare drum are disposed of at the flare tip (at the top of the 113 m tower), via a multi nozzle sonic flare tip.

Low Pressure System

The LP flare system collects vented hydrocarbons from process and utility equipment with design pressures of between 345 kPa and 2,000 kPa. There are two separate LP headers, one to accommodate low temperature relief streams and the other to accommodate venting at ambient or higher temperatures. The two LP headers are routed to the LP flare drum, which separates out liquid by gravity. Liquids collecting in the drum (usually condensed water from the glycol regeneration system) drain to the closed drains break drum. Liquids collected in the closed drains break drum are pumped back to the oily water drains separator prior to reinjection into the main process stream and water treated via the PW system.

Flaring – Normal Operations

A relatively small quantity of gas is required to be continuously flared associated with purge and pilot of the flare system and disposal of waste streams which are not recovered to the process. The continuous flows to the LP flare are:

- flare pilot
- LP flare header and storage tank purges
- glycol regeneration process, including still column overheads and flash drum.

The continuous flows to the HP flare are:

- flare pilot
- HP Flare Pilot
- flash gas from glycol flash drums (which is under on/off level control)
- flash gas from PW degasser
- flash gas from scrubber vessels, including fuel gas, stripping gas compressor, T200 export compressor and the glycol contactor integral suction scrubbers (all under on/off level control)

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- leakage past flare header valves such as PSVs and blow-down valves (BDVs).

Flaring – Intermittent Process Upsets and Activities

During process upsets, the process control valves on the main process equipment open to relieve excess pressure to the HP flare. The following sources make up non-continuous flaring (approximately 1,500 tpa).

Emergency Blowdown

The topsides equipment and piping is divided into isolatable sections, each with a dedicated BDV. During an ESD, each section is separately pressurization to the HP flare. Each section contains a fail open actuated BDV which allow blowdown of the entire platform inventory. Approximately 100 tonnes is flared during each planned ESD.

Transient Operations

The GWA process relies on warm operating temperatures (above 35 °C for T100 and above 46 °C for T200) to allow seawater cooling to prevent vapour breakout in the condensate processing train, and to meet a minimum inlet temperature of 32 °C for the condensate stripping column (the operation of which is adversely affected by low temperatures).

During transient operations, such as restarting production from the PoG, GWF-1, GWF-2, or GWF-3, it may not be possible to meet the required GWA process operating temperature requirements. In this event, temporary flaring of vapour break-out from the condensate train may be required. When possible, cold production from the subsea flowlines is commingled with warm platform well production to reduce flaring.

Manual Depressurisation

Manual depressurisation results in intermittent flaring of hydrocarbons, triggered by routine equipment maintenance, planned ESD testing and/or pressurisation of equipment and piping to remove the equipment from service. Equipment must be depressurised prior to draining, as the closed drains system is not intended for HP service.

Subsea Flowline Depressurisation

The fluid in the subsea flowlines/pipelines (which carry hydrocarbons from the subsea wells to the GWA platform) may on occasions need to be routed to the flare to allow the pressure in the flowlines to be reduced. The flowlines may require depressurisation for the following reasons:

- production flowline maintenance and critical Leak-off Testing (LOT)
- to facilitate remediation in the event of an unplanned hydrate blockage in the subsea flowlines
- flowline hydrate management
- manage flowline integrity limit
- suspension of redundant pipelines/flowlines.

3.6.2.3 Greenhouse Gas Emissions

The main sources of greenhouse gas (GHG) emissions associated with GWA production are shown in **Table 3-4**. GHG sources that are not part of the facility (e.g. onshore processing emissions) are included for completeness. In the context of this EP, the emissions are classified as direct and indirect emissions.

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Table 3-4: Direct and Indirect Greenhouse gas sources from the GWA facility and supply chain

Emission type	Emissions source	Location	Jurisdiction	Process
Direct	Offshore processing	Offshore	Commonwealth	GHG emissions from gas / diesel turbines (**Section 3.6.5.4**), flares, fugitives, and process vents
Indirect	Support vessels (on charter)	Offshore	Commonwealth	GHG emissions from internal combustion engines and fugitives on vessels
	Onshore processing*	Onshore	State	GHG emissions from venting reservoir CO2, combustion of gas as fuel, flares and fugitives associated with processing gas to LNG, LPG, condensate and domestic gas
	Transport	Transit	Subject to consumer location	GHG emissions from transport of products to market, including regasification and distribution of LNG in customer markets
	Regassification, distribution and combustion by third party user.	Market	Subject to consumer location	GHG emissions from combustion of products as part of power generation and other energy solutions within the final market

*ISO 19694:2021 defines indirect GHG emissions as *GHG emission that is a consequence of an organisation's operations and activities, but that arises from GHG sources that are not owned or controlled by the organisation.* For the purposes of this EP the "*organisation"* is the GWA facility and therefore onshore processing and support vessel operations are considered indirect emissions sources.

3.6.3 Produced Water System

PW is brought to the surface from the reservoir, separated out from hydrocarbons during the production process and discharged to the marine environment via the closed drains caisson.

The GWA PW system has been designed to process a maximum of 7,500 m^3/day; however, discharge rates are typically lower – in 2020, produced water discharge ranged from 339 – 2,155 m^3/day, with the higher discharge rate reflective of high water cut well production. PW rates may change in the future as high water cut wells are unloaded, cycled and produced. Overall, it is expected that PW rates will increase as the field ages.

3.6.3.1 PW System Description

The PW system on the GWA facility comprises lines that connect the process to the primary water/condensate separators, the PW degasser and to the closed drains (**Figure 3-4**).

The PW stream is primarily made up of:

- water recovered from the condensate stream by the primary water/condensate separators on T100 and T200
- a lesser quantity of water removed downstream by the condensate coalescers on T100 and T200

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- water from the underflow of the oily water drains separator (OWDS). This is predominantly water from the glycol reboiler overheads, which is routed to the OWDS from the LP Flare knock out (KO) Drum.

The PW system directs all PW streams from the process areas to the PW degasser to remove dissolved gas and condensate before disposal overboard via the Hazardous Closed Drains Caisson. Recovered condensate is skimmed off the top of the degasser vessel liquids and returned to the process via the Closed Drain Break Drum. Residual oil that may accumulate in the hazardous closed drains caisson is skimmed off the water and pumped to an ISO container for onshore disposal.

Adsorbent hydrocarbon filters to remove dispersed oil from the PW stream are installed on GWA. The system is used sparingly and primarily to manage oil in water (OIW) upsets.

An online analyser monitors the oil-in-water (OIW) content. If the OIW content is within specification, the PW is discharged overboard via the Hazardous Closed Drains Caisson.

In addition to continuous OIW monitoring, PW discharge monitoring includes routine chemical characterisation and ecotoxicity assessments of the PW. Refer to **Section 6** for a detailed discussion and ALARP justification regarding PW discharge from the GWA facility.

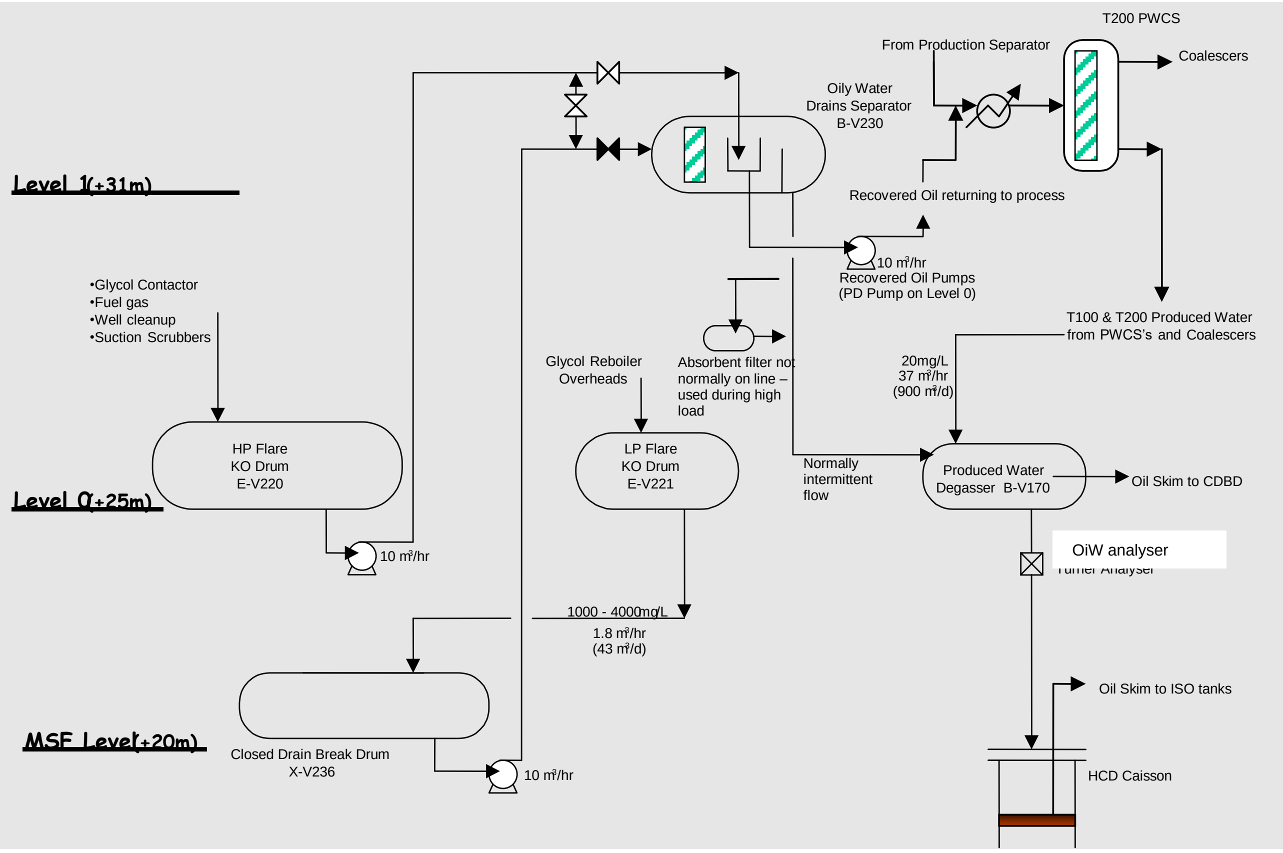

Figure 3-4: PW system configuration

3.6.4 Drainage Systems

The open and closed drains system consists of both hazardous and non-hazardous open drains. The open drains system is required for disposal of water and hydrocarbons, which are at atmospheric pressure (e.g. deck water). Drains from hazardous areas are segregated from drains from non-hazardous areas in order to prevent ingress of gases into a non-hazardous area via the drains system.

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3.6.4.1 Closed Drains

The process closed drains system is used for draining volatile hydrocarbon liquids from all process equipment. The drained liquids are routed to the closed drains break drum, which is located below deck in the module support frame. From here, the liquids are pumped to the oily water drains separator for further treatment. Closed drain piping systems are classed as topsides pressure containing/hazardous pipework.

Hydrocarbons recovered from the closed drains system and liquids collected in the HP flare drum are also sent to the oily water drains separator. From the OWDS, recovered hydrocarbons are pumped into the process trains whilst water is routed to the PW degasser. Hydrocarbons are then processed as per the process description in **Section 3.6.2.3**, which ultimately leads to the IFL. The Closed Drains Caisson forms part of the closed drain system used for PW disposal outlined in **Section 3.6.4**.

3.6.4.2 Hazardous Open Drains

Operational process and non-process discharges, some maintenance activities discharges and potential spills contained within hazardous open drain system are routed to the hazardous open drains caisson. The drains collect spillage, process drainage, and washdown water from equipment/flooring and rain/deluge water from all areas designated as hazardous. Any hydrocarbons captured in the caisson are periodically pumped out/recovered. These drains originate from deck drains, tundishes and drip trays located in hazardous areas, principally in modules with large plated areas e.g. Modules B, E and L. Hazardous open drain sub-headers leaving a module are fitted with individual seal pots to segregate hazardous areas. The purpose of these seals is to limit the spread of gas from one module to another via the drains system.

The hazardous open drains caisson primary and back up instrumentation provide live visibility of calculated hydrocarbon inventories in the caisson to prevent underflow. Level instrumentation provides data linked to the control system, is historised and utilised to implement response actions. The hazardous open drains caisson is equipped with a sump pump to recover any hydrocarbons which may accumulate in the caisson over a period of time. These liquids are routinely pumped to a waste oil ISO container for disposal onshore. The pump is manually started and run until seawater is observed at the sample point discharge. The sample line is located near the waste oil ISO container and leads to a tundish. Under routine conditions, the caisson is pumped out once per week. Non-routine flow conditions to the drain system (depending on process drainage and maintenance activities) may lead to the caisson being pumped out more frequently.

3.6.4.3 Drilling Facility Hazardous Open Drains

Currently the Drilling Hazardous Open Drains system collects rainwater and wash down water and directs the flow to the cuttings caisson. It also collects and drains drill water from the deluge systems during wet testing or any real events.

3.6.4.4 Non-hazardous Open Drains

Non-hazardous open drains cover the utility and power generation module (Module A). Operational non-process discharges, maintenance activities, washdown water and potential non-hazardous area spills are routed to the non-hazardous open drain system. The main sources for potential unplanned spillage of hydrocarbons are limited to:

- firewater pumps
- emergency generator
- gas turbine power generators (lube oil)
- diesel day tanks for gas turbines.

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The above equipment is provided with valved drip trays. Any lube oil drained down from machinery is collected in dedicated transportable containers. The main non-hazardous open drains collection system is routed directly overboard to allow for rainfall/washdown/deluge flows and for safety purposes.

3.6.5 Utility Systems

3.6.5.1 Platform Lighting

The GWA platform has appropriate lighting to ensure a safe working environment to support 24-hour operations. Lighting is split between emergency and normal lighting. Approximately 30% of the platform lighting is powered from the emergency generator supply in the appropriate module. The remainder is fed from the normal supply. The emergency light fittings have been located to illuminate the designated escape routes on the facility. There are also battery backed-up emergency lights on the facility.

There are navigational lights on the platform flare tower and on the booms and towers of the pedestal cranes. Helideck lighting is also provided to assist helicopter landing.

Unless required to support over the side activities (such as refuelling and lifting operations), lighting on the platform is directed to the work area, which aids in limiting light spill to sea.

3.6.5.2 Heating Ventilation and Air Conditioning System

The heating, ventilation and air conditioning (HVAC) system comprises HVAC equipment, ductwork and associated pipework. It provides independent and inter-dependent subsystems with pressurised, conditioned, purge and exhaust air services to various areas including accommodation, and various modules which can be operated on as required basis and others on a continuous basis.

Ozone-depleting substances are no longer used on GWA and refrigerants associated with the HVAC system are managed by a licenced refrigerant authority.

3.6.5.3 Seawater Treatment Systems

Seawater System

The primary function of the seawater system is to provide process and HVAC cooling. Secondary, continuous users are the fire ring main pressurisation electro-chlorination unit, caisson spillback lines and open drains seal pot water make-up.

Seawater is supplied by three shaft driven seawater lift pumps enclosed within protective caissons. An auxiliary totally submersed seawater lift pump supplies seawater for essential HVAC cooling, fire ring main pressurisation and chlorination requirements, when the main pumps are unavailable. It is also used for initial priming of the entire seawater system, prior to startup of the main pumps, in a black start situation.

Filtration of seawater to the condensate coolers is provided by two seawater filters located in the seawater to condensate cooler supply line.

Four seawater/tempered water plate heat exchangers transfer heat from the closed circuit tempered water system. Seawater is also used as the cooling medium for the HVAC tempered water plate heat exchangers.

The seawater from both sets of heat exchangers, as well as other users is routed by a collection system to the seawater dump caisson and then returned to the ocean. To prevent marine growth within the seawater system, an electrochlorination unit generates a concentrated sodium hypochlorite solution for injection into the circulation system, at a target chlorine level of 0.5 ppm. The seawater pump operates at 4275 m^3 per hour with an average discharge temperature of 32 °C.

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Tempered Water System

The tempered water system has the principal function of providing cooling for the well stream in the T100 and T200 production coolers and cooling gas downstream of the export compressor in the export compressor after cooler.

The system also provides subsidiary cooling in the following areas:

- stripping gas compressor lube and seal oil systems
- export compressor lube oil system
- glycol regeneration trim coolers
- drill water transfer pump recycle cooler
- auxiliary equipment room (AER) HVAC.

Two of three tempered water pumps are used to circulate inhibited fresh water within the closed system. Tempered water is not used for condensate cooling as the temperature difference between tempered water and the required condensate outlet temperature is inadequate. Cooling of the heated tempered water returning from its users is achieved by the use of seawater/tempered water heat exchangers

The tempered water carbon steel piping and vessels are protected from internal corrosion by dosing the water with a corrosion inhibitor. Regular testing of the tempered water system is undertaken to ensure the correct concentration of corrosion inhibitor is maintained. Periodic maintenance may require the draining of the tempered water system, resulting in the discharge of water and residue corrosion inhibitor to the marine environment.

Potable Water

The Reverse Osmosis (RO) potable water maker unit is the primary means for potable water supply at GWA. The unit can produce 40 m^3/day of potable water. Chlorinated seawater from the sea water distribution header is fed into the RO watermaker package. Within this package, the sea water pressure is boosted by a LP feed pump to maintain the required inlet pressure to the RO HP feed pump. Seawater passes through a media filter to remove coarse suspended solids, a carbon filter to remove chlorine and odour, and a cartridge filter to remove fine suspended solids. Anti-scalant is added and the seawater pressure boosted by the HP feed pump to pressurise the feed to the RO membranes. The seawater passes through the RO membrane separation units to produce potable water (permeate) and saline water (sent to the non-hazardous open drains system). The potable water then passes through a calcite filter to remineralise and into a two potable storage tanks before being transferred out to the potable water distribution. The RO package includes a Clean-in-Place (CIP) system for periodic cleaning.

A secondary potable water supply is also available. The water is transported to the platform by platform support vessel and transferred into the two potable storage tanks via a dedicated bunkering hose.

3.6.5.4 Power Generation

In addition to the export compressor power generation turbine, GWA's main power generation system (for electrical power supply) consists of six gas turbine-driven generator (GTG) units (Solar brand). The generators supply 3-phase electrical power at 6.6 kilovolt and 50 Hertz to the high voltage power distribution system, which in turn supplies power to all electrical equipment on the platform. All generator units have the capability to operate on fuel gas or diesel.

The GTG units are supplemented by a Battery Energy Storage System (BESS) which has been installed to support the GTGs in the event of GTG trip, thereby allowing the facility to operate on

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three online GTGs rather than four. The BESS consists a 1MWh capacity lithium-ion battery backup system installed within a standalone container in Module F.

In the event of failure of the main generation system, an emergency generator provides the platform emergency power. It starts automatically, connects to essential switchboard bus 'A' and maintains all essential and vital services. Essential services are those which when failing in operation or when failing if called upon, affects the continuity, quality or the quantity of the product. Vital services are those which, when failing in operation or if called upon, can cause unsafe condition of the process and/or electrical installation, jeopardize life or cause major damage to the installation.

Should the emergency generator fail, the two 415 Volt, 50 Hertz, 120 kVA Uninterruptable Power Supply (UPS) systems backed up by separate batteries, continue to keep vital equipment including fire and gas, ESD and PSD (Production Shutdown) systems to operate for a period of time. The power sources of the vital loads include UPS, emergency power system and battery backup.

3.6.5.5 Sewage and Putrescible Wastes

Sewage from the ablutions is disposed to ocean via the sewage caisson.

Putrescible waste (principally food scraps) is either ground to less than 25 mm diameter and disposed to ocean via the sewerage caisson or bagged and transported to shore for disposal as domestic waste.

3.6.5.6 Sand Management

In 2012, desanding equipment was commissioned to provide the capability to intercept and remove sand particles from the well stream that feeds the production processing equipment of GWA T200 (LP train). This equipment eliminates the need for production shutdowns to remove sand deposition from process vessels. The desanding system consists of a desander, accumulator and transportable disposal vessels.

The design basis for the equipment is to continuously collect sand in an accumulator on the platform, and periodically transfer sand to one of three transportable disposal vessels for shipment and onshore disposal. The desander is capable of processing up to 500 kg/day sand.

3.6.6 Lifting Operations

Two pedestal cranes are provided on the GWA facility, one on the east side and one on the west side. Both cranes are of 'A' frame design and driven by diesel engines. A 16 tonne beam mounted electric hoist is also located in module A, level one for the removal and installation of the seawater and fire water pumps.

Routine Lifting from Platform Support Vessels

Routine lifting operations primarily include transferring stores and equipment from a support vessel to the facility. Lifts can be conducted from either of the main cranes depending on weather conditions. Support vessels are equipped with dynamic positioning (DP) systems for holding station during lifting operations.

The types of 'lifted equipment' may vary but generally include containers or skips of various sizes. The stores and equipment required by the facility are secured inside the skip or container. Containers for supply of chemicals are also routinely lifted. The equipment is appropriately rated for offshore lifting.

Following the completion of offloading from the supply vessel, the facility backloads any items to be returned to shore to the supply vessel. These primarily include empty skips or containers or skips containing waste for onshore disposal.

Lifting around the Facility

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Once lifted to the lay down area, there may be a need for re-positioning of equipment at various locations throughout the facility for operational purposes. This includes lifting stores or equipment to various landing areas throughout the facility for unloading or use, moving waste bins to required areas and relocating ISO containers to Module B roof.

There may be occasions where a non-routine piece of equipment may need to be lifted. On these occasions, the equipment is packed up in a container or an approved lifting frame.

3.6.7 Diesel Bunkering

Low sulphur diesel is transferred to GWA in bulk from supply vessels via the east and west bunkering stations. Diesel is filtered prior to entering the storage facilities in the east and west crane pedestals. The diesel is pumped from this location to the filter/coalescer package for clean-up before distribution to the user areas. Diesel is metered and distributed to the users via a continuously pressured ring main. Unused diesel is recycled back to the crane pedestals. Each user is isolated from diesel supply interruptions by the provision of break tanks. Diesel is required for:

- temporary equipment;
- turbine generators (back up to fuel gas);
- emergency generator;
- drilling generator;
- east and west cranes;
- firewater pumps; and
- lifeboats.

3.6.8 Safety Features and Emergency Systems

A range of safety features and emergency systems have been integrated into the design and operation of the GWA facility to manage safety risk and associated major environment risk. The safety features and emergency measures in place of the GWA facility are listed in the GWA Safety Case.

3.7 Vessels

3.7.1 Support Vessel Operations

Vessels, either LNG or diesel-powered, are used in a support capacity for transferring materials, equipment, and personnel in emergency scenarios from the facility. Vessels are also used for project field work such as subsea intervention (e.g. IMR of subsea infrastructure).

3.7.2 Facility Support Vessel

Various facility support vessels are used (depending on schedules and availability) to transfer material and equipment to and from GWA. The specifications for the *Siem Thiima*, a typical support vessel are listed in **Table 3-5**. Current schedule is for a vessel to visit the facility fortnightly for supply activities. While in the field, the vessel also backloads materials and segregated waste for transport to the King Bay Supply Facility near Dampier and carries out standby duties during activities such as helicopter operations and working over the side, when required.

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Table 3-5: Indicative facility support vessel specifications (*Siem Thiima*)

Attribute	Details
Type	Facility Support Vessel
Length overall	89.2 m
Breadth	19.0 m
Draft	7.6 m
Dead weight tonnage	5,500 t
Accommodation	Berthing for 25 personnel
DP System	DP2
Fuel type	Dual fuel, diesel and LNG

3.7.3 Subsea Support Vessels

Subsea support vessels, including uncrewed surface vessels, are also used for field work such as subsea IMR activities. Vessels supporting offshore activities may vary depending on operational requirements, vessel schedules, capability and availability.

Typical subsea support vessels use DP to manoeuvre and to avoid anchoring when undertaking works near subsea infrastructure. However, these vessels are also equipped with anchors, which may be deployed in an emergency.

3.7.4 Heavy Lift Vessel

A heavy lift vessel (HLV) may be used for the removal of redundant equipment. The HLV uses a DP system to allow maneuverability and avoid anchoring when undertaking works, due to the proximity of subsea infrastructure. Indicative HLV specifications are provided in **Table 3-6**.

Table 3-6: Indicative heavy lift vessel specifications

Attribute	Details
Type	Heavy lift Vessel
Length overall	Up to 210 m
Breadth	Up to 47 m
Draft	Approximately 11 m
Dead weight tonnage	Up to 51,000 t
Accommodation	~ 60 persons
DP System	Minimum DP2
Fuel capacity	Up to 5000 m^3 in total (individual tanks in the order of 1000 m^3)

3.8 Helicopter Operations

Helicopters are the primary means of transporting passengers and/or urgent freight to/from the GWA facility and support vessels. They are also the preferred means of evacuating personnel in the event of an emergency. No helicopter refuelling occurs on GWA. Helicopter support is principally supplied from Karratha Airport. There are typically 5-7 transfers per week, depending on operational requirements.

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3.9 Hydrocarbon and Chemical Inventories and Selection

3.9.1 Hydrocarbons

The main hydrocarbon inventories associated with major topside process equipment is presented in MEE-03 in **Section 6.8.5**. Non-process inventories of hydrocarbons used on the GWA facility are outlined in **Table 3-7**.

Table 3-7: Bulk inventories of non-process hydrocarbons and chemicals

Material	Storage Means	Storage Capacity
Diesel	Diesel storage tanks (x2)	343 m^3 total (East crane pedestal 194 m^3, West crane pedestal 149 m^3)
Lube oil/seal oil/Hydraulic oil	Various size containers based on type and use	Various – general 20 L and 205 L drums and 1000-4000 L bulk containers

3.9.2 Chemical Usage

Chemicals are utilised on the GWA facility for a variety of purposes and can be divided into two broad categories (operational and facility maintenance), as described below.

3.9.2.1 Operational Chemicals

Operational Process Chemicals

A process chemical is the active chemical added to a process or static system, which provides functionality when injected in produced fluid, utility system streams or for pipeline treatment. These chemicals may be present in routine or non-routine discharge streams from the GWA facility. Examples include corrosion inhibitors, biocides, scale inhibitors, demulslifiers, glycols and hydrate inhibitors.

Operational Non-Process Chemicals

Non-process chemicals include chemicals which do not fall into the category described above but which may be required for operational reasons and, by virtue of their use, may be intermittently discharged or have the potential to be discharged (e.g. required as a result of maintenance or intervention activities). Examples include subsea control fluids, dyes and well intervention/workover chemicals.

3.9.2.2 Non-operational Chemicals

Non-operational chemicals include chemicals which are required for general maintenance or ‘housekeeping’ activities and are critical for overall maintenance of the facility and its equipment. These may include paints, degreasers, greases, lubricants and domestic cleaning products. They may also include chemicals required for specialty tasks, such as laboratory testing and analysis. Maintenance chemicals generally present negligible risk to the environment as they are not discharged as a result of their use (e.g. paint) or are used intermittently and discharged in low volumes (e.g. domestic cleaning products).

3.9.2.3 Indicative Chemical Inventories

An indicative list of bulk chemicals commonly used on the GWA facility, and estimated storage quantities, is summarised in **Table 3-8**. Other chemicals may be used on GWA in the future if chemical requirements change, for example, during GWF-3 commissioning (initial start-up) activities, there may be also be temporary well clean-up skid which may include water clarifiers. In addition to the chemicals listed, the GWA facility may also maintain other small volumes of various operational chemicals and facility maintenance chemicals as previously described.

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Table 3-8: Indicative bulk inventories of chemicals

Material	Storage Means	Storage Capacity
Corrosion Inhibitor	Transportable containers from supplier (usually one connected, one on standby)	4 m^3 per container. Generally maximum 8 m^3.
Triethylene Glycol (TEG)	Glycol storage tank	23 m^3
MEG	2 x MEG storage tank	30 m^3
Biocide	Stored in the Chemical Store on GWA.	20 L containers
Scale Inhibitor (provision for future use)	Transportable containers from supplier	4 m^3 per container.
Subsea Control Fluid	Hydraulic Power Unit Tank stores 'in use' fluid. Additional fluid stored in drums.	~2 m^3

3.9.3 Environmental Consideration During Chemical Selection, Assessment and Approval

Operational chemicals required by the Petroleum Activities Program are selected and approved in accordance with Woodside's process for selecting and assessing chemicals. This process is used to reduce potential impacts and risks associated with chemical use to ALARP by selecting chemicals with the lowest practicable environmental impacts and risks, subject to technical constraints.

A summary of the environmental requirements of the Chemical Selection and Assessment Environment Guideline is outlined below.

Environmental Selection Criteria

Woodside's process for selecting and assessing chemicals 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 (background on the OCNS scheme is provided below).

Operational chemicals are selected/assessed in compliance with the Woodside process for selecting and assessing chemicals, specifically:

- where operational chemicals with an OCNS rating of Gold/Silver/E/D and no OCNS substitution or product warning are selected, or a substance is considered to pose little or no risk to the environment, no further control is required. Such chemicals do not represent a significant impact on the environment under standard use scenarios and therefore are considered ALARP and acceptable
- if other OCNS-rated or non–OCNS-rated operational chemicals are selected, the chemical is assessed as follows:
  - if there is **no planned discharge** of the operational chemical to the marine environment, written technical verification of the 'no discharge' fate is provided, and no further assessment is required
  - if there is **planned discharge** of the operational chemical to the marine environment, a further assessment and ALARP justification is conducted.

The ALARP assessment considers chemical toxicity and biodegradation, and bioaccumulation potential, using industry standard classification criteria (Centre for Environment, Fisheries and Aquaculture Science scheme criteria).

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

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

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 are investigated, with preference for options with a hazard quotient (HQ) band of Gold or Silver, or in OCNS Group E or D with no substitution or product warnings.

If no more environmentally suitable alternatives are available, further risk-reduction measures (e.g. controls related to use and discharge) are considered for the specific context and implemented where relevant to ensure the risk is ALARP and acceptable.

Once the further assessment/ALARP justification has been completed, confirmation that the environmental risk as a result of chemical use is ALARP and acceptable is obtained from the relevant manager.

Background Overview of OCNS

The OCNS Scheme 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 listed 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 one of two schemes (as shown in **Figure 3-5**):

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

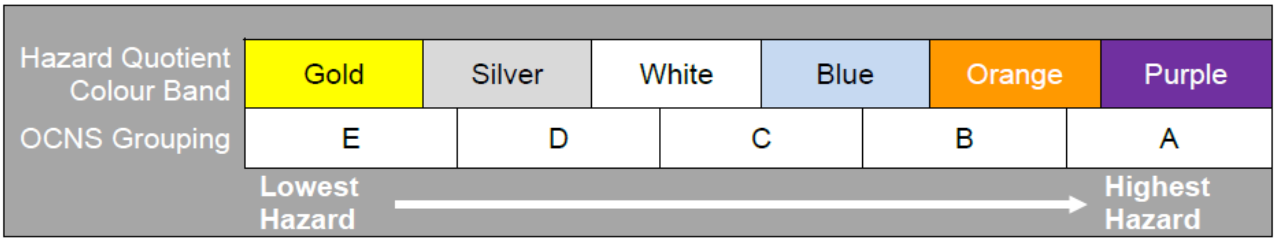

Figure 3-5: OCNS ranking scheme

3.10 Subsea Inspection, Monitoring, Maintenance, and Repair Activities

Subsea infrastructure is designed not to require significant intervention. Inspection and maintenance are undertaken to ensure the integrity of the infrastructure and identify problems before they present a risk of loss of containment. Intervention may be required to repair identified problems.

To manage subsea threats (risks) the IMMR process requires an appropriate response to be selected to manage specific equipment risks. This is typically one of: Inspection, Maintenance, Monitoring or Repair (IMMR).

The IMMR process for subsea infrastructure, including redundant equipment (**Section 3.10.4**), maintains equipment in good condition and repair, for production and to enable future removal.

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Subsea activities are typically undertaken from a subsea support vessel or Uncrewed Surface Vessel (USV) and may use an ROV with transponders to inspect equipment. For some activities, ROVs may also be deployed from the GWA platform.

Maintenance and repair activities may require the deployment of frames/baskets which are temporarily placed on the seabed. These typically have a perforated base with a seabed footprint of about 15 m^2. This temporary equipment is removed from field via recovery to project vessels at the completion of IMR activities.

Typical IMR activities are described below.

3.10.1 Inspections

Inspection of subsea infrastructure is the process of physical verification and assessment of components in order to detect changes to the as-installed location and condition by comparison to initial state following installation and previous inspections. Details of typical subsea infrastructure inspections/surveys and indicative frequencies are provided in **Table 3-9.** Inspection of ETA wellheads are determined by the WOMP. Scope and frequency of subsea equipment (operational and redundant) and pipeline inspections are determined using a Risk Based Inspection (RBI) methodology and associated plans.

RBI is commonly used within the industry as a method for determining inspection frequencies (Energy Institute, 2009; DNV, 2019). RBI for pipeline systems that have reached cessation of production inherently pose less risk to the environment and may drive a less frequent inspection frequency.

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Table 3-9: Typical subsea infrastructure inspections/surveys and frequencies

Type of Inspection/Survey	Subsea infrastructure	Purpose	Approximate Frequency
General Visual Inspection	All subsea infrastructure, including exploration wellheads	Check general infrastructure integrity.	Varied – every 2-8 years
Close Visual Inspections	All subsea infrastructure	Investigate certain subsea infrastructure components.	Varied – every 2-6 years
Cathodic Protection	All subsea infrastructure	Check for corrosion and renew sacrificial anodes, if required.	Varied – every 2-6 years
Wall Thickness Surveys	Production and crossover manifolds, flowlines and pipelines	Monitor the condition of subsea infrastructure. (i.e. ultrasonic testing). Typically only performed if a specific threat is identified through other means.	Typical: Once every 25 years. Worst Case: Once every 5 years
Acoustic survey including Multibeam Sonar (MBES)	Pipelines.	Identify buckling, movement, scour and seabed features. Low frequency/ intensity signals undertaken on the flowlines.	Varied – every 1-6 years
Non-Destructive Testing	Pipeline and manifolds (if required)	Evaluates the properties of material/items using electromagnetic, radio graphic, acoustic resonance technology, ultrasonic, or magnetic equipment.	Typical: Once every 25 years. Worst Case: Once every 25 years per well
Seabed sampling surveys including minor grabs/cores	NA	Identify benthic fauna, sediment characteristics, determine level of penetration / compaction, etc. Grabs/cores typically disturb 0.1m^2 of seabed per sample.	Typical: Once every 25 years. Worst Case: Once every 5 years
Anode inspections and/or replacement	Production and crossover manifolds, trees, flowlines and pipelines	Samples taken of anode materials for testing.	Typical: Once every 25 years.
Marine growth sampling	All subsea infrastructure	Samples taken of marine growth for testing.	Typical: Once every 25 years. Worst Case: Once every 5 years
Sub bottom profiling	Around subsea components	Low frequency echo sounder undertaken to identify returns of metals under the seabed	Varied – every 1-6 years
Laser surveys	Dimensional check on spools	Used to conduct dimensional checks on spools etc. and measure proximity.	Varied – every 1-6 years

3.10.2 Monitoring

Monitoring of subsea infrastructure refers to the process of surveillance of the physical and chemical environment that a subsea system or component is exposed to in order to determine if and when damage may occur, and (where relevant) predict the rate or extent of that damage. Monitoring activities may include process composition testing, corrosion probes, corrosion mitigation checks, metocean and seismic monitoring, and cathodic protection testing. Other monitoring activities include process monitoring (temp, pressure, etc.), cyclone weather monitoring, and hydraulic fluid usage.

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3.10.3 Maintenance

Maintenance activities on subsea infrastructure are those required at regular or planned intervals to prevent deterioration or failure of infrastructure. Typical maintenance activities are described in **Table 3-10.**

Table 3-10: Typical maintenance activities and frequencies

Type of maintenance	Subsea infrastructure	Purpose	Approximate Frequency
Cycling of valves via control system	Wells and manifolds	Test functionality of technical integrity valves	Every 6 months for well barriers during operations
Marine growth removal	Production and cross over manifolds and retrieval components (e.g. chokes) and jacket cleaning	Reduce weight or gain visual access	Based on outcomes from visual inspections (**Table 3-9)** and marine growth trends on regional infrastructure
Flushing of chemical hydraulic fluid lines	Hydraulic fluid lines	For repair scenarios	When required for repair
Leak and pressure testing	All subsea infrastructure	Test integrity of subsea infrastructure	Following installation of subsea infrastructure components after a repair or intervention, prior to return to service

3.10.4 Repair

Repair activities are those required when a subsea system or component is degraded, damaged or has deteriorated to a level outside of acceptance limits. Damage sustained may not necessarily pose an immediate threat to continued system integrity but may present an elevated level of risk to environment or production reliability. Due to the design of subsea infrastructure and materials used, repairs are undertaken on an as needs basis. The requirements and frequency of these repairs are dictated by the outcome of the inspection and maintenance regimes described in **Table 3-9** and **Table 3-10**. Typical subsea repair activities included but not limited to, are described below.

- subsea choke and/or battery module replacement
- chemical injection metering valve insert replacement
- SCM or electrical distribution unit (EDU) replacement
- power and communications router, tree and downhole replacement
- multi-phase flow meter retrievable module replacement
- acoustic sand detector replacement
- hydraulic control router replacement
- hydraulic flying lead (HFL) replacement
- electrical flying lead (EFL) replacement
- pipeline or spool support with grout bag, mattress, anchors or rock dumping
- spool disconnection and/or replacement
- umbilical jumper replacement and/or relocation, including PoG subsea communications system repair
- flowline/pipeline replacement
- scour prevention installation

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- cathodic protection system replenishment/repair.

When equipment is replaced, the redundant equipment, may remain *in-situ* or be removed from the field. The location of redundant subsea infrastructure items is recorded as part of the ROV as left survey and included in a database for GWA subsea inventory (**Table 3-3**).

3.10.5 Subsea Chemical Usage

Planned chemical discharges may occur during a range of subsea system operation and IMR activities. However, these are either small volumes, or discharged intermittently. Operational chemicals to be used in the GWA subsea infrastructure are selected and assessed using Woodside's chemical selection and assessment guideline, as detailed in **Section 3.9.3**. Typical chemicals which are used in the GWA subsea infrastructure and may be released during IMR activities include, but are not limited to:

- control fluid – The subsea control fluid presently used in GWA subsea systems is HW443 (with the exception of the closed loop IFL SSIV system, which uses HW525). HW443 is a water-based product; the major component of which is ethylene glycol. Control fluid may be dosed with dye to support integrity monitoring.
- hydrate control – MEG and TEG are used for hydrate control
- corrosion inhibitor - Corrosion inhibitor is generally used to manage and prevent corrosion within pipeline and flowlines
- biocide - Biocides are generally used to prevent the bacterial growth in pipelines that may cause corrosion
- acid - Where removal of calcium deposits is required Woodside typically uses sulphamic (or equivalent) acid. Alternatives such as citric acid or calcium wash may be used
- oxygen scavenger - Oxygen scavenger is used to reduce/de-oxygenate the pipeline and prevent corrosion and aerobic bacterial growth
- surfactant - Surfactants are formulated to remove water and organic deposits from pipelines
- grout - The material used in grout, mattresses and rock is typically concrete-based
- staurolite products – Used for abrasive/sand blasting to clean and remove marine growth, the main component is staurolite, which is a naturally forming mineral.

3.10.6 Typical Discharges During IMR Activities

Minor environmental discharges are expected during subsea IMR activities (e.g. during pressure/leak testing or flushing). Where practicable, flushing is performed before a subsea component is disconnected to reduce residual hydrocarbon or chemical releases to the environment upon disconnection. The flushing chemicals used for this activity may be supplied from either the facility or a chemical package via a downline from a support vessel. Where possible, flushed fluids will return to the platform and be processed and treated through the production system. **Table 3-11** below shows typical discharge volumes during different IMR activities.

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Table 3-11:Typical Discharge Volumes During Different IMR and Subsea Activities

Activity	Description
Pressure/Leak testing	Chemical dye estimated <10L.
Flushing	Residual hydrocarbon or chemical release (corrosion inhibitor and oxygen scavenger) volume is dependent upon injection port size, component geometry and pumping rates.
Hot stab change out	Hydrocarbons or control fluid estimated <10L.
SCM Changeout	A typical release of diluted acid is estimated to be 400L and of control fluid is estimated to be 10L.
Jumper and Umbilical Replacement	Typical releases of hydraulic fluid, MEG and corrosion inhibitor are estimated to be <40L each, typical acid release of <80 L.
Choke Change Out	Release of hydrocarbons <10L and a typical release of MEG is estimated to be 280L, typical acid release of <80 L.
Tree cap change out	Release of hydrocarbons estimated <50L and a typical release of MEG is estimated to be <50L.
Logic plate change out	Release of hydrocarbons estimated <20L and a typical release of MEG is estimated to be <20L.
Flowline or spools repair, replacement and recovery	Typical release of hydrocarbon or other chemicals depends on equipment configuration and flushing ability. This will be subject to an ALARP determination for the activity, as per normal practice.

3.10.7 Marine Growth Removal

Due to the relatively high rate of marine growth on the NWS, it is often necessary to remove excess growth prior to undertaking many subsea IMR activities. Marine growth removal is undertaken by an ROV or a diver. The different techniques are described in **Table 3-12**.

Table 3-12: Marine growth removal techniques

Activity / Equipment	Description
Water jetting	Uses HP water to remove marine growth.
Brush systems	Uses brushes attached to a ROV to remove marine growth.
Acid (typically sulphamic Acid)	Chemically dissolves calcium deposits.
Sand/abrasive blasting	Additional cleaning to allow close visual inspections.

3.10.8 Sediment Relocation

If sediment builds up around a pipeline or other subsea infrastructure, an ROV-mounted suction pump/dredging unit may be used to relocate the sediment to allow inspection/works to be undertaken. This activity is limited to the relocation of small amounts of sediment material in the immediate vicinity of the subsea infrastructure (i.e. within the existing footprint). Sediment relocation typically results in minor seabed disturbance and some localised turbidity.

3.10.9 Pigging Operations

During pipeline or flowline life cycle there may be a need to conduct pigging for a variety of reasons, e.g. inspection, maintenance, repair or to facilitate modifications. Should pigging of these pipelines be required, provision has been made for the installation/recovery of a temporary subsea/topsides pig launcher/receiver. The entire pipeline pigging system including the launcher, receiver and the respective pipelines are designed for maximum operation pressure of the production system.

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The IFL can be pigged using the GWA sphere launcher, which is a permanently installed pig trap. Generally, there are no routine discharges associated with this operation. The SSIV may be temporarily locked open for pigging activities.

3.11 Platform Well Production, Management and Maintenance Activities

As the GWA facility has platform based wells, a number of well management and well maintenance activities are conducted from the platform. This may include routine maintenance and inspection activities through to well interventions, workovers and well kill.

Interventions of the GWA subsea wells require a suitable vessel or drill rig to accommodate and support intervention packages and do not form part of the scope of this EP. An outline of platform based well management and maintenance activities are provided below.

3.11.1 Well Intervention

Well intervention activities can be initiated by a number of scenarios that may occur during the Operate Phase of a well’s lifecycle. Interventions may be undertaken for reservoir surveillance, enhancing productivity / injectivity, assessing wellbore condition and restoring well integrity.

Well interventions may include the following activities:

- wellhead maintenance (including actuator, valve, choke and tree change outs)
- annulus fluid top-ups, Echo meter shots and chemical inhibition
- electric-line, slick-line and coiled tubing interventions
- logging or surveys
- fishing junk or lost-in-hole equipment
- setting and recovering plugs and wireline insert subsurface safety valves
- mitigating safety critical failures (e.g. failed safety valve)
- chemical squeeze operations
- perforating the wellbore.

3.11.2 Routine Wellhead Maintenance

Wellhead maintenance is conducted routinely on all surface wellheads/trees in accordance with the relevant Facility Well Integrity Management Plan.

Wellhead maintenance consists of greasing and functioning the wellhead/Xmas tree valves and replacement of any non-serviceable items. Integrity testing of the valves is also completed and recorded by the facility.

3.11.3 Well Workover

Well workovers generally involve recovery and re-installation or replacement of production / injection completion strings. On the GWA facility, well workovers are undertaken using a Hydraulic Workover Unit (HWU). Workovers may be required to replace or repair failed downhole well equipment including tubing, casing, liners or other completion components. In order to be worked over the well must be plugged, as outlined below.

During the workover activities, the well fluids are isolated by a deep well plug (and packer) and Blowout Preventer (BOP). In addition, the combination of the choke/kill manifold and brine is used as means of detecting and controlling the well fluids. If a kick is detected, appropriate controls are initiated to prevent further escalation, e.g. kill fluid pumped into the well (see below) or BOP shut.

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3.11.4 Well Kill

This is an operation to displace reservoir fluids from the wellbore by replacing them with a weighted fluid system (kill fluid) to achieve zero and stable shut-in tubing head pressure. A well kill may be required in the event that well integrity is compromised and provides a means of mitigation until such time that a more permanent fix can be implemented to re-instate full well integrity. A well kill may also be carried out to facilitate planned, routine well workover and intervention activities.

The kill fluid formula is selected according to the characteristics of the well and the reservoir fluids. Chemically treated and coarsely filtered seawater has been concluded to be an acceptable kill fluid for all GWA wells.

The following two well kill options would most likely be used on GWA:

- bull heading, where well kill fluid is pumped at a high rate and the hydrocarbon is forced back into the reservoir
- lubricate and bleed, where the reservoir is isolated/plugged and well kill fluid is introduced into the well bore and the hydrocarbon (gas) is bled off.

If well integrity is compromised and depending on the scenario, a mobile well kill package may be mobilised to the platform to kill the well.

3.11.5 Management of Activities

During intervention and workover activities, well control for the prevention of any release of reservoir fluids to the environment is achieved by various barriers such as plugs (including deep set), kill fluids and BOPs. Two or more confirmed barriers are maintained under normal circumstances and in cases with fluid columns being maintained, wells are constantly monitored for kicks. Should a barrier fail or a kick is detected, appropriate actions (consistent with good oil field practice and standards) are undertaken to restore barrier integrity and / or well control. However, as the work being undertaken on the GWA facility relates to production wells, the reservoir pressure is known and therefore, the potential for kicks are low; especially if the fluid level is maintained.

3.11.6 Chemical Use and Discharges

Interventions, workovers and well kills may typically involve the use and discharge of chemicals which may include, but not limited to:

- glycol
- high viscous (hi-vis) polymer pills or sweeps
- surfactant and / or solvent pills or sweeps
- fluid loss control and / or lost circulation material pills
- seawater, raw or inhibited with any combinations including biocide, oxygen scavenger, caustic or soda ash
- brine, KCl / NaCl, raw or inhibited with any combinations including biocide, oxygen scavenger, caustic or soda ash.

Any chemicals or fluids used for the above operations are selected in accordance with Woodside's chemical selection and approval guideline (**Section 3.9.3**).

3.11.7 Well Clean-up

When commissioning wells or conducting well workovers, there is a need to clean-up the remaining fluids left behind in the well, which consists of chemicals, residual hydrocarbons or other foreign fluids in the wellbore.

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- gas: routed into the production process where possible, or flared if unsuitable
- fluids: routed to the HP flare KO drum which discharges liquids to the hazardous closed drain system
- wastes (may include fluids and sand / solids): managed as appropriate based on composition. Solids are separated for onshore disposal. An additional strainer may be placed in the flowlines prior to the main separators to remove any large debris that may be present within the wellbore.

Platform well clean-up activities are managed within 30mg/L 24 hour rolling average OIW concentrations.

3.11.8 Production from High Water Cut Wells

Water production on GWA wells has increased over time, resulting in a number of high water cut wells (e.g. GWA03, 05, 08, 18 and 19) that are available for production without further well intervention required. Routine GWA water production operates under a 30 mg/L OIW limit over a 24-hour rolling average. Previously it was necessary to choke back or shut in these high water cut wells to meet the 24-hour 30 mg/l rolling average.

Well unloading of long-term shut-in high water cut wells requires a faster than usual bean-up rate to ensure a successful kick-off of these wells and unload the formation water in the wellbore. This ensures the gas velocity is sufficient to lift the accumulated column of liquid in the wellbore initially and subsequently sustain production of reservoir fluids without loading the wellbore with water. This rapid bean up does not allow sufficient water residence time in the separation process units, potentially resulting in higher than normal instantaneous OIW values. Historically, these higher than normal OIW values caused the well to be shut-in again, before the kick-off activity could be completed.

Trials in 2019-2021 demonstrated that elevated OIW concentrations experienced during short-term high or unstable water production through topsides process equipment, did not represent long term OIW performance, as OIW concentrations reduced at steady water production rates. Further production from the unloaded high water cut wells showed decreasing peaks in OIW on restart, depending on the duration of shut in. Accordingly, startup of high water cut wells is now classified into well unloading, well cycling and normal production (**Table 3-13**). Well unloading and well cycling only occur as planned activities with relevant operational controls, as detailed in **Section 6.6.5**.

Table 3-13: High Water Cut Well start up activities based on duration since last production

Activity	Description	Production history
Non-routine: Well Unloading	Offline for a substantial period of time and can behave differently when returned to production Requires faster than usual bean-up rate to ensure a successful kick-off to unload formation water in the wellbore Rapid bean up does not allow sufficient water residence time in the separation process units potentially resulting in higher than normal instantaneous OIW values	>12 months since last production
Non-routine: Well Cycling	Has been unloaded following an extended shut in period. A receding aquifer with reservoir properties such as high permeability sands to facilitate aquifer movement into the reservoir. Sufficient reservoir pressure to support well kick off Shut in when gas can no longer be lifted to topsides due to water-gas ratio (WGR), cycled on and off approximately three monthly	>3 and <12 months since last production
Routine: Normal production	Wells that are part of normal, recent production (including high water cut)	< 3 months since last production

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4. DESCRIPTION OF THE EXISTING ENVIRONMENT

4.1 Overview

In accordance with Regulations 13(2) and 13(3) of the Environment Regulations, this section describes the existing EMBA by the activity (planned and unplanned, as described in **Section 3**), including details of the particular relevant values and sensitivities of the environment, which were used for the risk assessment.

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 combined potential spatial extent of surface and in-water hydrocarbons at concentrations above ecological impact thresholds, in the event of the following scenarios (**Section 6.8.3**):

- Scenario 1 - Well blow-out at seabed – highest flow rate subsea well (GDA-05)
- Scenario 2 - Well blow-out at surface – platform wellhead release (GWA-08).
- Scenario 4 - Subsea release from IFL (including 2TL inventory) downstream of SSIV but within 500 m of GWA facility; and
- Scenario 5 - Surface release from IFL (including 2TL inventory) from rupture of riser at GWA facility.

The ecological impact thresholds used to delineate the EMBA are defined in **Section 6.8.1.2**. The EMBA also includes any areas that are predicted to experience shoreline contact with hydrocarbons above threshold concentrations.

Woodside recognises that hydrocarbons may be visible beyond the EMBA at lower concentrations than the ecological impact thresholds defined in **Section 6.8.1.2**. These visible hydrocarbons are not expected to cause ecological impacts. In respect of this, an additional socio-cultural EMBA (SEMBA) is defined, as the potential spatial extent within which social-cultural impacts may occur from changes to the visual amenity of the marine environment. Receptors relevant to the socio-cultural EMBA include Commonwealth and State marine protected areas (MPAs), National and Commonwealth Heritage Listed places, areas of tourism and recreation, and commercial and traditional fisheries. The EMBA and socio-economic EMBA are shown in **Figure 4-1** and described in **Table 4-1**.

The EMBA presented does not represent the predicted coverage of any one hydrocarbon spill or a depiction of a slick or plume at any particular point in time. Rather, the areas are a composite of a large number of theoretical paths, integrated over the full duration of the simulations under various metocean conditions.

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Table 4-1: Hydrocarbon spill thresholds used to define EMBA for surface and in-water hydrocarbons

<table>
<tr><th>Hydrocarbon Type</th><th>EMBA[1]</th><th>Socio-cultural EMBA[1]</th><th>Planning Area for Scientific Monitoring</th></tr>
<tr><td>Surface</td><td>10 g/m^2
This represents the minimum oil thickness (0.01 mm) at which ecological impacts (e.g. to birds and marine mammals) are expected to occur.</td><td colspan="2">1 g/m^2
This represents a wider area where a visible sheen may be present on the surface and, therefore, the concentration at which socio-cultural impacts to the visual amenity of the marine environment may occur. However, it is below concentrations at which ecological impacts are expected to occur.
This low exposure value also establishes the planning area for scientific monitoring (NOPSEMA guidance note: A652993, April 2019).</td></tr>
<tr><td>Dissolved</td><td colspan="2">50 ppb
This represents potential toxic effects, particularly sublethal effects to highly sensitive species (NOPSEMA guidance note: A652993, April 2019). As dissolved hydrocarbons are within the water column and not visible, impacts to socio-cultural receptors are associated with ecological impacts. Therefore, dissolved hydrocarbons at this threshold also represent the level at which socio-cultural impacts may occur.</td><td rowspan="2">10 ppb
This low exposure value establishes the planning area for scientific monitoring (based on potential for exceedance of water quality triggers) (NOPSEMA guidance note: A652993, April 2019). This area is described further in Appendix D: Figure 5-1.
In the event of a spill, DNP will be notified of AMPs which may be contacted by hydrocarbons at this threshold.</td></tr>
<tr><td>Entrained</td><td colspan="2">100 ppb
This represents potential toxic effects, particularly sublethal effects to highly sensitive species (NOPSEMA guidance note: A652993, April 2019). As entrained hydrocarbons are within the water column and not visible, impacts to socio-cultural receptors are associated with ecological impacts. Therefore, entrained hydrocarbons at this threshold also represent the level at which socio-cultural impacts may occur.</td></tr>
<tr><td>Shoreline</td><td>100 g/m^2
This represents the threshold that could impact the survival and reproductive capacity of benthic epifaunal invertebrates living in intertidal habitat.</td><td>10 g/m^2
This represents the volume where hydrocarbons may be visible on the shoreline but is below concentrations at which ecological impacts are expected to occur.</td><td>N/A</td></tr>
</table>

[1] *Further details including the source of the thresholds used to define the EMBA in this table are provided in **Section 6.8.1***

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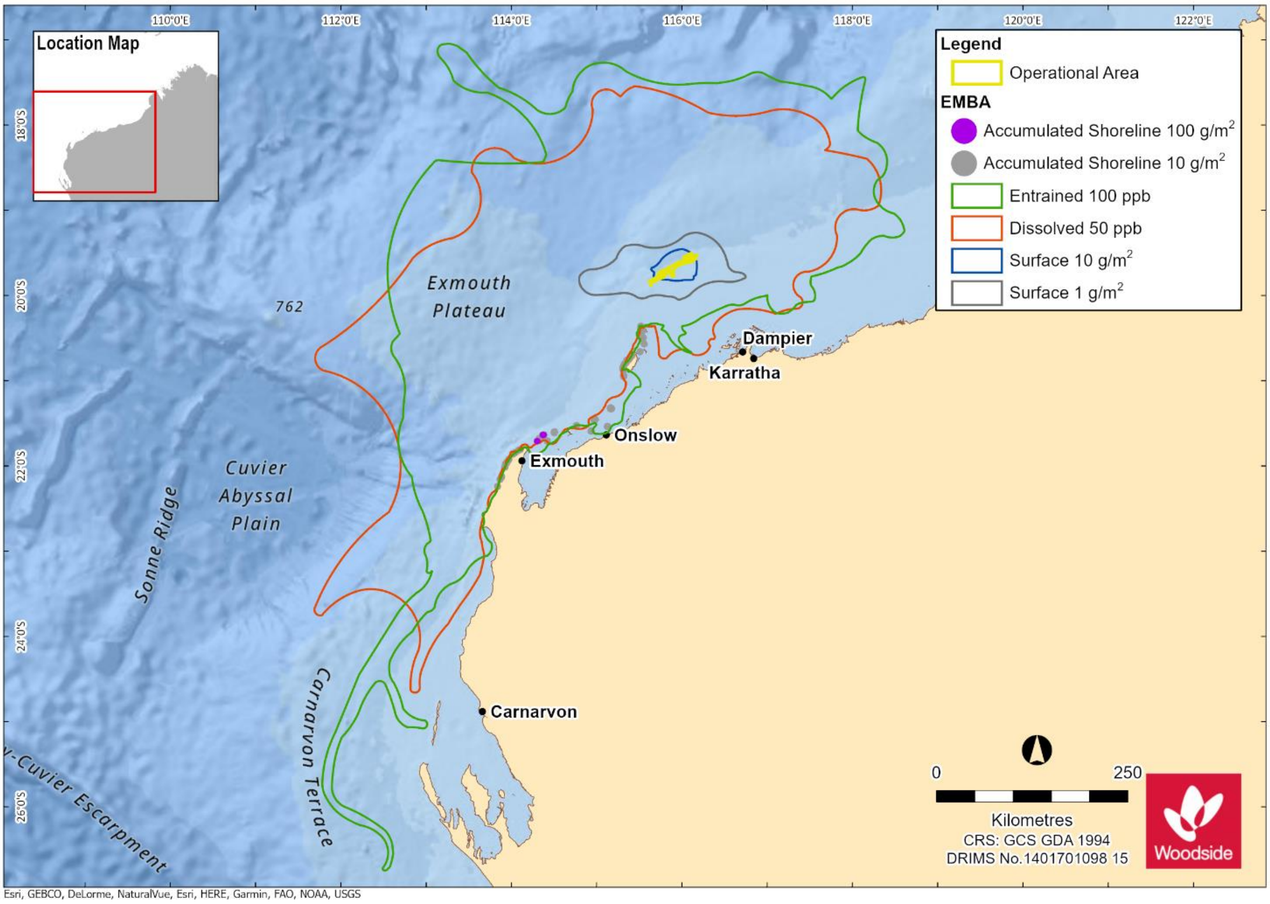

Figure 4-1: Environment that may be affected by the Petroleum Activities Program

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4.2 Regional Context

The Operational Area is located in Commonwealth waters within the North-west Marine Region (NWMR), as defined under the Integrated Marine and Coastal Regionalisation of Australia (IMCRA v4.0) (Commonwealth of Australia, 2006), in water depths of about 77 to 200 m. Within the NWMR, the Operational Area lies within the NWS Province (**Figure 4-2**). The EMBA also overlaps the South-west Marine Region. Woodside's Description of Existing Environment (**Appendix C, Section 2**) summarised the characteristics for the relevant marine bio-regions.

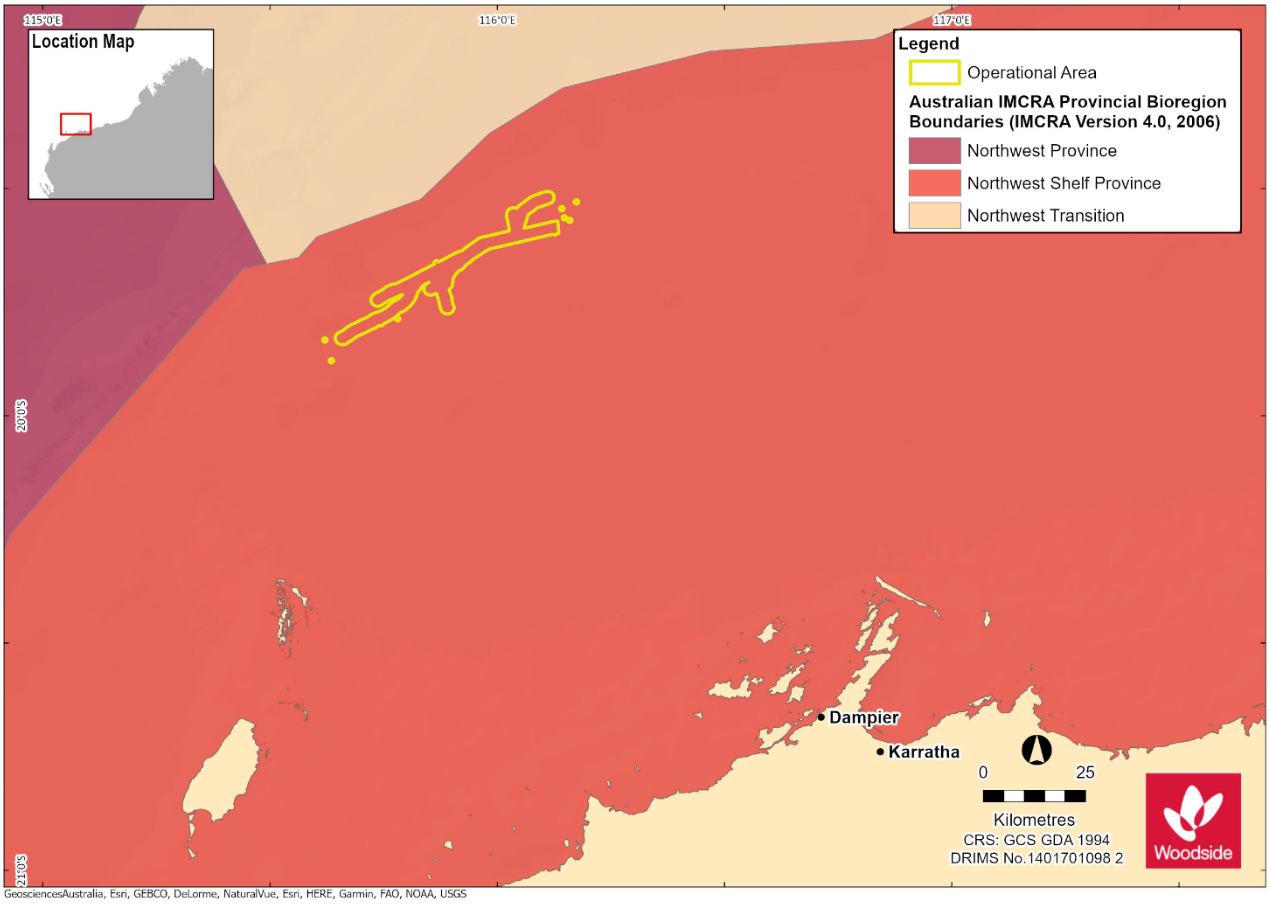

Figure 4-2: Location of the Operational Area and relevant marine bio-regions

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4.3 Matters of National Environmental Significance (EPBC Act)

Table 4-2 and **Table 4-3** summarise the MNES overlapping the Operational Area and EMBA, respectively, according to Protected Matters Search Tool (PMST) results (**Appendix E**). It should be noted that the EPBC Act PMST is a general database that conservatively identifies areas in which protected species have the potential to occur.

Additional information on these MNES are provided in subsequent sections of this chapter and described in detail in **Appendix C, Section 3**.

Table 4-2: Summary of MNES identified by the EPBC Act PMST as potentially occurring within the Operational Area

MNES	Number	Relevant Section
World Heritage Properties	0	**Section 4.9.1.4**
National Heritage Places	0	**Section 4.9.1.4**
Wetlands of International Importance (Ramsar)	0	N/A
Commonwealth Marine Area	1	N/A
Listed Threatened Ecological Communities	0	N/A
Listed Threatened Species	16	**Section 4.6**
Listed Migratory Species	28	**Section 4.6**

Table 4-3: Summary of MNES identified by the EPBC Act PMST as potentially occurring within the EMBA

MNES	Number	Relevant Section
World Heritage Properties	1	**Section 4.9.1.4**
National Heritage Places	1	**Section 4.9.1.4**
Wetlands of International Importance (Ramsar)	0	N/A
Commonwealth Marine Area	2	N/A
Listed Threatened Ecological Communities	0	N/A
Listed Threatened Species	28	**Section 4.6**
Listed Migratory Species	44	**Section 4.6**

4.4 Physical Environment

The Operational Area lies on the outer continental shelf in waters approximately 77 to 200 m deep (**Figure 4-3**). The bathymetry within the Operational Area is generally flat, which is consistent with the broader NWS Province shelf region (Baker et al. 2008). The seabed has a gentle (0.05°) seaward gradient extending to a steep distal slope occurring between 200 to 300 km offshore in water depths of around 200 m (Dix et al. 2005). The continental slope then descends more rapidly from the shelf edge to depths greater than 1,000 m to the north-west (James et al. 2004).

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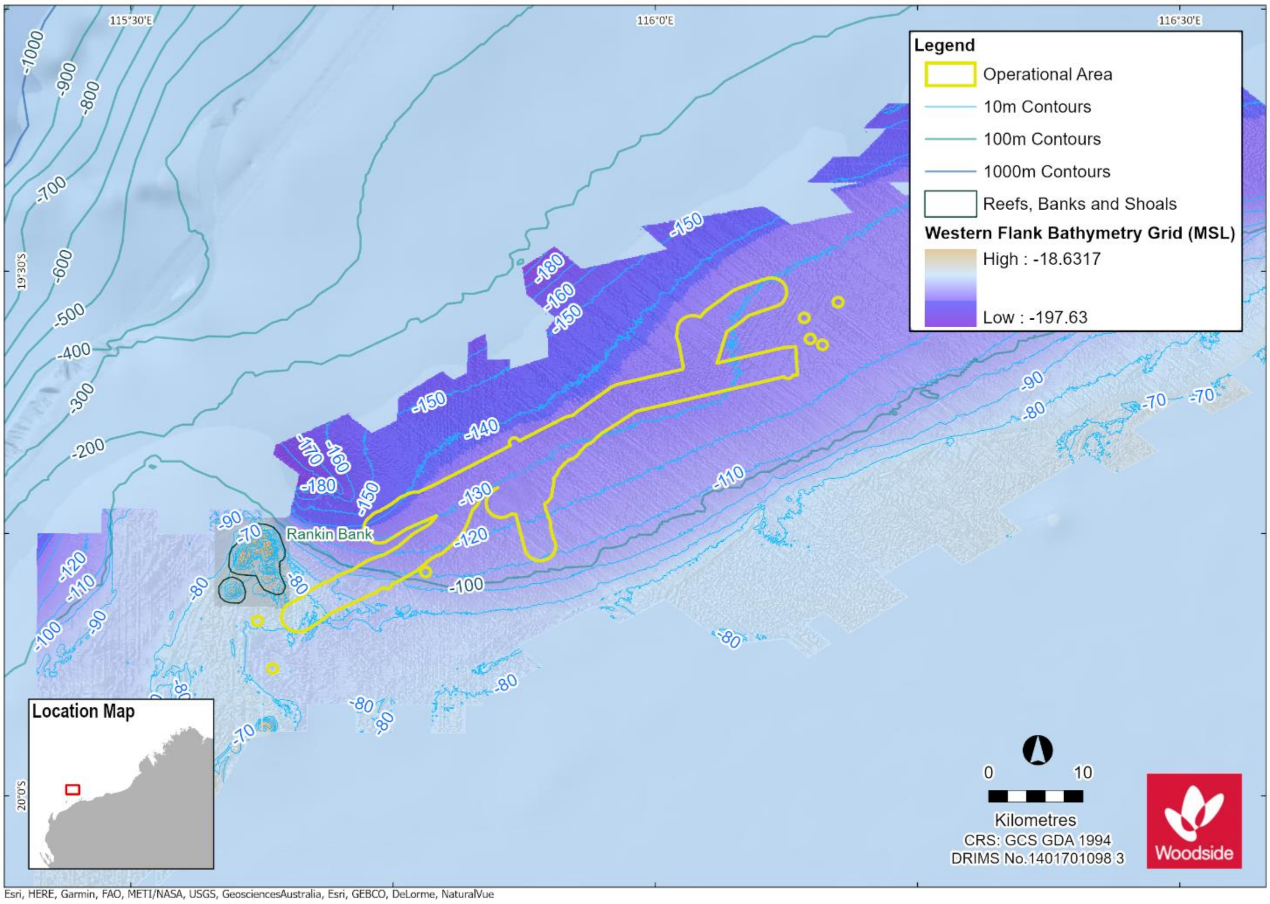

Figure 4-3: Bathymetry of the Operational Area

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4.5 Habitats and Biological Communities

Sediments in the Operational Area are broadly consistent with those in the NWS Province, with typically low levels of potential contaminants of geogenic origin (often below laboratory limits of detection), with the exception of localized areas of elevated barium (AIMS 2014b, RPS 2012a). Elevated barium has been attributed to contamination from historical drilling activities (AIMS 2014b), as barite (barium sulphate) is commonly used in drilling fluids. Sediments in the outer NWS Province are relatively homogenous and are typically dominated by sands and a small portion of gravel (Baker et al. 2008). Fine sediment size classes (e.g. muds) increase with proximity to the shoreline and the shelf break, but are less prominent in the intervening continental shelf (Baker et al. 2008). Carbonate sediments typically account for the bulk of sediment composition, with both biogenic and precipitated sediments present on the outer shelf (Dix et al. 2005). Beyond the shelf break, the proportion of fine sediments increases along the continental slope towards the Exmouth Plateau and the abyssal plain (Baker et al. 2008).

Historical discharge of drill cuttings around wells and the GWA platform has resulted in potential contamination of sediments with drilling fluids (primarily barium, introduced through the historical use of barite in drilling muds). This contamination is typically localised within 200-400 m of the GWA platform, with other potential contaminants such as heavy metals present in low concentrations (BMT Oceanica 2015). Sediments in the Operational Area are expected to be comprised primarily of fine sands, very fine sands and silt, with monitoring near the GWA platform indicating these size fractions constitute the majority of sediments (BMT Oceanica 2015).

While hard substrates are not known to occur within the Operational Area, they occur in the region more broadly and can host more diverse benthic communities. Hard substrate may be associated with the Ancient coastline at 125 m depth contour Key Ecological Feature (KEF) (**Section 4.7**), which overlaps the Operational Area.

Rankin Bank is on the continental shelf, approximately 3 km from the Operational Area at the closest point and approximately 33 km away from the GWA platform. While not a KEF, Rankin Bank, along with Glomar Shoal, is 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 of the Pilbara region (AIMS 2014a). Rankin Bank consists of three submerged shoals delineated by the 50 m depth contour with water depths of approximately 18–30.5 m (AIMS 2014a).

Rankin Bank represents a diverse marine environment, predominantly composed of consolidated reef and algae habitat (~55% cover), followed by hard corals (~25% cover), unconsolidated sand/silt habitat (~16% cover), and benthic communities composed of macroalgae, soft corals, sponges and other invertebrates (~3% cover) (AIMS 2014a). 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 NW Australia (Heyward et al. 2012).

Rankin Bank has been shown to support a diverse fish assemblage (AIMS 2014a). 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) was mapped by AIMS on behalf of Woodside (2014b) and hosts filter feeding communities in areas of consolidated substrate interspersed by sand.

Glomar Shoal is a shallow sedimentary bank comprised of coarser biogenic material than the surrounding seabed. The shoal is 26 to 70 m below the sea surface (Falkner et al. 2009) and lies approximately 60 km east of the Operational Area and 90 km east of the GWA facility. Glomar Shoal has also been identified as a KEF (Falkner et al. 2009). This KEF encompasses a wider area than the shoal feature itself and is located 42 km east of the Operational Area.

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Key habitats and ecological communities within the EMBA are identified in **Table 4-4** and described in below.

Table 4-4: Habitats and Communities within the EMBA

Habitat/Community	Key locations within the EMBA
Seabed characteristics	
Glomar Shoal	Glomar Shoal is a shallow sedimentary bank comprised of coarser biogenic material than the surrounding seabed. The shoal is 26 to 70 m below the sea surface (Falkner et al. 2009) and lies approximately 60 km east of the Operational Area and 90 km east of the GWA facility. Glomar Shoal has also been identified as a KEF (Falkner et al. 2009). This KEF encompasses a wider area than the shoal feature itself and is located 42 km east of the Operational Area.
Ancient Coastline at 125 m Depth Contour	The Ancient Coastline at 125 m Depth Contour KEF, overlaps part of the Operational Area (DAWE 2019a; **Section 4.7**). Areas of this KEF comprise hard substrate and may occur within the Operational Area. Hard substrate seabed habitats present within the Operational Area are likely to support filter feeding biota such as sponges and gorgonians (sea whip and fans), as reported for hard substrate seabed habitat in similar water depths along this outer shelf area of the NWS.
Marine primary producers	
Coral	• Rankin Bank (3 km west) • Glomar Shoal (60 km east) • Montebello Islands (53 km south) • Barrow Island (90 km south) • Ningaloo Coast (280 km south-south west) • Muiron Islands (233 km south-south west)
Seagrass beds and macroalgae	• Montebello Islands (53 km south) • Barrow Island (90 km south) • Ningaloo Coast (280 km south-south west) • Muiron Islands (233 km south-south west) • Exmouth Gulf (245 km south-west)
Mangroves	• Ningaloo Coast (280 km south-south west) • Montebello Islands (53 km south) • Exmouth Gulf (245 km south-west)
Other communities and habitats	
Plankton	Plankton within the Operational Area and EMBA are expected to be representative of the wider NWMR, as detailed in **Appendix C, Section 4.3.** Peak primary productivity within the EMBA occurs in late summer/early autumn, along the shelf edge of the Ningaloo Reef. It also links to a larger biologically productive period in the area that includes mass coral spawning events, peaks in zooplankton and fish larvae abundance (CALM 2005a), with periodic upwelling throughout the year. Further detail regarding productivity at other notable locations within the EMBA (e.g. North-west Cape) is provided in **Appendix C, Section 4.3.3.**
Pelagic and demersal fish populations	Pelagic and demersal fish populations within the Operational Area and EMBA are expected to be representative of the NWMR (described in **Appendix C, Section 5.3**). Particular features within the EMBA that are known to support pelagic and demersal fish populations include the Ancient Coastline at 125 m Depth Contour KEF (which is mapped as overlapping the Operational Area), the Continental Slope Demersal Fish Communities KEF, the Western demersal slope and associated fish communities of the Central Western Province KEF, Rankin Bank

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Habitat/Community	Key locations within the EMBA
	and Glomar Shoal (including the Glomar Shoal KEF). Detail regarding these features is provided in **Appendix C, Section 9**. Notably, the presence of subsea infrastructure associated with the GWA facility has resulted in the development of demersal fish communities that would otherwise not occur in the Operational Area due to the generally featureless, soft substrate that is present (McLean et al. 2017).
Epifauna and infauna	Filter feeders such as sponges, ascidians, soft corals, and gorgonians are animals that feed by actively filtering suspended matter and food particles from water by passing the water over specialised filtration structures (DEWHA 2008). Filter feeders within the EMBA are expected to be representative of the NWMR, with notable areas of high sponge diversity occurring in the Commonwealth waters of Ningaloo Marine Park and at shoals (such as Glomar Shoal) within the EMBA (see **Appendix C, Section 5.4**). Discrete areas of hard substrate hosting sessile filter feeding communities may also be associated within the Ancient Coastline at 125 m Depth Contour KEF, which overlaps the Operational Area. Filter feeder communities within the Operational Area are present on the subsea infrastructure and GWA platform, which provides hard substrate for attachment in an otherwise generally featureless, soft and sandy substrate.

4.6 Protected Species

A total of 90 EPBC Act listed species considered to be MNES were identified as potentially occurring within the EMBA, of which a subset of 52 species were identified as potentially occurring within the Operational Area. The full list of marine species identified from the PMST reports is provided in **Appendix E**. including several MNES that are not considered to be credibly impacted (e.g. terrestrial species within the EMBA). Criteria for determining species to be considered for impact assessment is outlined in **Appendix C: Section 3.2**.

Species identified as potentially occurring within the Operational Area and EMBA, and Biologically Important Areas (BIAs) or Habitat Critical to their Survival (Habitat Critical) that overlap the Operational Area and EMBA, are listed in **Table 4-5** to **Table 4-13.** A description of species is included in **Appendix C, Section 6 – Section 8**.

Figure 4-4 to **Figure 4-8** show the spatial overlap with relevant BIAs and Habitat Critical areas and the Operational Area.

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4.6.1 Fish, Sharks and Rays

Table 4-5: Threatened and Migratory Fish, Shark and Ray Species predicted to occur within the Operational Area and EMBA

Species name	Common name	Threatened status	Migratory status	Potential for interaction	
				Operational Area	*EMBA*
Pristis zijsron	Green sawfish	Vulnerable	Migratory	Species or species habitat known to occur within area.	Species or species habitat known to occur within area.
Rhincodon typus	Whale shark	Vulnerable	Migratory	Foraging, feeding or related behaviour known to occur within area.	Foraging, feeding or related behaviour known to occur within area.
Carcharodon carcharias	White shark	Vulnerable	Migratory	Species or species habitat may occur within area.	Species or species habitat known to occur within area.
Carcharias taurus	Grey nurse shark	Vulnerable	N/A	Species or species habitat may occur within area.	Species or species habitat known to occur within area.
Pristis clavata	Dwarf sawfish	Vulnerable	Migratory	N/A	Species or species habitat known to occur within area.
Carcharhinus longimanus	Oceanic whitetip shark	N/A	Migratory	Species or species habitat likely to occur within area.	Species or species habitat likely to occur within area.
Manta birostris	Giant manta ray	N/A	Migratory	Species or species habitat likely to occur within area.	Species or species habitat known to occur within area.
Isurus paucus	Longfin mako	N/A	Migratory	Species or species habitat likely to occur within area.	Species or species habitat likely to occur within area.
Anoxypristis cuspidata	Narrow sawfish	N/A	Migratory	Species or species habitat may occur within area.	Species or species habitat known to occur within area.
Manta alfredi	Reef manta ray	N/A	Migratory	Species or species habitat likely to occur within area.	Species or species habitat known to occur within area.

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Species name	Common name	Threatened status	Migratory status	Potential for interaction	
				Operational Area	***EMBA***
Isurus oxyrinchus	Shortfin mako	N/A	Migratory	Species or species habitat likely to occur within area.	Species or species habitat likely to occur within area.
Lamna nasus	Porbeagle, Mackerel Shark	N/A	Migratory	N/A	Species or species habitat may occur within area.

Table 4-6: Fish, Shark and Ray BIAs within the Operational Area and EMBA

Species	BIA type	Approximate Distance and Direction of BIA from Operational Area (km)
Whale shark	Foraging (northward from Ningaloo along 200 m isobath)	0 km
	Foraging (high density prey)	272 km south-west

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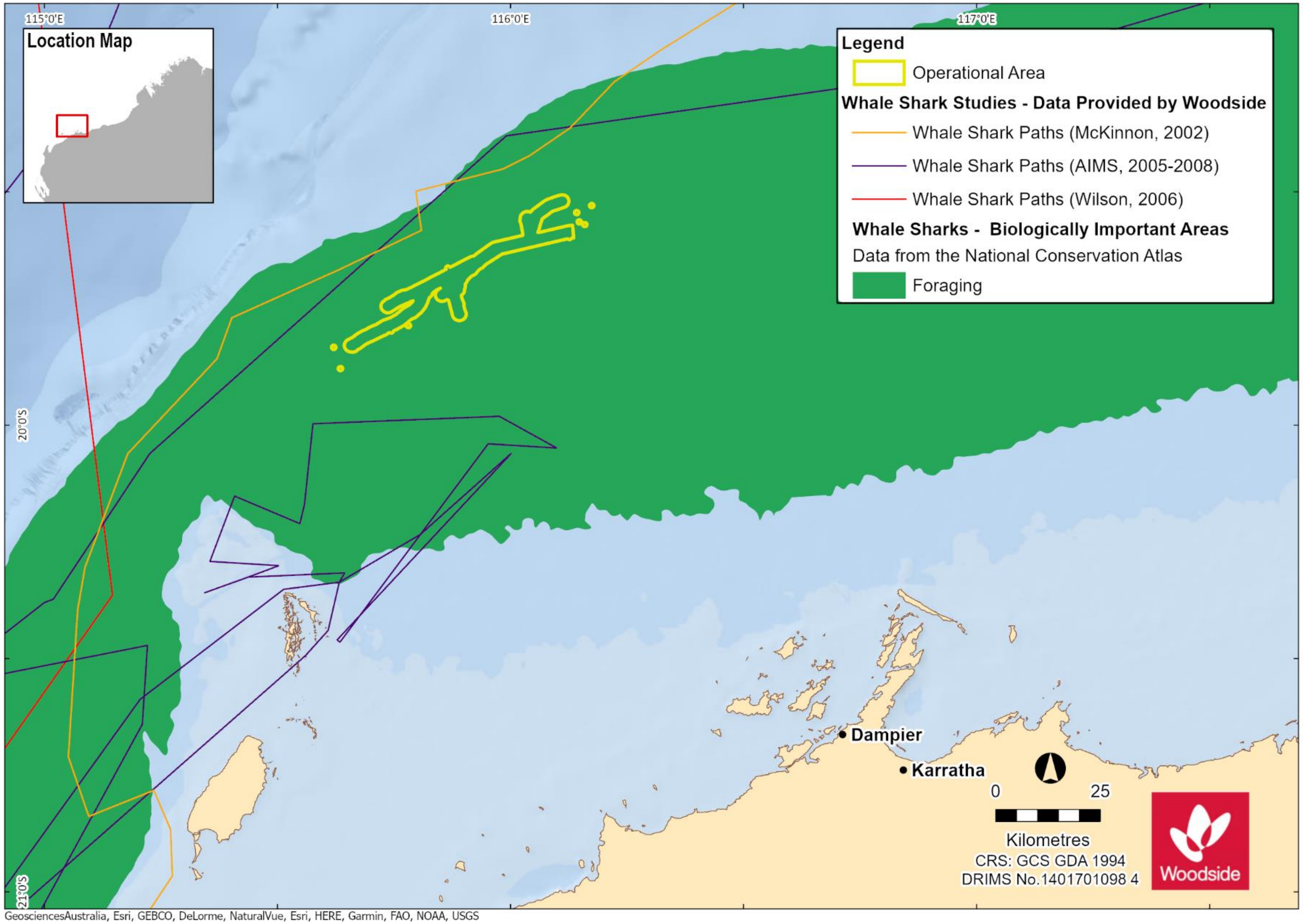

Figure 4-4: Whale Shark BIAs and satellite tracks of whale sharks tagged between 2005 and 2008 (Double et al. 2012, 2014)

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4.6.2 Marine Reptiles

Table 4-7: Threatened, Migratory and Marine reptile species predicted to occur within the Operational Area and EMBA

Species name	Common name	Threatened status	Migratory status	Potential for interaction	
				Operational Area	*EMBA*
Natator depressus	Flatback turtle	Vulnerable	Migratory	Species or species habitat known to occur within area.	Breeding known to occur within area.
Chelonia mydas	Green turtle	Vulnerable	Migratory	Species or species habitat likely to occur within area.	Breeding known to occur within area.
Eretmochelys imbricata	Hawksbill turtle	Vulnerable	Migratory	Species or species habitat likely to occur within area.	Breeding known to occur within area.
Dermochelys coriacea	Leatherback turtle	Endangered	Migratory	Species or species habitat likely to occur within area.	Foraging, feeding or related behaviour known to occur within area.
Caretta caretta	Loggerhead turtle	Endangered	Migratory	Species or species habitat likely to occur within area.	Breeding known to occur within area.
Aipysurus apraefrontalis	Short-nosed sea snake	Critically Endangered	N/A	N/A	Species or species habitat known to occur within area.
Aipysurus foliosquama	Leaf-scaled sea snake	Critically Endangered	N/A	N/A	Species or species habitat known to occur within area
Aipysurus pooleorum	Shark bay sea snake	N/A	N/A	N/A	Species or species habitat may occur within area
Hydrelaps darwiniensis	Black-ringed sea snake	N/A	N/A	N/A	Species or species habitat may occur within area.
Aipysurus tenuis	Brown-lined sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Aipysurus duboisii	Dubois' sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Hydrophis elegans	Elegant sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.

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Species name	Common name	Threatened status	Migratory status	Potential for interaction	
				Operational Area	*EMBA*
Hydrophis czeblukovi	Fine-spined sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Acalyptophis peronii	Horned sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Ephalophis greyi	North-western mangrove sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Aipysurus laevis	Olive sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Disteira major	Olive-headed sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Hydrophis mcdowelli	Small-headed sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Disteira kingii	Spectacled sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Aipysurus eydouxii	Spine-tailed sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Hydrophis ornatus	Spotted sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Astrotia stokesii	Stoke’s sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Emydocephalus annulatus	Turtle-headed sea snake	N/A	N/A	N/A	Species or species habitat may occur within area.
Pelamis platurus	Yellow-bellied sea snake	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.

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Table 4-8: Marine turtle BIAs within the EMBA

Species	BIA type (closest location)	Approximate distance and direction of BIA from Operational Area (km)
Flatback turtle	Mating (Barrow Island; Montebello Islands)	50 km south
	Nesting (Barrow Island, Montebello Islands)	50 km south
	Internesting (Montebello Islands)	Overlaps
	Foraging (Barrow Island; Montebello Islands)	50 km south
Green turtle	Mating (Barrow Island; Montebello Islands)	48 km south
	Nesting (Montebello Islands; Barrow Island)	48 km south
	Internesting (Barrow Island; Montebello Islands)	27 km south
	Foraging (Barrow Island; Montebello Islands)	48 km south
Hawksbill turtle	Mating (Montebello Islands; Barrow Island)	50 km south
	Nesting (Montebello Islands; Barrow Island)	51 km south
	Internesting (Lowendal Islands group; Montebello Islands; Barrow Island)	31 km south
	Foraging (Barrow Islands – shallow water coral reef and artificial reef (pipeline) habitat)	87 km south
Loggerhead turtle	Internesting (Montebello Islands, Lowenthal Island)	41 km south
	Nesting (Montebello Islands, Lowenthal Island)	58 km south
Leatherback turtle	*No BIAs within the EMBA or Operational Area*	

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Table 4-9: Habitat Critical to the Survival of Marine Turtles occurring within the EMBA

Species	Genetic stock	Nesting locations	Approximate distance and direction from Operational Area (km)	Inter-nesting buffer	Nesting period	Hatching period
Green turtle	NWS	Adele Island, Maret Island, Cassini Island, Lacepede Islands, Barrow Island, Montebello Islands (all with sandy beaches), Serrurier Island, Dampier Archipelago, Thevenard Island, Northwest Cape, Ningaloo coast	35 km south	20 km	Nov–Mar (peak: Dec–Feb)	Jan–May (peak: Feb–Mar)
Loggerhead turtle	WA	Dirk Hartog Island, Muiron Islands, Gnaraloo Bay, Ningaloo coast	245 km south-west	20 km	Nov–Mar (peak: Jan)	Jan–May
Flatback turtle	South-west Kimberly	Eighty Mile Beach, Eco Beach, Lacepede Islands	327 km south-east	60 km	All year (peak: Dec–Jan)	All year
	Pilbara	Montebello Islands, Mundabullangana Beach, Barrow Island, Cemetery Beach, Dampier Archipelago (including Delambre Island and Huay Island), coastal islands from Cape Preston to Locker Island	Overlaps	60 km	Oct–Mar (peak: Nov–Jan)	Feb–Mar
Hawksbill turtle	Western Australia	Montebello Islands (including Ah Chong Island, South East Island and Trimouille Island), Lowendal Islands (including Varanus Island, Beacon Island and Bridled Island), Dampier Archipelago (including Rosemary Island and Delambre Island)	35 km south	20 km	All year (peak: Oct–Jan)	All year (peak: Dec–Feb)
Leatherback turtle	*No overlap – nesting located in Northern Territory and North Queensland*					

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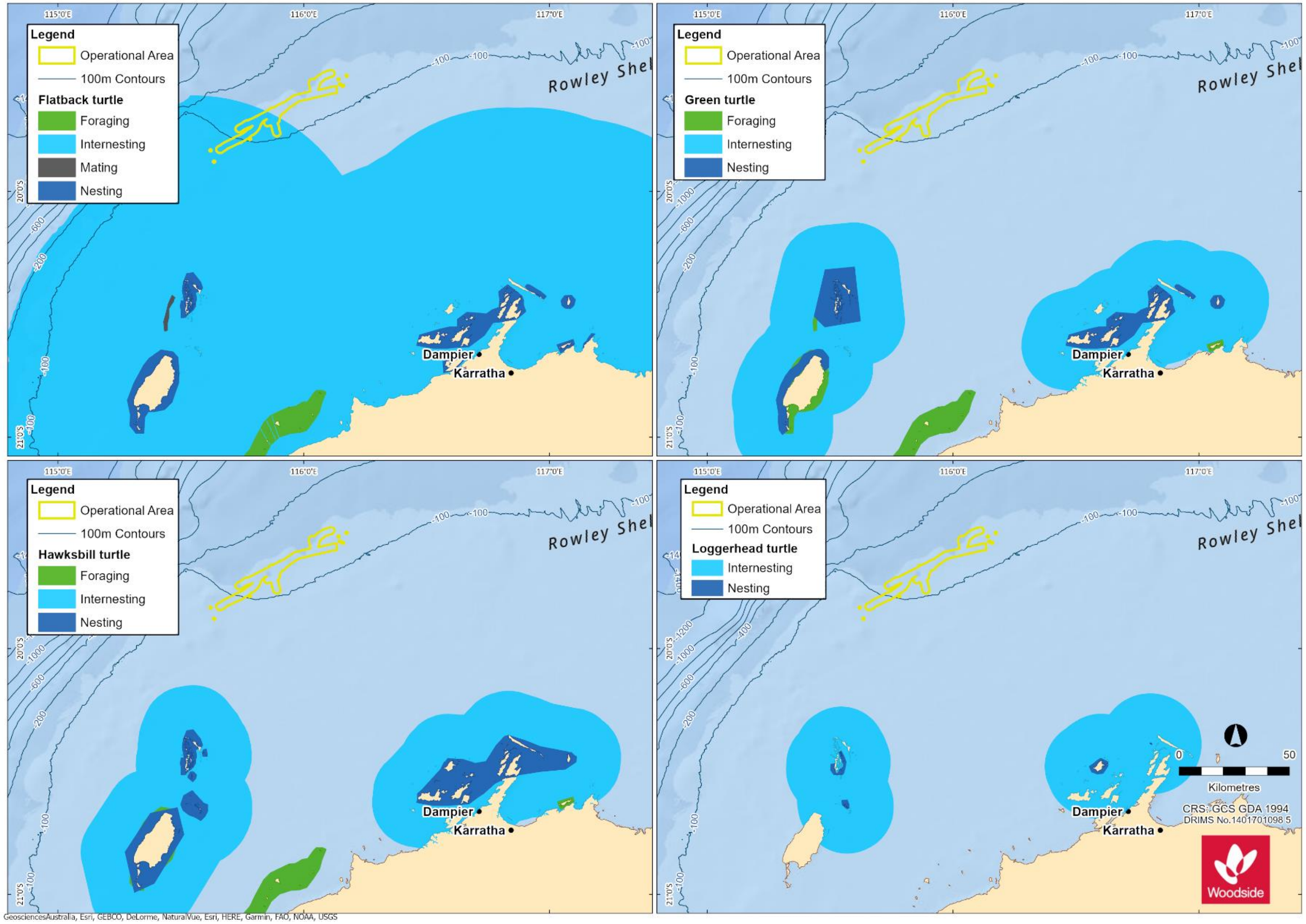

Figure 4-5: Marine turtle BIAs overlapping and adjacent to the Operational Area

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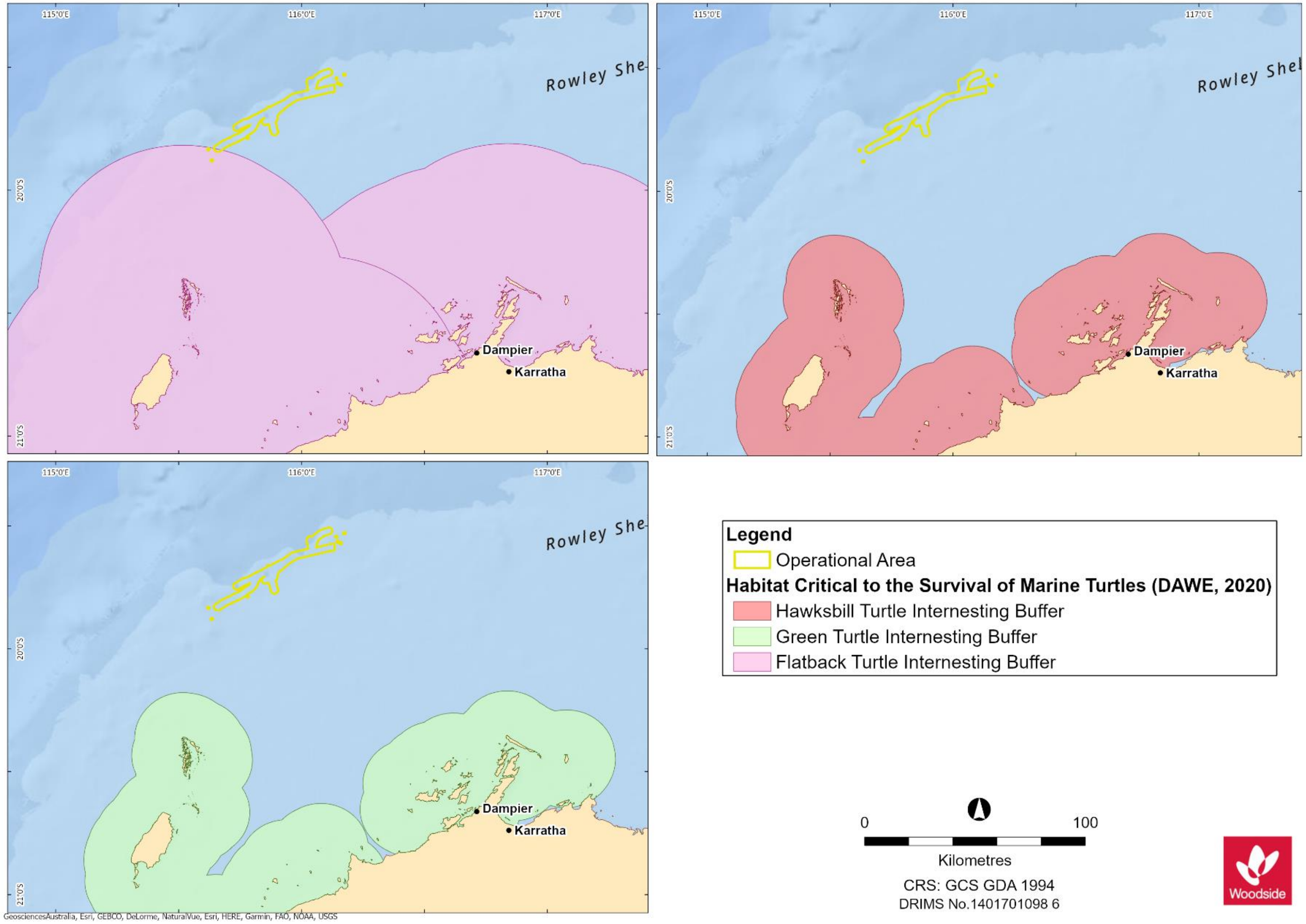

Figure 4-6: Habitat Critical to the Survival of Marine Turtles overlapping and adjacent to the Operational Area

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4.6.3 Marine Mammals

Table 4-10: Threatened and Migratory marine mammal species predicted to occur within the Operational Area and EMBA

Species name	Common name	Threatened status	Migratory status	Potential for interaction	
				Operational Area	***EMBA***
Balaenoptera physalus	Fin whale	Vulnerable	Migratory	Species or species habitat likely to occur within area.	Foraging, feeding or related behaviour likely to occur within area.
Megaptera novaeangliae	Humpback whale	Vulnerable	Migratory	Breeding known to occur within area.	Breeding known to occur within area.
Balaenoptera borealis	Sei whale	Vulnerable	Migratory	Species or species habitat likely to occur within area.	Foraging, feeding or related behaviour likely to occur within area.
Balaenoptera musculus	Blue whale	Endangered	Migratory	Species or species habitat likely to occur within area.	Migration route known to occur within area.
Eubalaena australis	Southern right whale	Endangered	Migratory	N/A	Species or species habitat likely to occur within area.
Balaenoptera edeni	Bryde's whale	N/A	Migratory	Species or species habitat may occur within area.	Species or species habitat likely to occur within area.
Orcinus orca	Killer whale	N/A	Migratory	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Physeter macrocephalus	Sperm whale	N/A	Migratory	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Tursiops aduncus (Arafura/Timor Sea populations)	Spotted bottlenose dolphin	N/A	Migratory	Species or species habitat may occur within area.	Species or species habitat known to occur within area.
Mesoplodon grayi	Gray's Beaked Whale	N/A	N/A	N/A	Species or species habitat may occur within area
Tursiops truncatus s. str.	Bottlenose dolphin	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Delphinus delphis	Common dolphin	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.

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Species name	Common name	Threatened status	Migratory status	Potential for interaction	
				Operational Area	*EMBA*
Ziphius cavirostris	Cuvier's beaked whale	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Kogia simus	Dwarf sperm whale	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Pseudorca crassidens	False killer whale	N/A	N/A	Species or species habitat likely to occur within area.	Species or species habitat likely to occur within area.
Tursiops aduncus	Indian Ocean bottlenose dolphin	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat likely to occur within area.
Stenella longirostris	Long-snouted spinner dolphin	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Peponocephala electra	Melon-headed whale	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Feresa attenuata	Pygmy killer whale	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Kogia breviceps	Pygmy sperm whale	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Grampus griseus	Risso's dolphin	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Steno bredanensis	Rough-toothed dolphin	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Globicephala macrorhynchus	Short-finned pilot whale	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Stenella attenuata	Spotted dolphin	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Stenella coeruleoalba	Striped dolphin	N/A	N/A	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Balaenoptera bonaerensis	Antarctic Minke Whale	N/A	Migratory	N/A	Species or species habitat likely to occur within area.
Mesoplodon densirostris	Blainville's beaked whale	N/A	N/A	N/A	Species or species habitat may occur within area.

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Species name	Common name	Threatened status	Migratory status	Potential for interaction	
				Operational Area	***EMBA***
Dugong dugon	Dugong	N/A	Migratory	N/A	Breeding known to occur within area.
Lagenodelphis hosei	Fraser's dolphin	N/A	N/A	N/A	Species or species habitat may occur within area.
Sousa chinensis	Indo-Pacific humpback dolphin	N/A	Migratory	N/A	Species or species habitat known to occur within area.
Balaenoptera acutorostrata	Minke whale	N/A	N/A	N/A	Species or species habitat may occur within area.

Table 4-11: Marine mammal BIAs within the EMBA

Species	BIA type	Approximate distance and direction from Operational Area (km)
Dugong	Calving (Exmouth Gulf)	245 km south-west
	Nursing (Exmouth Gulf)	245 km south-west
	Breeding (Exmouth Gulf)	245 km south-west
	Foraging (high density seagrass beds) (Exmouth Gulf)	245 km south-west
Blue whale	Foraging (Ningaloo)	278 km south-west
	Migration (Augusta to Derby)	26 km north-west
Humpback whale	Migration (north and south) (south of Shark Bay, north to Kimberley Region)	22 km south-east
	Resting (Exmouth Gulf)	250 km south-west

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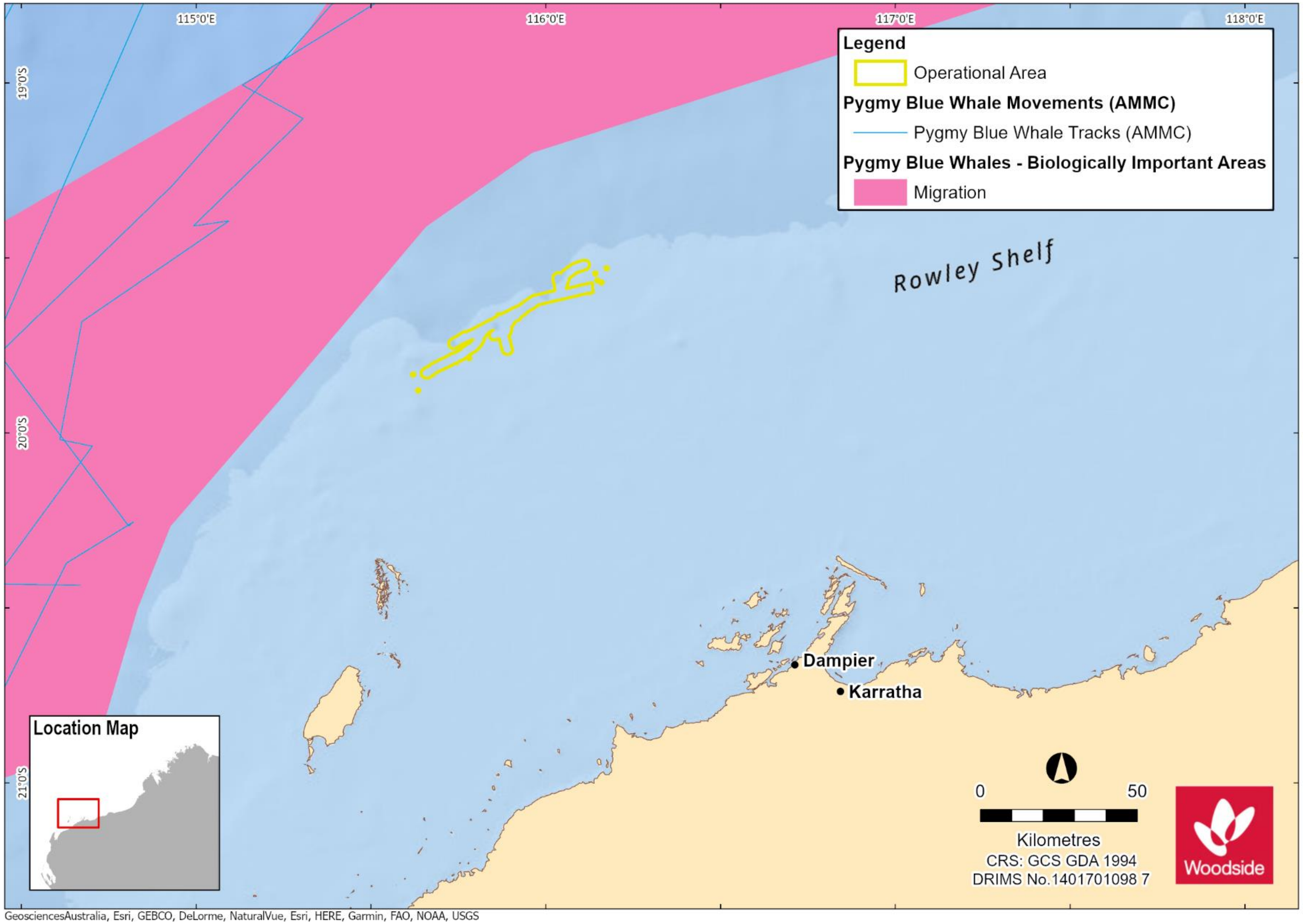

Figure 4-7: Pygmy blue whale BIAs and satellite tracks of whales (Double et al., 2012, 2014)

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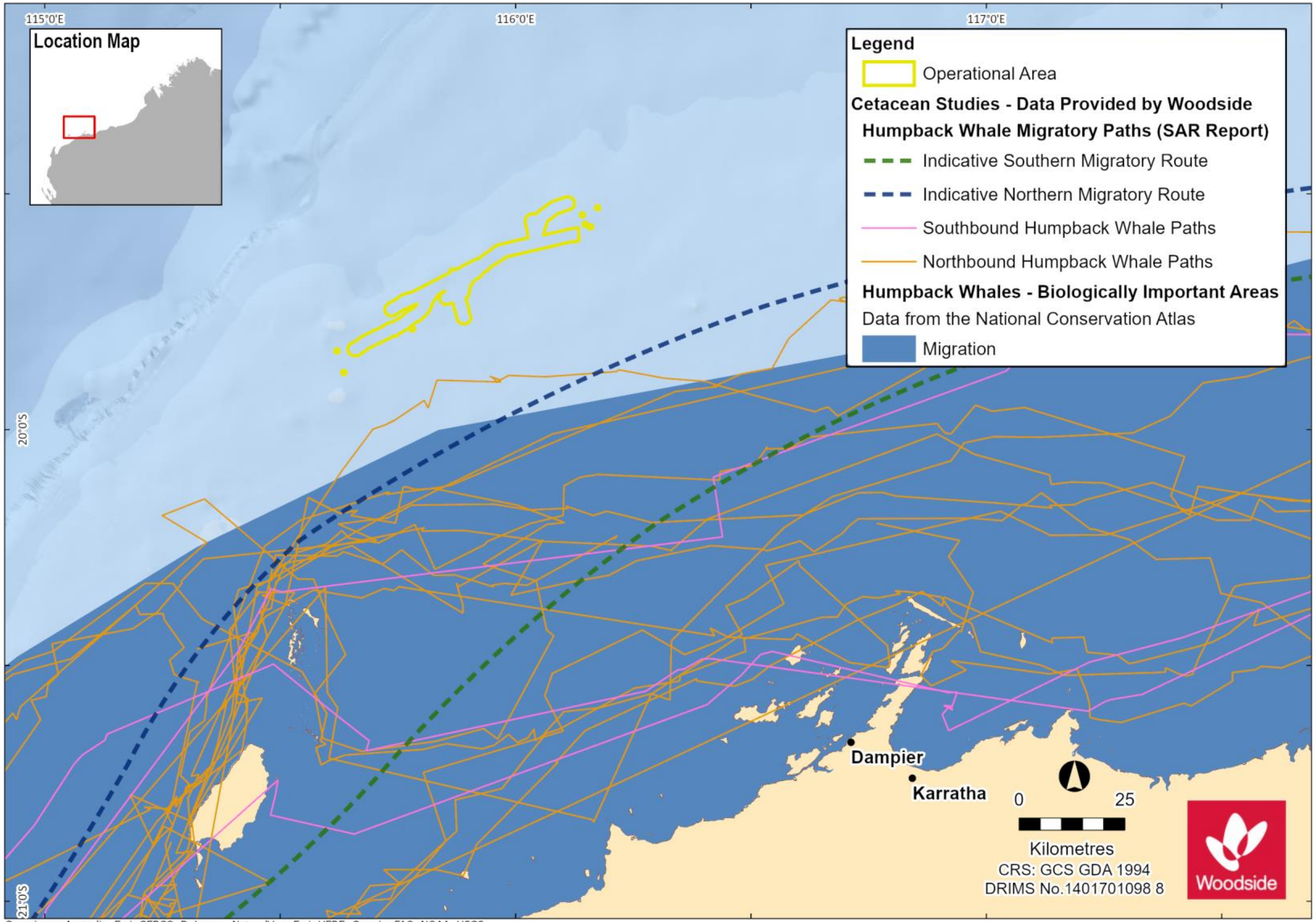

Figure 4-8: Humpback whale BIAs and satellite tracks of whales (Double et al., 2012, 2010)

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4.6.4 Seabirds and Migratory Shorebirds

Table 4-12: Threatened, Migratory and Marine seabird and shorebird species predicted to occur within the Operational Area and EMBA

Species name	Common name	Threatened status	Migratory status	Potential for interaction	
				Operational Area	*EMBA*
Anous tenuirostris melanops	Australian lesser noddy	Vulnerable	N/A	N/A	Species or species habitat may occur within area
Charadrius leschenaultii	Greater sand plover	Vulnerable	Migratory	N/A	Species or species habitat likely to occur within area
Thalassarche carteri	Indian yellow-nosed albatross	Vulnerable	Migratory	N/A	Foraging, feeding or related behaviour may occur within area
Sternula nereis nereis	Australian fairy tern	Vulnerable	N/A	Species or species habitat may occur within area.	Breeding known to occur within area.
Pterodroma mollis	Soft-plumaged petrel	Vulnerable	N/A	N/A	Foraging, feeding or related behaviour likely to occur within area.
Calidris canutus	Red knot	Endangered	Migratory	Species or species habitat may occur within area.	Species or species habitat known to occur within area.
Papasula abbotti	Abbott’s booby	Endangered	N/A	N/A	Species or species habitat may occur within area.
Macronectes giganteus	Southern-giant petrel	Endangered	Migratory	N/A	Species or species habitat may occur within area.
Numenius madagascariensis	Eastern curlew	Critically Endangered	Migratory	Species or species habitat may occur within area.	Species or species habitat known to occur within area.
Calidris ferruginea	Curlew sandpiper	Critically Endangered	Migratory	N/A	Species or species habitat known to occur within area.

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Species name	Common name	Threatened status	Migratory status	Potential for interaction	
				Operational Area	*EMBA*
Limosa lapponica menzbieri	Northern Siberian bar-tailed godwit	Critically Endangered	N/A	N/A	Species or species habitat known to occur within area.
Anous stolidus	Common noddy	N/A	Migratory	Species or species habitat may occur within area.	Species or species habitat likely to occur within area.
Thalasseus bergii	Greater Crested Tern	N/A	Migratory	N/A	Breeding known to occur within area
Fregata minor	Greater frigatebird	N/A	Migratory	Species or species habitat may occur within area.	Species or species habitat may occur within area.
Fregata ariel	Lesser frigatebird	N/A	Migratory	Species or species habitat likely to occur within area	Species or species habitat likely to occur within area.
Calonectris leucomelas	Streaked shearwater	N/A	Migratory	Species or species habitat likely to occur within area	Species or species habitat likely to occur within area.
Sterna bergii	Crested tern	N/A	Migratory	N/A	Breeding known to occur within area.
Ardenna carneipes	Flesh-footed shearwater	N/A	Migratory	N/A	Species or species habitat likely to occur within area.
Sterna dougallii	Roseate tern	N/A	Migratory	N/A	Breeding known to occur within area.
Ardenna pacifica	Wedge-tailed shearwater	N/A	Migratory	N/A	Breeding known to occur within area.
Phaethon lepturus	White-tailed tropicbird	N/A	Migratory	N/A	Foraging, feeding or related behaviour likely to occur within area
Larus novaehollandiae	Silver gull	N/A	N/A	N/A	Breeding known to occur within area.
Sterna fuscata	Sooty tern	N/A	N/A	N/A	Breeding known to occur within area.

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Table 4-13: Seabird and shorebird BIAs within the Operational Area and EMBA

Species	BIA type	Approximate distance and direction from Operational Area (km)
Wedge-tailed shearwater	Breeding and Foraging (Montebello Island, Lowendal Island Barrow Island)	Overlaps
	Foraging in high numbers (Houtman Abrolhos Islands)	713 km south-west
Fairy tern	Breeding (Pilbara and Gascoyne coasts and islands)	47 km south
Lesser frigatebird	Breeding (Pilbara coasts and islands)	205 km east
Roseate tern	Breeding (Montebello, Lowendal and Barrow Island Groups)	49 km south
White-tailed tropicbird	Breeding (Rowley Shoals)	260 km

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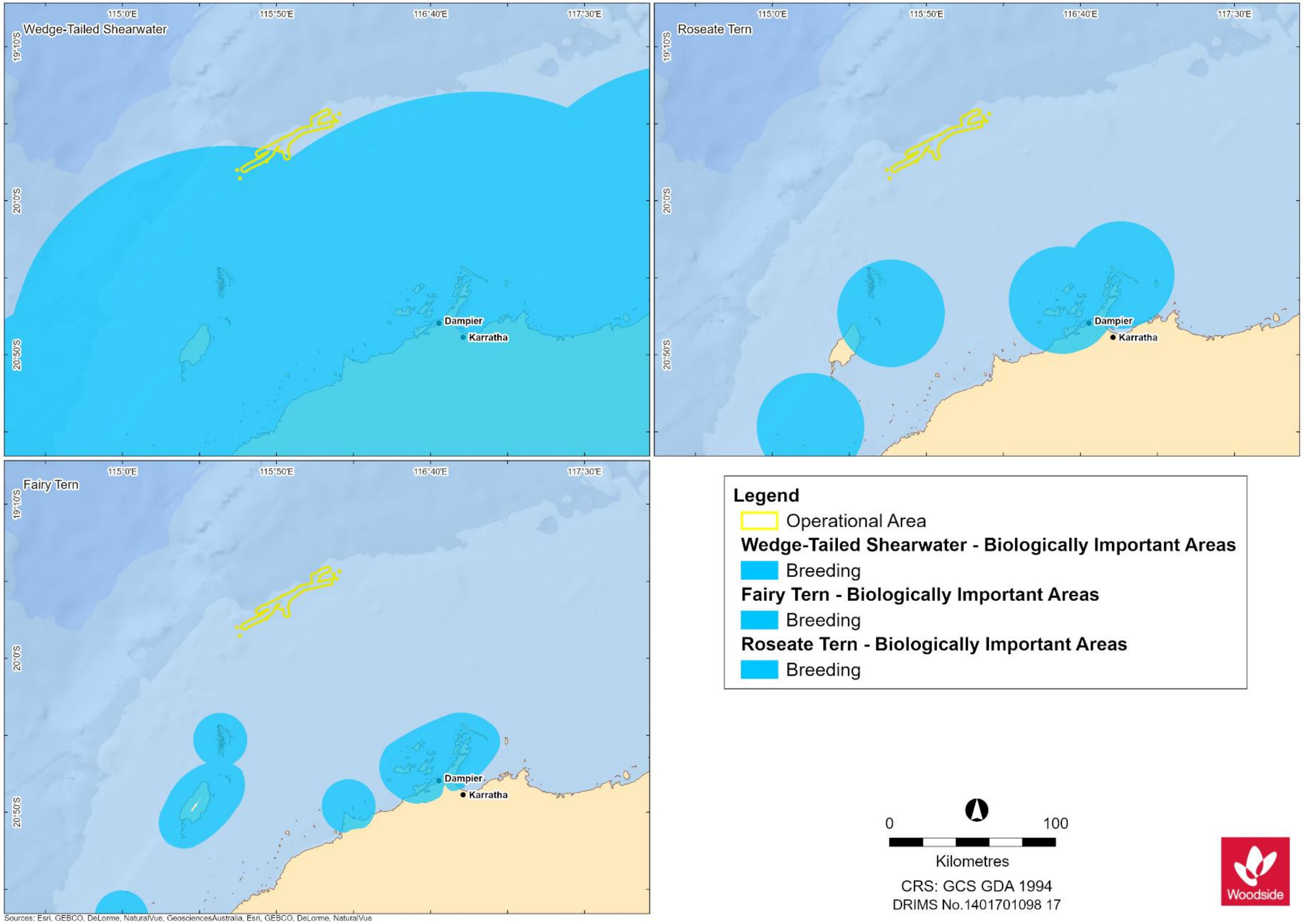

Figure 4-9: Seabirds BIAs overlapping and adjacent to the Operational Area

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4.6.5 Seasonal Sensitivities for Protected Species

Seasonal sensitivities for protected migratory species identified as potentially occurring within the Operational Area are identified in **Table 4-14**. Movement patterns of all protected species identified in **Section 4.6** are described in **Appendix C, Section 6 – Section 8.**

Table 4-14: Key seasonal sensitivities for protected migratory species identified as occurring within the Operational Area

Species	January	February	March	April	May	June	July	August	September	October	November	December
Fish, sharks and rays												
Whale shark – northern and southern migration (NWMR) (TSSC, 2015d)												
Whale shark – foraging/ aggregation (Ningaloo Coast) (TSSC, 2015d)												
Great white shark – northern migration (to North West Cape) (DSEWPaC, 2013a)												
Marine reptiles[4]												
Flatback turtle, Pilbara Coast genetic stock – nesting												
Flatback turtle, Pilbara Coast genetic stock – hatching												
Green turtle, NWS genetic stock – nesting												
Green turtle, NWS genetic stock - hatching												
Hawksbill turtle Western Australia genetic stock – nesting												
Hawksbill turtle Western Australia genetic stock – hatching												
Leatherback turtle – nesting												
Leatherback turtle – hatching												
Mammals												
Fin whale												
Humpback whale - northern migration (Double et al., 2010; TSSC, 2015a)												

[4] *Information regarding seasonal occurrence of marine turtles has been taken from the Recovery Plan for Marine Turtles in Australia 2017-2027 (Commonwealth of Australia, 2017).*

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Species	January	February	March	April	May	June	July	August	September	October	November	December
Humpback whale – southern migration (Double et al., 2010; TSSC, 2015a)												
Sei whale – migration (DEH, 2005)												
East Indian Ocean (EIO) pygmy blue whale – northern migration (Double *et al.*, 2012; 2014)												
East Indian Ocean (EIO) pygmy blue whale – southern migration (Double *et al.* 2012; 2014)												
Seabirds and shorebirds												
Red knot – non-breeding season (NWMR) (TSSC, 2016a)												
Eastern curlew – non-breeding (NWMR) (DoE, 2015d)												
Wedge-tailed shearwater – various breeding sites (DSEWPaC 2012c, Environment Australia 2002)												
	Species may be present in the Operational Area											
	Peak period. Presence of animals is reliable and predictable each year											

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4.7 Key Ecological Features (KEFs)

One KEF overlaps the Operational Area. KEFs within the Operational Area and EMBA are identified in **Table 4-15** and described in **Appendix C, Section 9**.

Table 4-15: KEFs within the Operational Area and EMBA.

Key Ecological Feature	Approximate distance and direction from Operational Area (km)
Ancient Coastline at 125 m Depth Contour	Overlaps
Continental Slope Demersal Fish Communities	25 km west-south west
Glomar Shoal	42 km east
Exmouth Plateau	131 km west
Canyons Linking the Cuvier Abyssal Plain and the Cape Range Peninsula	202 km south-west
Commonwealth Waters Adjacent to Ningaloo Reef	247 km south-west
Western demersal slope and associated fish communities of the Central Western Province	713 km south-west

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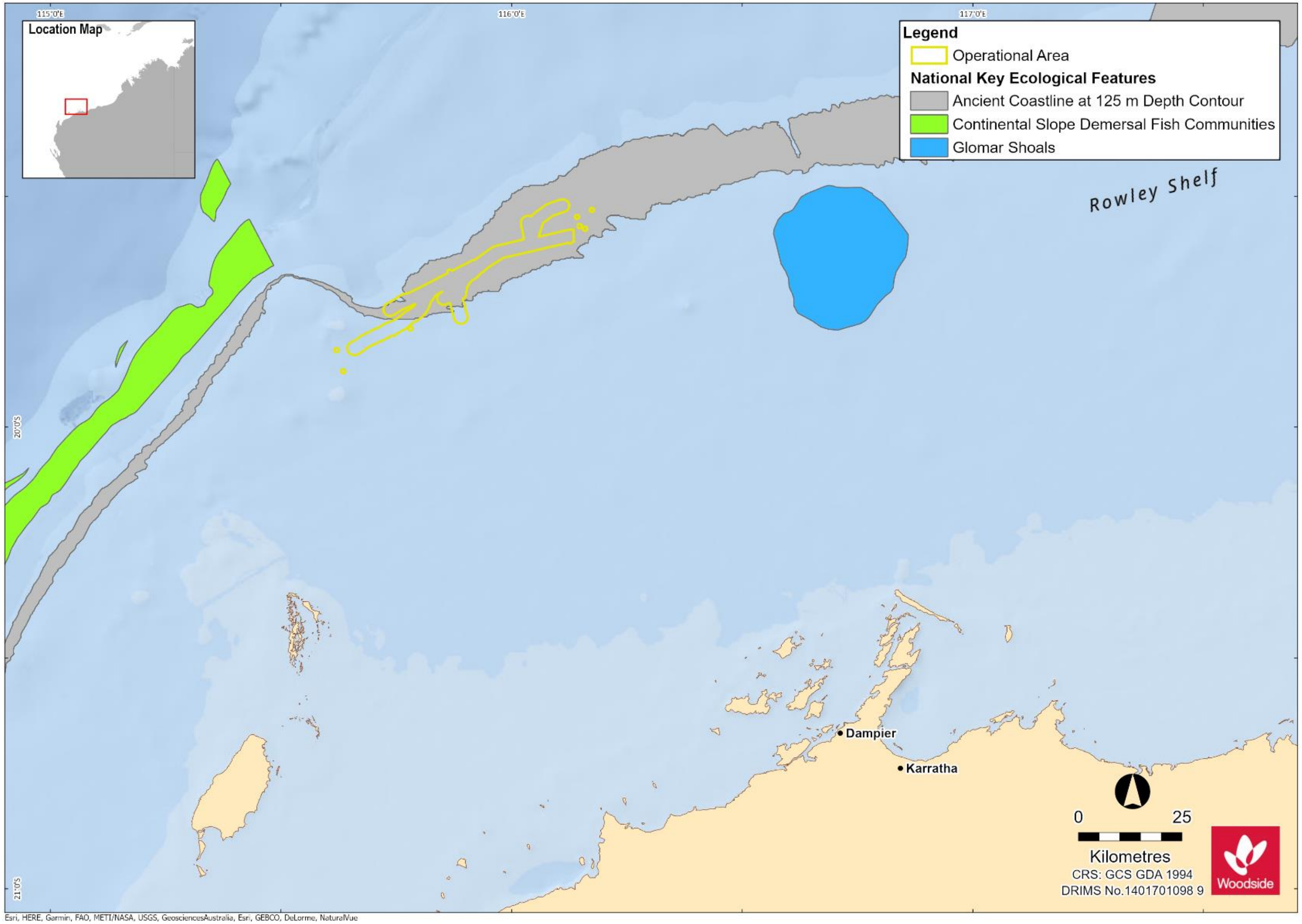

Figure 4-10: KEFs overlapping and adjacent to the Operational Area

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4.8 Protected Places

No protected places overlap the Operational Area. Protected places within the EMBA are identified in **Table 4-16** and presented in **Figure 4-11**.

Appendix C, Section 10 outlines the values and sensitivities of protected places and other sensitive areas in the EMBA.

Table 4-16: Established protected places and other sensitive areas overlapping the EMBA

	Distance and direction from Operational Area to protected place or sensitive area (km)	Park zone and IUCN category* overlapping Operational Area and/or EMBA
AMPs		
Argo-Rowley Terrace Marine Park	198 km north	Special Purpose Zone - VI
Gascoyne Marine Park	217 km south-west	Special Purpose Zone - VI, Recreational Use Zone - IV
Montebello Marine Park	13 km south	Special Purpose Zone - VI
Ningaloo Marine Park	248 km south-west	National Park Zone - II, Recreational Use Zone - IV
Shark Bay Marine Park	554 km south-west	Multiple Use Zone - VI
State Marine Parks and Nature Reserves		
Marine Parks		
Barrow Island Marine Park	99 km south	Sanctuary Zone - Ia
Montebello Islands Marine Park	48 km south	Sanctuary Zone - IA, Recreational Use Zone - IV, Special Purpose Zone - VI
Ningaloo Marine Park	249 km south-south west	Sanctuary Zone - IA, Recreational Use Zone - IV, Special Purpose Zone - VI
Marine Management Areas		
Barrow Island Marine Management Area	67 km south	Special Purpose Zone - VI
Muiron Islands Marine Management Area	227 km south-south west	Special Purpose Zone - VI, Sanctuary Zone - IA
Nature Reserves		
Boodie, Middle and Double Islands Nature Reserve	96 km south	National Park Zone - II
Muiron Islands Nature Reserve	238 km south-south west	National Park Zone - II
Thevenard Island Nature Reserve	185 km south-south west	National Park Zone - II
Airlie Island Nature Reserve	116 km south-south west	National Park Zone - II
Bessieres Island Nature Reserve	203 km south-west	National Park Zone - II
Jurabi Coastal Park Nature Reserve	264 km south-west	National Park Zone - II
National Parks		
Cape Range National Park	284 km south-south west	National Park Zone - II

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	Distance and direction from Operational Area to protected place or sensitive area (km)	Park zone and IUCN category* overlapping Operational Area and/or EMBA
Other sensitive areas		
Rankin Bank	3 km west	N/A
Glomar Shoal	60 km east	N/A

**Conservation objectives for IUCN categories include:*

Ia: Strict Nature Reserve

Ib: Wilderness Area

II: National Park

III: Natural Monument or Feature

IV: Habitat/Species Management Area

V: Protected Landscape/Seascape

VI: Protected area with sustainable use of natural resources – allow human use but prohibits large scale development.

IUCN categories for the marine park are provided and, in brackets, the IUCN categories for specific zones within each Marine Park as assigned under the North-west Marine Parks Network Management Plan 2018 and South-west Marine Parks Network Management Plan 2018.

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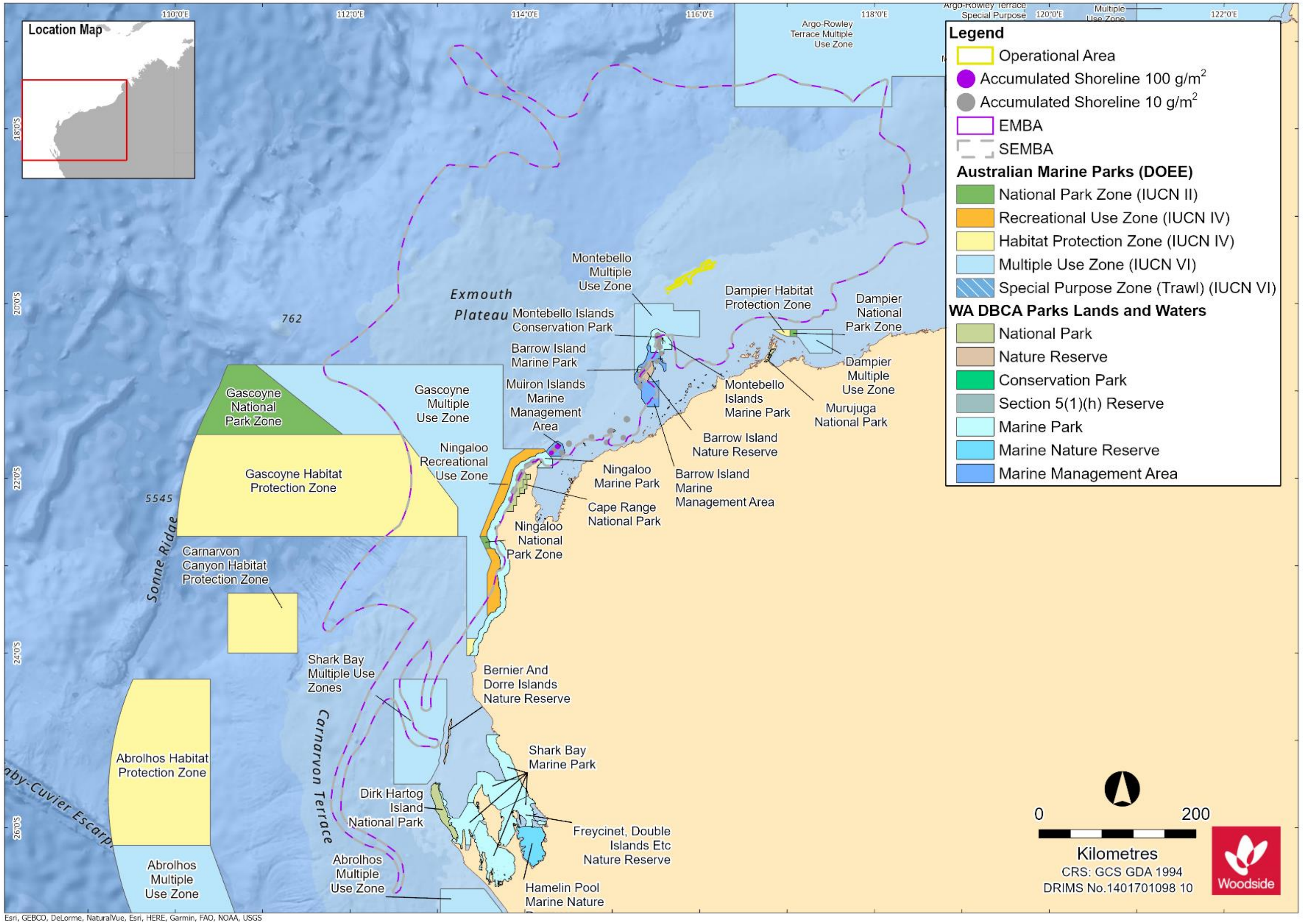

Figure 4-11: Protected areas adjacent to the Operational Area

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4.9 Socio-Economic Environment

4.9.1 Cultural Heritage

4.9.1.1 European Sites of Significance

There are no known sites of European cultural heritage significance within the Operational Area. **Appendix C, Section 11.1.2** describes cultural heritage sites within the EMBA.

4.9.1.2 Indigenous Sites of Significance

Indigenous Australian people have a strong continuing connection with the area that extends back some 50,000 years. Woodside acknowledges this unique connection between Aboriginal peoples and the land and sea in which the company operates. Woodside also understands that while marine resources used by Indigenous people are generally limited to coastal waters, for activities such as fishing, hunting and maintenance of culture and heritage - many Aboriginal groups have a direct cultural interest in decisions affecting the management of deeper offshore waters.

Within the EMBA, the Pilbara and the adjacent coastlines have a long history of occupancy by Aboriginal communities. The longstanding relationship between Aboriginal people and the land and sea is prevalent in Indigenous culture today and Indigenous heritage places including archaeological sites which are protected under the *Aboriginal Heritage Act 1972* (WA) or EPBC Act.

The Department of Aboriginal Affairs (DAA) Heritage Inquiry System was searched for the EMBA, which indicated a number of registered Indigenous heritage places (see site details in **Appendix F**). The exact location, access and traditional practices for a number of these sites are not disclosed and if required, such as in the event of a major oil spill, would involve prioritising further consultation with key contacts within DAA and relevant local Aboriginal communities.

4.9.1.3 Underwater Heritage

A search of the Australian National Shipwreck Database, which records all known Maritime Cultural Heritage (shipwrecks, aircraft, relics and other underwater cultural heritage) in Australian waters indicated that there are no sites within the Operational Area, or within 10 km of the Operational Area.

4.9.1.4 World, National and Commonwealth Heritage Listed Places

No listed heritage places overlap the Operational Area. World, National and Commonwealth heritage places within the EMBA are identified in **Table 4-17**. **Appendix C, Section 10.2** outlines the values and sensitivities of these places.

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Table 4-17: World Heritage Properties and National / Commonwealth Heritage Listed Places within the EMBA

Listed Place	Distance and direction from Operational Area to Listed Place (km)
World Heritage Properties	
Ningaloo Coast	230 km south-west
National Heritage Places	
Ningaloo Coast	230 km south-west
Barrow Island and the Montebello-Barrow Islands Marine Conservation Reserves	48 km south-south west
Commonwealth Heritage Places	
Ningaloo Marine Area – Commonwealth waters	248 km south-west
Learmonth Air Weapons Range Facility	304 km south-west

4.9.2 Commercial Fisheries

A number of Commonwealth and State fishery management areas are located within the Operational Area and EMBA. Fish Cube data were requested to analyse the potential for interaction of fisheries with the Operational Area, which was used to determine consultation with WA State-managed fisheries that may be impacted by proposed petroleum activities (DPIRD, 2020). **Table 4-18** provides an assessment of the potential interaction and **Appendix C, Section 11.5.1** provides further detail on the fisheries that have been identified through desk-based assessment and consultation (**Section 5**).

Figure 4-12 shows fisheries identified as having a potential interaction with the Petroleum Activities Program.

Table 4-18: Commonwealth and State managed commercial Fisheries overlapping the Operational Area

Fishery name	Potential for interaction within Operational Area	
Commonwealth Managed Fisheries		
Southern Bluefin Tuna Fishery	×	This fishery management area overlaps with the Operational Area. Fishing mainly occurs in the Great Australian Bight during summer months, and off the New South Wales coastline during winter months (AFMA, 2020). The fishery has not been active in the Operational Area within the last five years (ABARES, 2019). Woodside considers there to be no potential for interaction with this fishery and the Petroleum Activities Program given the current distribution of fishing effort.
Western Skipjack Fishery	×	This fishery management area overlaps the Operational Area however, this fishery is not currently active (since 2009). Therefore, there is no potential for interaction with this fishery at present.
Western Tuna and Billfish Fishery	×	Whilst this fishery management area overlaps the Operational Area, fishing effort in the last five years has been concentrated in south-west WA (typically as far north as Carnarvon) and occasionally off South Australia. Woodside considers there to be no potential for interaction with this fishery given the current distribution of fishing effort.
State Managed Fisheries		
West Australian Abalone Fishery	×	Whilst the Operational Area is overlapped by this fishery management area, the abalone fishery is typically only active to depths of up to 40 m. As the depths of the Operational Area are greater than 79 m and as there was no fishing effort reported within the Catch and Effort System (CAES) blocks overlapping the

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Fishery name	Potential for interaction within Operational Area	
		Operational Area in the last five years, no interaction with this fishery is anticipated.
Mackerel Managed Fishery	✓	The Mackerel Managed Fishery has been active within the Operational Area in the last five years. Given the Operational Area overlaps this fisheries management area (specifically, the Pilbara management area – Area 2) and as there has been recent fishing effort in this area, it is considered that there is the potential for interaction with this fishery.
Marine Aquarium Managed Fishery	×	Whilst this fishery management area overlaps the Operational Area, this fishery is typically active within waters less than 30 m deep. Water depths within the Operational Area are greater than 75 m. In addition, no fishing effort has been recorded by this fishery within the CAES blocks overlapping the Operational Area in the last five years. No interaction with this fishery is therefore anticipated.
Onslow Prawn Managed Fishery	×	This fishery management area overlaps the Operational Area however no fishing effort has been recorded within the CAES blocks overlapping the Operational Area in the last five years and fishing primarily occurs in water depths of 15 m or less for this fishery. No interaction with this fishery is therefore anticipated.
Pilbara Crab Managed Fishery	×	The Operational Area is overlapped by Area A of this fishery. Fishing is permitted within Area A (limited to 300 traps). No fishing effort was reported in the CAES data within the Operational Area for the last five years. Fishing effort also typically occurs in water depths less than 50 m, whereas the Operational Area is located in water depths greater than 79 m. No interaction with this fishery is therefore anticipated.
Pilbara Fish Trawl Interim Managed Fishery (PFTIMF) *Part of the Pilbara Demersal Scalefish Fishery (includes trawl, trap and line fisheries)*	×	The Operational Area overlaps Area 6, which is closed to trawling (i.e. closed to this fishery). Fishing effort for this fishery has been recorded within the CAES blocks overlapping the Operational Area in the last five years. As the Operational Area overlaps an active area of the fishery it is considered that there is potential for interaction with this fishery.
Pilbara Trap Managed Fishery (PTMF) *Part of the Pilbara Demersal Scalefish Fishery (includes trawl, trap and line fisheries)*	✓	The Operational Area overlaps active areas of this fishery management area. Fishing effort is typically focused in waters less than 50 m, however, through consultation fishers have reported setting traps in waters greater than 50 m deep. Additionally, fishing effort has been reported in the CAES blocks overlapping the Operational Area in the last five years. Therefore it is considered there is potential for interaction with this fishery.
Pilbara Line Fishery (PLF) *Part of the Pilbara Demersal Scalefish Fishery (includes trawl, trap and line fisheries)*	✓	The Operational Area overlaps this fishery management area. Fishing effort has been reported in the CAES blocks overlapping the Operational Area in the last five years. Therefore it is considered there is potential for interaction with this fishery.
Specimen Shell Managed Fishery	×	The Operational Area is overlapped by this fishery management area however shells are typically collected in waters less than 30 m deep and no fishing effort was recorded in the CAES blocks overlapping the Operational Area in the last five years. No interaction with this fishery is therefore anticipated.
South-west Coast Salmon Managed Fishery	×	As no fishing occurs north of the Perth metropolitan area, no interaction with this fishery is anticipated.

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Fishery name	Potential for interaction within Operational Area	
West Coast Deep Sea Crustacean Managed Fishery	×	As no fishing effort was recorded within the CAES blocks overlapping the Operational Area and as fishing effort is concentrated in water depths of 500 – 800 m (significantly deeper than the Operational Area), no interaction with this fishery is anticipated.
Pilbara Developing Crab Fishery	×	This fishery area overlaps the Operational Area, however, fishing is limited to inshore coastal waters (particularly within Nickol Bay) and no fishing effort has been recorded within the CAES blocks overlapping the Operational Area in the last five years. No interaction with this fishery is therefore anticipated.
Pearl Oyster Managed Fishery	×	This fishery management area overlaps the Operational Area however fishing effort is limited to 35 m depth. No fishing effort has been recorded within the CAES blocks overlapping the Operational Area in the last five years. No interaction with this fishery is therefore anticipated.

Commercial fisheries not overlapping with the Operational Area, but occurring within the EMBA are described in **Appendix C, Section 11.5.1** and include the following:

- Commonwealth managed fisheries:
  - North-west Slope Trawl Fishery
  - Southern Tuna and Billfish Fishery
  - Western Deepwater Trawl Fishery
- State managed fisheries:
  - Exmouth Gulf Prawn Fishery
  - Exmouth Gulf Crab Developing Fishery
  - Gascoyne Demersal Scalefish Managed Fishery
  - Nickol Bay Prawn Managed Fishery
  - Land and Hermit Crab Fishery
  - Mud Crab Fishery
  - Sea Cucumber Fishery
  - Octopus Interim Managed Fishery
  - Shark Bay Crab Managed Fishery
  - Shark Bay Prawn Fishery
  - Shark Bay Scallop Managed Fishery
  - West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery
  - West Coast Demersal Scalefish Fishery
  - West Coast Rock Lobster Managed Fishery.

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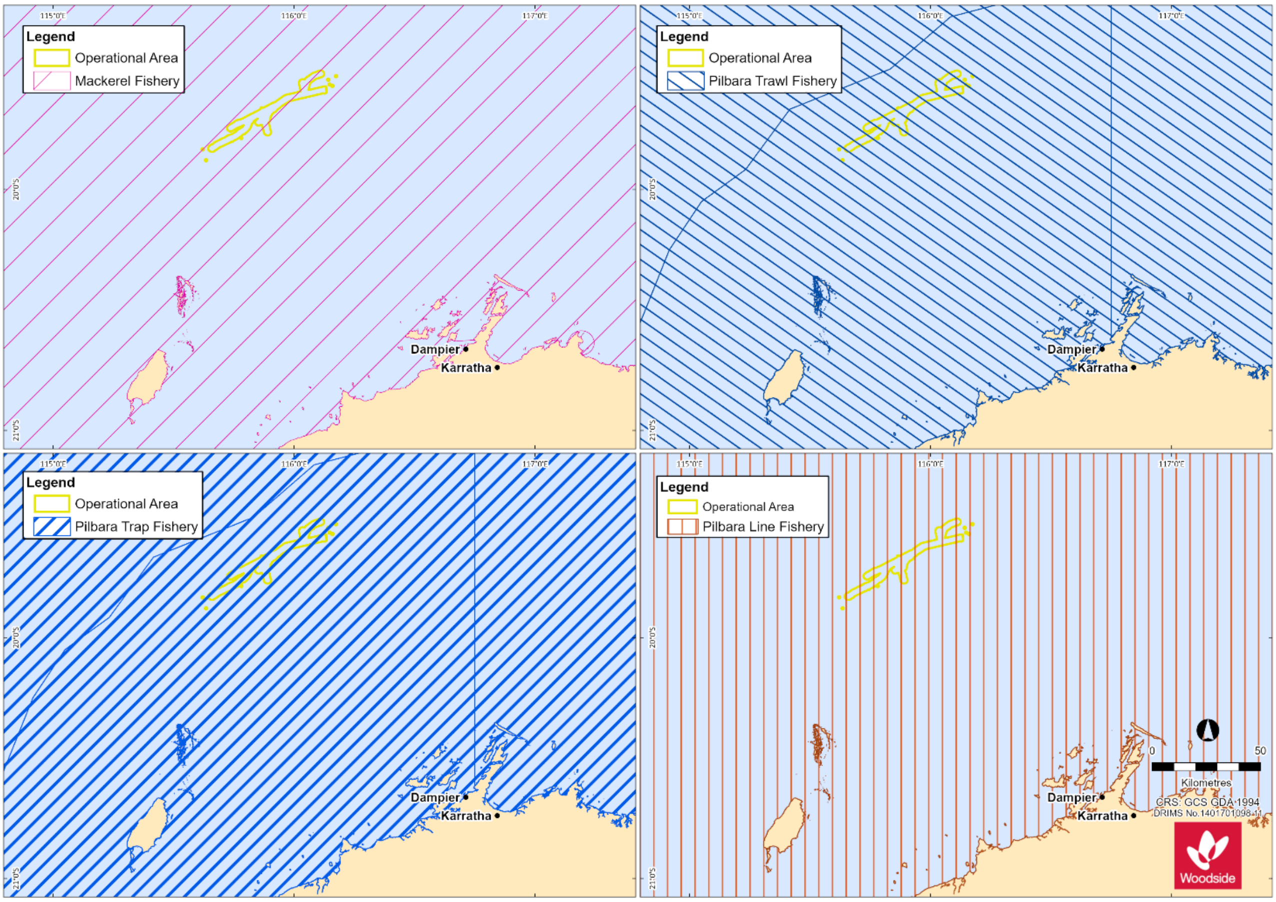

Figure 4-12: State Managed commercial fisheries overlapping the Operational Area with a potential for interaction with the Petroleum Activities Program

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4.9.3 Traditional Fisheries

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 wider EMBA, have a known history of fishing when areas were occupied (as from historical records) (CALM 2005, DEC 2007).

4.9.4 Tourism and Recreation

No tourist activities take place specifically within the Operational Area. However ,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 and Planning 2012).

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 Coast World Heritage Property (approximately 229 km south-west of the Operational Area). Activities undertaken include recreational fishing, snorkelling and scuba diving and wildlife watching and encounters (including whale sharks, manta rays, humpback whales and turtles) (Schianetz et al. 2009).

The Montebello Islands (53 km from the Operational Area), are the closest location for tourism with some charter boat operators taking visitors to these islands (DEC 2007).

Recreational fishing in the Pilbara and Gascoyne regions is mainly concentrated around coastal waters and islands and has grown considerably with the expanding regional centres, seasonal tourism and increasing residential and fly in/fly out work force, particularly in the Pilbara region (Fletcher et al. 2017). Some recreational fishing has historically taken place at Rankin Bank and the Glomar Shoal (approximately 3 km west and 60 km east of the Operational Area respectively). However, due to the distance from access nodes, such as Dampier and Onslow (approximately 130 km and 202 km from the Operational Area at the closest point respectively) recreational fishing effort is expected to be restricted to relatively large vessels and hence is considered to be low.

4.9.5 Commercial Shipping

The Australian Maritime Safety Authority (AMSA) has introduced a network of marine fairways across the NWMR off WA to reduce the risk of vessel collisions with offshore infrastructure. It is noted that the fairway overlaps the Operational Area (GWF-2 and EY pipelines) west of the GWA platform (**Figure 4-13**). Vessel tracking data suggest shipping is concentrated to the south-east of the Operational Area, which is likely associated with ports.

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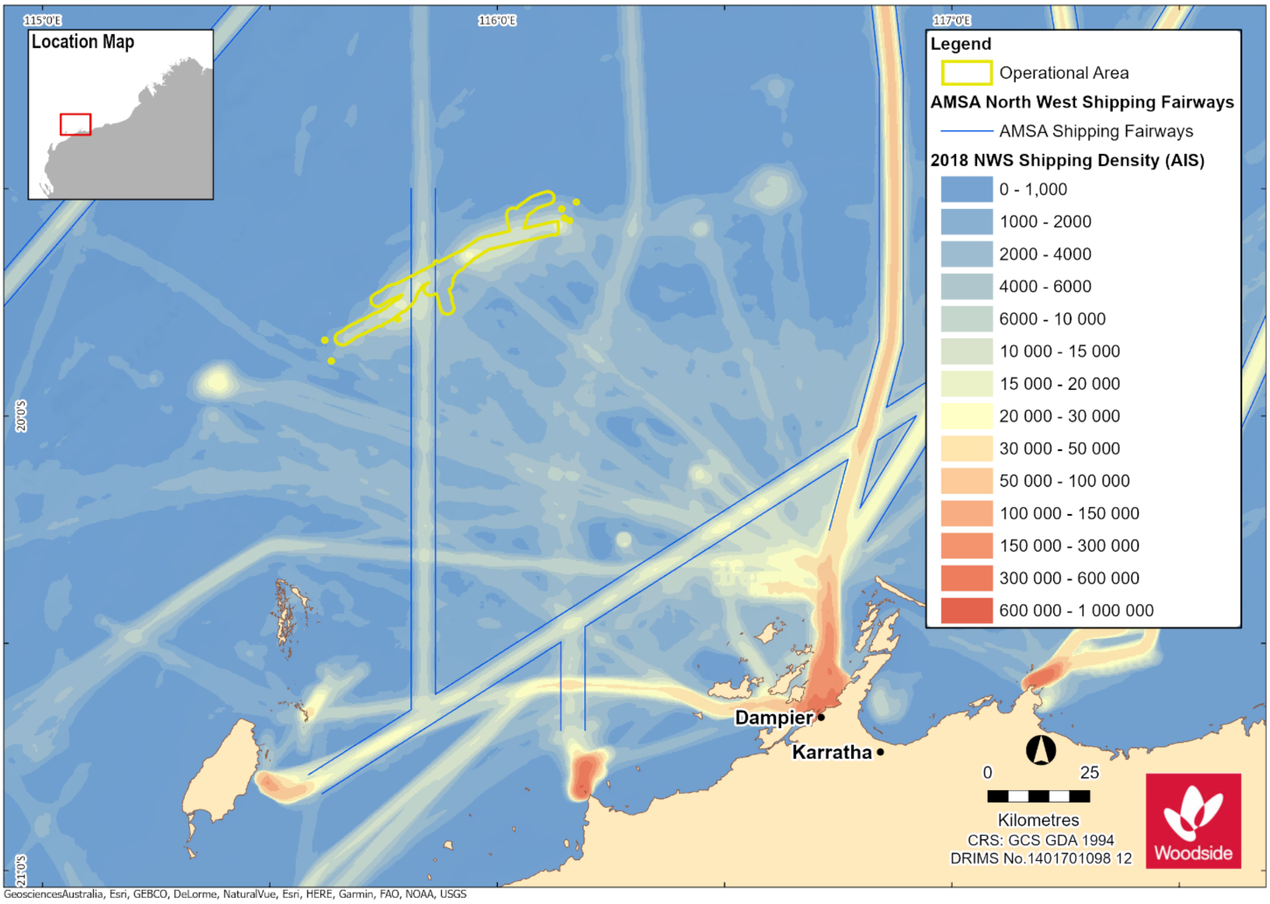

Figure 4-13: Vessel density map for the Operational Area and EMBA, derived from AMSA satellite tracking system data (vessels include cargo, LNG tanker, passenger vessels, support vessels, and others/unnamed vessels)

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4.9.6 Oil and Gas

Table 4-19 details other oil and gas facilities located within 50 km of the Operational Area. **Appendix C, Section 11.9** describes current oil and gas development within the EMBA, also shown in **Figure 4-13**.

Table 4-19: Other Oil and Gas Facilities located within 50 km of the Operational Area

Facility Name and Operator	Distance and Direction from Operational Area to the facility (km)
North Rankin Complex (Woodside)	adjacent
Wheatstone Platform (Chevron)	26 km west
Okha (Woodside)	29 km west
Pluto (Woodside)	30 km west
Angel (Woodside)	44 km east
Reindeer (Santos)	50 km south-east

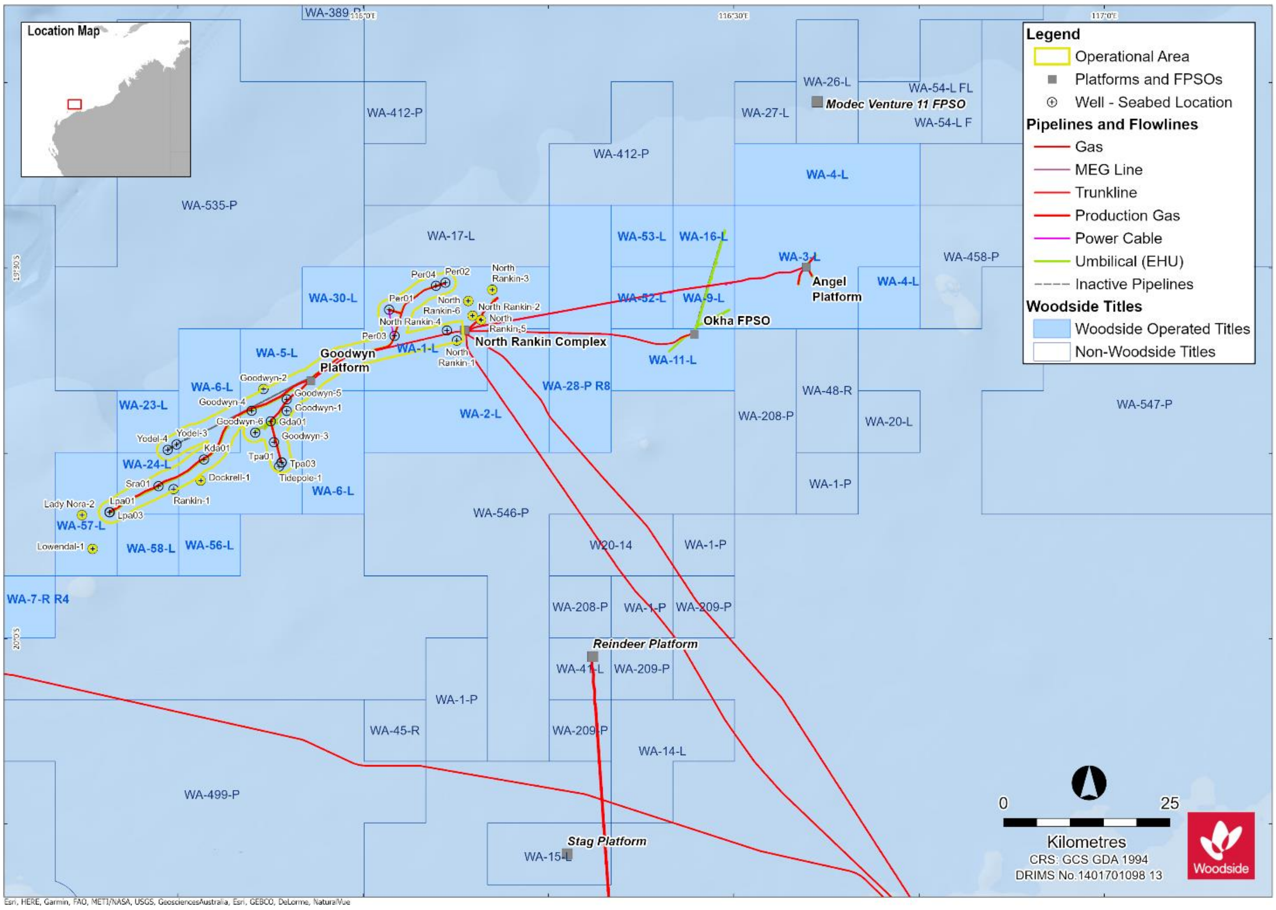

Figure 4-14: Oil and gas Infrastructure within the Operational Area and EMBA

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4.9.7 Defence

The are no defence areas overlapping the Operational Area. Defence areas overlapping the EMBA are presented in **Figure 4-15**.

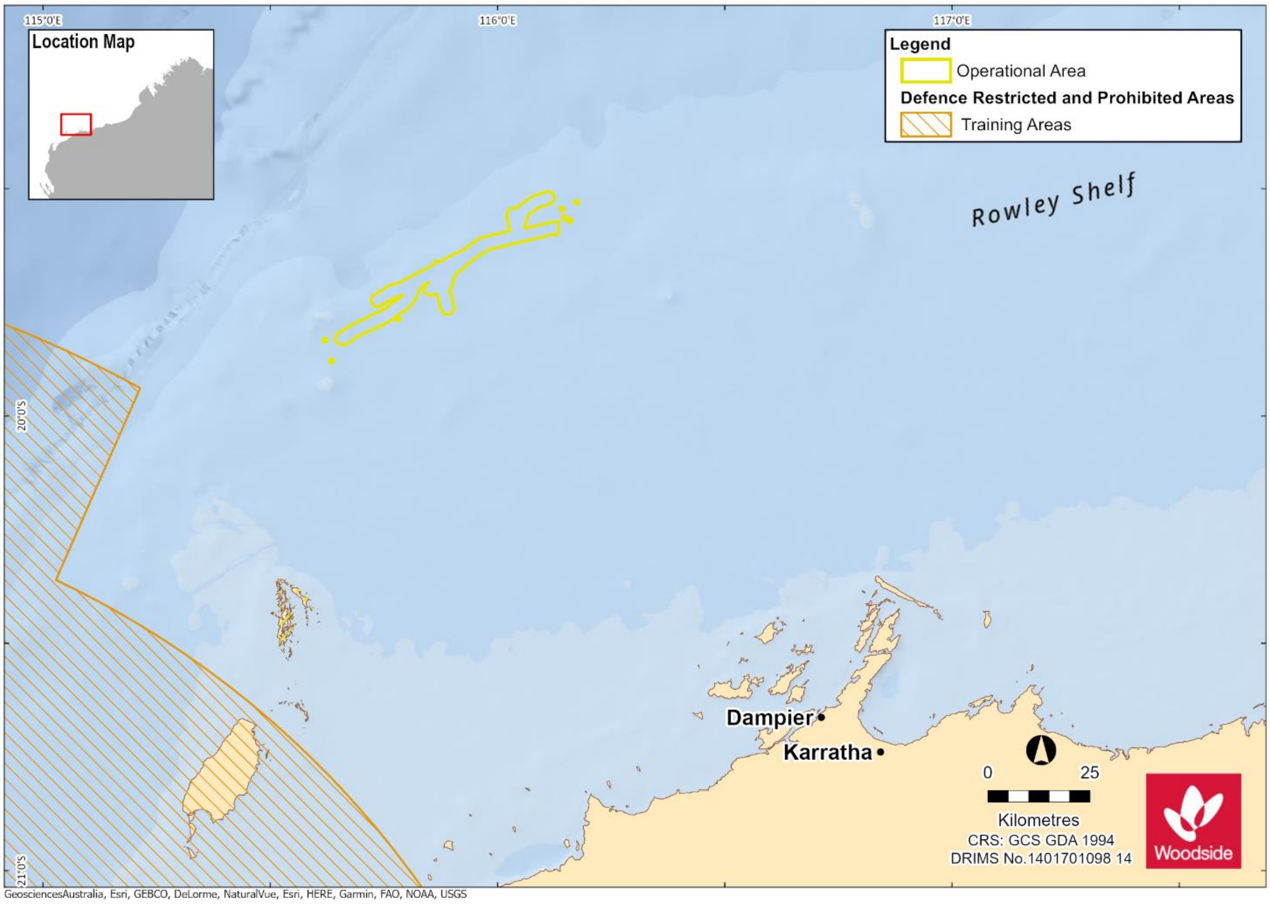

Figure 4-15: Defence areas within and adjacent to the Operational Area

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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 subregulation 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 Northern Territory 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 Northern Territory 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 Expectation 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 - November 2021*
- *GN1847 - Responding to public comment on environment plans - September 2020*
- *GN1344 - Environment plan content requirements - September 2020*
- *GN1488 - Oil pollution risk management - February 2021*
- *GN1785 – Petroleum activities and Australian Marine Parks – June 2020*
- *GL1887 – Consultation with Commonwealth agencies with responsibilities in the marine area – July 2020*
- *NOPSEMA Bulletin #2 – Clarifying statutory requirements and good practice consultation – November 2019*

Australian Fisheries Management Authority:

- *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:

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- *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 with information relevant 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.

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Table 5-1: Assessment of Relevant Stakeholders for the Petroleum Activity Program

Stakeholder	Relevant to activity	Reasoning
Commonwealth Government department or agency		
Australian Border Force (ABF)	Yes	Responsible for offshore border control enforcement and coordinating maritime security.
Australian Fisheries Management Authority (AFMA)	No	Responsible for Commonwealth-managed fisheries. No Commonwealth fisheries are relevant to the activity.
Australian Hydrographic Office (AHO)	Yes	Maritime safety and responsible for Notice to Mariners and AUSCOAST warnings.
Australian Maritime Safety Authority (AMSA) – maritime safety	Yes	Statutory agency for vessel safety and navigation and legislated responsibility for oil pollution response in Commonwealth waters.
Australian Maritime Safety Authority (AMSA) – marine pollution	Yes	Statutory agency for vessel safety and navigation and legislated responsibility for oil pollution response in Commonwealth waters.
Department of Agriculture, Water and the Environment (DAWE) – fisheries	No	The Department provides policy advice to the Australian Government on a range of economic and environmental fisheries issues, including the conservation of the marine ecosystems and biodiversity that support commercially valuable fisheries resources. The Department requests to be consulted where an activity has the potential to impact fishing operations in Commonwealth waters. No Commonwealth fisheries are relevant to the activity.
DAWE – biosecurity (marine pests, vessels, aircraft and personnel)	Yes	DAWE administers, implements and enforces the Biosecurity Act 2015. The Department requests to be consulted where an activity has the potential to transfer marine pests. DAWE also has inspection and reporting requirements to ensure that all conveyances (vessels, installations and aircraft) arriving in Australian territory comply with international health regulations and that any biosecurity risk is managed. The Department requests to be consulted where an activity involves the movement of aircraft or vessels between Australia and offshore petroleum activities either inside or outside Australian territory
Department of Defence (DoD)	No	The proposed Operational Area does not overlap Defence training areas.
Department of Industry, Science, Energy and Resources (DISER)	Yes	Department of relevant Commonwealth Minister and is required to be consulted under the OPGGS (Env) Regulations.
Director of National Parks (DNP)	No	Responsible for managing Australian Marine Parks (AMPs). The proposed Operational Area does not overlap an Australian Marine Park but consultation material is provided for information purposes only.
WA Government department or agency		
Department of Biodiversity, Conservation and Attractions (DBCA)	No	Responsible for managing Australian Marine Parks (AMPs). The proposed Operational Area does not overlap a State Marine Park but consultation material has been provided for information purposes.

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Stakeholder	Relevant to activity	Reasoning
Department of Mines, Industry Regulation and Safety (DMIRS)	Yes	Department of relevant WA Government Minster and is required to be consulted under the OPGGS (Env) Regulations.
Department of Primary Industries and Regional Development (DPIRD)	Yes	Responsible for State-managed fisheries.
Department of Transport (DoT)	Yes	Manages oil spill response in WA State waters.
Commonwealth managed fisheries*		
Southern Bluefin Tuna Fishery	No	The fishery has not been active in the Operational Area within at least the last five years.
Western Skipjack Tuna Fishery	No	The fishery has not been active in the Operational Area within at least the last five years.
Western Tuna and Billfish Fishery	No	The fishery has not been active in the Operational Area within at least the last five years.
WA managed fisheries*		
West Australian Abalone Fishery	No	The fishery has not been active in the Operational Area within the last five years.
Mackerel Managed Fishery (Area 2)	Yes	The fishery has been active in the Operational Area within the last five years.
Marine Aquarium Managed Fishery	No	The fishery has not been active in the Operational Area within the last five years.
Onslow Prawn Managed Fishery	No	The fishery has not been active in the Operational Area within the last five years.
Pilbara Crab Managed Fishery	No	The fishery has not been active in the Operational Area within the last five years.
Pilbara Fish Trawl Interim Managed Fishery	Yes	The fishery has been active in the Operational Area within the last five years.
Pilbara Trap Managed Fishery	Yes	The fishery has been active in the Operational Area within the last five years.
Pilbara Line Fishery	Yes	The fishery has been active in the Operational Area within the last five years.
Specimen Shell Managed Fishery	No	The fishery has not been active in the Operational Area within the last five years.
South-west Coast Salmon Managed Fishery	No	The fishery has not been active in the Operational Area within the last five years.
West Coast Deep Sea Crustacean Managed Fishery	No	The fishery has not been active in the Operational Area within the last five years.
Pilbara Developing Crab Fishery	No	The fishery has not been active in the Operational Area within the last five years.
Pearl Oyster Managed Fishery	No	The fishery has not been active in the Operational Area within the last five years.

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Stakeholder	Relevant to activity	Reasoning
Industry		
BP Developments Australia	Yes	Adjacent Titleholder.
Mobil	Yes	Adjacent Titleholder.
Santos	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 (CFA)	No	Represents the interests of licence holders in Commonwealth-managed fisheries. No Commonwealth fisheries are relevant to the Activity.
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.
Western Australian Fishing Industry Council (WAFIC)	Yes	Represents the interests of licence holders in WA-managed fisheries.

**Fisheries have 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, water depth, and likelihood of fishing in the future*

5.4 Stakeholder Consultation

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

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

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Table 5-2: Stakeholder Consultation Activities

Stakeholder	Information provided	Stakeholder response	Woodside response	Woodside assessment and outcome
Australian Government department or agency				
ABF	On 4 May 2021, Woodside emailed ABF advising of the proposed activity (Appendix F, reference 1.1) and provided a Consultation Information Sheet.	No feedback received.	No response required.	Woodside has addressed maritime security-related issues in **Section 6** of this EP based on previous offshore activities. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
AHO	On 4 May 2021, Woodside emailed the AHO advising of the proposed activity (Appendix F, reference 1.2) and provided a Consultation Information Sheet, and shipping traffic density map.	No feedback received.	No response required.	Woodside notes confirmation from AMSA on 5 May 2021 that it will undertake the following notification to the AHO, which is referenced as a **Control 1.5** in this EP: Woodside to notify AHO to generate a temporary Maritime Safety Information **Notifications** (MSIN) and temporary Notice to Mariners (NTM) for activities where vessel activities are undertaken for more than three weeks at a time in the Operational Area as defined in the Operations Environment Plan. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
AMSA (marine safety)	On 4 May 2021, Woodside emailed AMSA advising of the proposed activity (Appendix F, reference 1.2) and provided a Consultation Information Sheet and a shipping traffic density map.	On 5 May 2021, AMSA emailed Woodside requesting: The AHO be contacted no less than four working weeks before operations commence for the promulgation of related notices to mariners.	On 11 June 2021, Woodside proposed the following notifications protocols as being more appropriate for ongoing operations: • Woodside to notify AMSA JRCC where vessels are undertaking stationary IMMR activities in shipping lanes before activity commencement.	Consultation ongoing.

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Stakeholder	Information provided	Stakeholder response	Woodside response	Woodside assessment and outcome
		AMSA's Joint Rescue Coordination Centre (JRCC) be notified at least 24–48 hours before operations commence Provide updates to the AHO and JRCC should there be changes to the activity. Vessels exhibit appropriate lights and shapes to reflect the nature of operations and comply with the International Rules of Preventing Collisions at Sea. AMSA provided advice on obtaining vessel traffic plots, including digital datasets and maps.	• Woodside to notify AMSA JRCC where vessel activities are undertaken for more than three weeks at a time in the Operational Area as defined in the Operations Environment Plan. • Woodside to notify AHO to generate a temporary Maritime Safety Information Notifications (MSIN) and temporary Notice to Mariners (NTM) for activities where vessel activities are undertaken for more than three weeks at a time in the Operational Area as defined in the Operations Environment Plan. Woodside also confirmed vessels will exhibit appropriate lights and shapes to reflect the nature of operations and the obligation to comply with the International Rules for Preventing Collisions at Sea.	
	On 2 August 2021, Woodside emailed AMSA seeking confirmation of proposed notification protocols.	On 5 August 2021, AMSA emailed Woodside, suggesting minor changes to proposed protocols.	Woodside notes AMSA's response.	Woodside has considered AMSA's requests for notifications and provided a notifications protocol relevant to ongoing operations. Woodside will notify: • AMSA JRCC where vessels are undertaking stationary IMMR activities in, or in close proximity (defined as within 1 km of a shipping lane) to, shipping lanes before activity commencement, as referenced as **Control 1.6** in this EP. • AMSA JRCC where vessel activities are undertaken in, or in close proximity (defined as within 1 km of a shipping lane)

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Stakeholder	Information provided	Stakeholder response	Woodside response	Woodside assessment and outcome
				to, shipping lanes before activity commencement as referenced as **Control 1.6** in this EP. • AHO to generate a temporary Maritime Safety Information Notifications (MSIN) and temporary Notice to Mariners (NTM) for activities where vessel activities are undertaken for more than three weeks at a time in the Operational Area as defined in the Operations Environment Plan, as referenced as **Control 1.5** in this EP. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
AMSA (marine pollution)	On 4 May 2021, Woodside emailed AMSA advising of the proposed activity (Appendix F, reference 1.3) and provided a Consultation Information Sheet.	No feedback received.	No response required. Woodside to provide the Oil Pollution First Strike Plan to AMSA.	Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
	On 6 July 2021, Woodside emailed AMSA and provided a Consultation Information Sheet and the GWA Operations First Strike Plan (Appendix F, reference 1.16).	No feedback received.	No response required. Woodside has provided the Oil Pollution First Strike Plan to AMSA.	Woodside has addressed oil pollution planning and response at **Appendix D**. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.

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Stakeholder	Information provided	Stakeholder response	Woodside response	Woodside assessment and outcome
DAWE	On 13 May 2021, Woodside emailed DAWE advising of the proposed activity considering biosecurity matters (Appendix F, reference 1.4) and provided a Consultation Information Sheet and a fisheries map.	On 25 May 2021, DAWE emailed Woodside acknowledging the consultation material and would respond if it had any questions. DAWE requested to be kept informed of future developments relating to the project. DAWE also requested Woodside to communicate with the Australian Fisheries Management Authority and relevant fishing industry representation organisations in the region for future developments.	On 10 June 2021, Woodside emailed DAWE acknowledging its request to kept informed about future developments. It also acknowledged that it would consult the Australian Fisheries Management Authority and relevant fishing industry representation organisations in the region if future developments had the potential to impact the interests of stakeholders relevant to Commonwealth-managed fisheries.	Woodside has assessed the relevancy of Commonwealth fisheries issues in **Section 4.9.2**of this EP. Woodside has addressed maritime biosecurity issues in **Section 6.7** of this EP based on previous offshore activities. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
DISER	On 4 May 2021, Woodside emailed DISER advising of the proposed activity (Appendix F, reference 1.5) and provided a Consultation Information Sheet.	No feedback received.	No response required.	Woodside has provided sufficient information and opportunity to respond. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
DNP	On 4 May 2021, Woodside emailed DNP advising of the proposed activity considering potential risks to Australian marine Parks (Appendix F, reference 1.6), and provided a Consultation Information Sheet.	No feedback received.	Woodside to follow up.	
	On 10 June 2021, Woodside emailed the DNP to establish whether it wished to provide feedback on the proposed Activity.	No feedback received.	No response required.	Woodside has provided sufficient information and opportunity to respond. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.

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Stakeholder	Information provided	Stakeholder response	Woodside response	Woodside assessment and outcome
WA Government				
DBCA	On 6 May 2021, Woodside emailed DBCA advising of the proposed activity (Appendix F, reference 1.7) and provided a Consultation Information Sheet.	On 24 May 2021, DBCA emailed Woodside acknowledging Woodside's advice. DBCA noted ecologically important areas including marine parks and island/coastal conservation reserves located in the vicinity of the ongoing operations. DBCA encouraged Woodside to ensure it possessed all baseline information required to implement a Before-After, Control-Impact (BACI) framework in planning its management response in the event of a substantial hydrocarbon release. DBCA advised Woodside that its published reports on marine park and reserve monitoring were to inform DBCA marine park management and was not necessarily suitable to provide all baseline information required for oil spill risk assessment and management planning. DBCA recommended that Woodside refer to the Commonwealth Department of Agriculture, Water and the Environment's National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds.	On 19 July 2021, Woodside emailed DBCA and reaffirmed the areas of ecological importance in the proximity of the operational area will not be impacted by planned activities, noting that details of particular values and sensitivities of the environment within and in proximity to operational areas and the environment that maybe affected (EMBA) are included in Environment Plans for impact assessment and risk evaluation. Woodside noted it maintained sound knowledge and understanding of areas of ecological importance through the regular maintenance of an information system detailing; credible published scientific research, industry and research agencies (government and university) baseline and monitoring programs, and Woodside studies that can be accessed to support the implementation of an oil spill scientific monitoring program in the highly unlikely event of a hydrocarbon spill. Woodside also advised it was committed to sharing knowledge and contributes to the Index of Marine Surveys for Assessment (IMSA) hosted by the Department of Water and Environmental Regulation (WA) and supported by the WA Marine Science Institution. Woodside also advised its oil spill scientific monitoring program (SMP) would provide for a quantitative assessment of the overall environmental impacts in the event of an unplanned hydrocarbon release, or any	Woodside considers its response adequately addresses stakeholder interests and no further consultation is required.

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Stakeholder	Information provided	Stakeholder response	Woodside response	Woodside assessment and outcome
		DBCA provided contact details in the event of a hydrocarbon release. DBCA noted that it will not implement an oiled wildlife management response on behalf of a petroleum operator except as part of a whole of government response mandated by regulatory decision makers, and any advice or assistance from DBCA, at any scale, will occur on a full cost recovery basis. In the event of a hydrocarbon release, DBCA requested that Woodside notify DBCA's Pilbara regional office as soon as practicable. DBCA requested that Woodside commit to the monitoring and clean-up of any DBCA interests affected by an oil spill in consultation with DBCA.	release event with the potential to contact sensitive environmental receptors. The design and execution of the scientific monitoring would be dependent on the nature and scale of the spill and the receptors predicted to be impacted. Woodside has considered DAWE's National Light Pollution Guidelines vessel activities was considered in the assessment of potential impacts to turtle behaviour, based on recommendations in the National Light Pollution Guidelines. This impact assessment determined that the impacts of lighting are as low as reasonably practicable. Lighting on the GWA facility and any activity vessels is required as a priority for safe operation. Woodside's Oil Pollution First Strike Plan for this activity includes a commitment that DBCA will be notified via phone call as soon as practicable in the event of a hydrocarbon release. This plan describes the incident management structure, notification and reporting requirements, the operational area, activity specific credible spill scenarios, and the hydrocarbon spill response strategies available for the protection of priority receptors. Woodside notes that DBCA will not implement an oiled wildlife management response on behalf of a petroleum operator.	

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Stakeholder	Information provided	Stakeholder response	Woodside response	Woodside assessment and outcome
DMIRS	On 4 May 2021, Woodside emailed DMIRS advising of the proposed activity (Appendix F, reference 1.8) and provided a Consultation Information Sheet.	No feedback received.	No response required.	Woodside has provided sufficient information and opportunity to respond. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
DPIRD	On 4 May 2021, Woodside emailed DPIRD advising of the proposed activity (Appendix F, reference 1.9) and provided a Consultation Information Sheet and a fisheries map.	No feedback received.	No response required.	Woodside has consulted individual licence holders, WAFIC and the PPA and considers this adequately addresses stakeholder interests and no further consultation is required.
DoT	On 4 May 2021, Woodside emailed DoT advising of the proposed activity (Appendix F, reference 1.10) and provided a Consultation Information Sheet.	No feedback received.	No response required. Woodside to provide the Oil Pollution First Strike Plan to AMSA.	Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
	On 6 July 2021, Woodside emailed DoT and provided a Consultation Information Sheet and the GWA Operations First Strike Plan (Appendix F, reference 1.17).	On 9 July 2021, DoT emailed Woodside advising it would review the Plan and revert if it had any questions.	No response required. Woodside has provided the Oil Pollution First Strike Plan to DoT.	Woodside has addressed oil pollution planning and response at **Appendix D**. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
WA Managed Fisheries				

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Stakeholder	Information provided	Stakeholder response	Woodside response	Woodside assessment and outcome
Licence holders in the Mackerel Managed Fishery (Area 2), Pilbara Fish Trawl Interim Managed Fishery, Pilbara Trap Managed Fishery and the Pilbara Line Fishery	On 4 May 2021, Woodside mailed licence holders advising of the proposed activity (Appendix F, reference 1.11) and provided a Consultation Information Sheet, and Commercial Fishing Information Sheet.	No feedback received.	No response required.	Woodside has provided sufficient information and opportunity to respond. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
Industry				
BP Developments Australia	On 4 May 2021, Woodside emailed BP advising of the proposed activity (Appendix F, reference 1.12) and provided a Consultation Information Sheet, and Titleholder map.	No feedback received.	No response required.	Woodside has provided sufficient information and opportunity to respond. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
Mobil	On 4 May 2021, Woodside emailed Mobil advising of the proposed activity (Appendix F, reference 1.12) and provided a Consultation Information Sheet.	No feedback received.	No response required.	Woodside has provided sufficient information and opportunity to respond. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
Santos	On 4 May 2021, Woodside emailed Santos advising of the proposed activity (Appendix F, reference 1.12) and provided a Consultation Information Sheet.	No feedback received.	No response required.	Woodside has provided sufficient information and opportunity to respond. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
Industry representative organisations				

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Stakeholder	Information provided	Stakeholder response	Woodside response	Woodside assessment and outcome
APPEA	On 4 May 2021, Woodside emailed APPEA advising of the proposed activity (Appendix F, reference 1.13) and provided a Consultation Information Sheet.	No feedback received.	No response required.	Woodside has provided sufficient information and opportunity to respond. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
PPA	On 4 May 2021, Woodside emailed PPA advising of the proposed activity (Appendix F, reference 1.14) and provided a Consultation Information Sheet and a fisheries map.	No feedback received.	No response required.	Woodside has provided sufficient information and opportunity to respond. Woodside considers this adequately addresses stakeholder interests and no further consultation is required.
WAFIC	On 4 May 2021, Woodside emailed WAFIC advising of the proposed activity (Appendix F, reference 1.15) and provided a Consultation Information Sheet and a fisheries map.	WAFIC had no specific comments. WAFIC noted that non-active fisheries and the biological distribution of aquatic resource may need to be considered during the development and review of an EP, as these fisheries may be impacted indirectly.	Woodside notes WAFIC's feedback.	Woodside considers this adequately addresses stakeholder interests and no further consultation is required.

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5.5 Ongoing Consultation

Woodside is committed to the engagement listed in Table 5-3 based on stakeholder feedback

Table 5-3: Assessment of Ongoing Stakeholder Consultation

Stakeholder	Activity
AMSA	Woodside will notify AMSAs JRCC, where vessel activities are undertaken in shipping lanes or for extended periods of time outside of shipping lanes.
AHO	Woodside will notify the AHO to generate a temporary Maritime Safety Information Notifications (MSIN) and temporary NTMs for activities where vessels will be in field for more than 3 weeks.

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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.

Impacts and 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 and risk assessment groupings are based on environmental aspect[5] (e.g. emissions, physical presence, etc.). For all hazardous events considered, the worst credible consequence was assumed.

The ENVID identified 15 impacts and 22 risks associated with the Petroleum Activities Program. Planned activities and unplanned events are summarised in **Table 6-1** and **Table 6-2**. The assigned risk ratings were determined with controls in place as described in **Section 2.6.3**.

The analysis and evaluation for the Petroleum Activities Program indicate that current environmental risks and impacts associated with the activity are reduced to ALARP and are of an acceptable level, as discussed further in **Section 6.6** to **Section 6.8**.

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

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Table 6-1: Environmental impact and risk analysis summary table – planned activities

Aspect	EP Section	Source of Impact	Key Potential Environmental Impacts (Refer to relevant EP section for details)	Controlled Impact Classification		Residual Impact Level (ALARP controls in place)	Acceptability of Impact
Planned Activities (Routine and Non-routine)							
Physical presence: disturbance to marine users	**6.6.1**	Presence of GWA platform and subsea infrastructure excluding and/or displacing other users from PSZ and Operational Area, respectively.	Potential isolated social impact potentially resulting from interference with other sea users (e.g. commercial and recreational fishing, and shipping).	F		Social and Cultural – No lasting effect (< 1 month). Localised impact not significant to areas/items of cultural significance.	Broadly Acceptable
Physical presence: disturbance to seabed	**6.6.2**	Presence of GWA facility and subsea infrastructure modifying marine habitats.	Localised modification of seabed habitat (formation of artificial reef) within Operational Area.	E		Environment – Slight, short-term impact (<1 year) on species, habitat (but not affecting ecosystem function), physical or biological attribute.	Broadly Acceptable
		Subsea operations, inspection, maintenance and repair activities resulting in disturbance to seabed.	Potential minor, localised modification of seabed habitat within Operational Area.	E		Environment – Slight, short-term impact (< 1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	Broadly Acceptable
Routine acoustic emissions: generation of noise during routine operations	**6.6.3**	Noise generated within the Operational Area from: • GWA facility and associated infrastructure • vessels; and • helicopters.	Localised behavioural impacts to marine fauna around vessels and GWA platform.	F		Environment – No lasting effect (< 1 month). Localised impact not significant to environmental receptor.	Broadly Acceptable
Routine and non-routine discharges: discharge of hydrocarbons and chemicals during subsea operations and activities	**6.6.4**	Discharge of subsea control fluids.	Localised, short-term decrease in water quality around subsea system within Operational Area.	F		Environment – No lasting effect (< 1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
		Discharge of hydrocarbons remaining in subsea pipeworks and equipment as a result of subsea intervention works.	Potential slight short-term, localised decrease in water quality at release location during IMR activities.	F		Environment – No lasting effect (< 1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
		Discharge of chemicals remaining in subsea pipeworks and equipment or the use of chemicals for subsea inspection, maintenance and repair (IMR) activities.	Potential slight short-term, localised decrease in water quality at release location during IMR activities.	F		Environment – No lasting effect (< 1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
Routine and non-routine discharges: discharge of PW	**6.6.5**	Discharge of PW from GWA platform.	Potential minor, short-term impact to water quality, marine sediments and marine biota.	E		Environment – Slight short-term impact (< 1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	Broadly Acceptable
Routine and non-routine discharges: discharges of sewage, putrescible waste, grey water, bilge water, drain water, cooling water and brine	**6.6.6**	Discharge of sewage, greywater and putrescible waste from vessels and GWA facility to the marine environment.	Potential slight, short-term, localised ongoing increase in nutrients and oxygen demand around GWA platform and vessels.	F	Cumulative E	Environment – No lasting effect (< 1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
		Discharge of deck, bilge and drain water from vessels and GWA facility to the marine environment.	Potential slight, short-term localised decrease in water quality at discharge location.	F		Environment – No lasting effect (< 1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
		Discharge of RO brine from vessels and GWA facility to the marine environment.	Negligible, localised increase in salinity at the discharge location.	F		Environment – No lasting effect (< 1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
		Discharge of cooling water from vessels and GWA facility to the marine environment.	Potential slight, localised increase in water temperature, and short-term water quality changes around discharge location.	F		Environment – No lasting effect (< 1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
Routine and non-routine atmospheric emissions: fuel combustion, flaring and fugitives	**6.6.7**	GWA facility gas turbines, operational flaring and fugitive emissions, and vessel emissions	Potential slight short-term, localised air quality changes, limited to the airshed local to the facility.	F		Environment – No lasting effect (< 1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable

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Aspect	EP Section	Source of Impact	Key Potential Environmental Impacts (Refer to relevant EP section for details)	Controlled Impact Classification	Residual Impact Level (ALARP controls in place)	Acceptability of Impact
Routine light emissions: light emissions from platform lighting, vessels operations and operational flaring	**6.6.8**	Light emissions from GWA facility and vessels.	Negligible, localised potential for behavioural disturbance of species in close proximity to GWA platform and vessels.	F	Environment – No lasting effect (< 1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable
		Light emissions from GWA facility during flaring.	Negligible, localised potential for behavioural disturbance of species in close proximity to GWA platform and vessels.	F	Environment – No lasting effect (< 1 month). Localised impact not significant to environmental receptors.	Broadly Acceptable

Table 6-2: Environmental impact and risk analysis summary table – unplanned events

Aspect	EP Section	Source of Risk	Key Potential Environmental Impacts (Refer to relevant EP section for details)	Risk Rating				Acceptability of Impact
				Consequence Classification	Residual Impact Level (ALARP controls in place)	Likelihood	Residual Risk Rating	
Unplanned Events (Accidents / Incidents)								
Unplanned hydrocarbon or chemical release: Hydrocarbon release during bunkering/ refuelling and chemical release during transfer storage and use	**6.7.1**	Accidental spill of hydrocarbons to the environment during bunkering / refuelling.	Potential minor short term impacts to the marine environment: Including disruption to marine fauna, including protected species and/or temporary impacts to water quality.	D	Environment – Minor short-term impact (1-2 years) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	2	M	Broadly acceptable
		Accidental discharge of chemicals to the marine environment from storage, use or transfer.	Potential slight, localised, short term impacts to marine water quality.	E	Environment – Slight, short-term impact (< 1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	2	M	Broadly acceptable
Unplanned discharges: Hazardous and non-hazardous waste Management	**6.7.2**	Incorrect disposal or accidental discharge of non-hazardous and hazardous waste to the marine environment.	Potential slight short term impacts to the marine fauna, and localised temporary impacts to water quality and marine sediments.	E	Environment – Slight, short-term impact (< 1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	2	M	Broadly acceptable
Physical presence: Vessel collision with marine fauna	**6.7.3**	Physical presence of vessels resulting in collision with marine fauna.	Potential injury or death of marine fauna (single animal), including protected species.	E	Environment – Slight, short-term impact (< 1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	1	L	Broadly acceptable
Physical presence: Introduction of invasive marine species (IMS)	**6.7.4**	Invasive species in vessel ballast tanks or on vessels / submersible equipment.	Potential introduction of IMS possibly resulting in an alteration of the localised environment.	E	Environment – Slight, short-term impact (< 1 year) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	1	L	Broadly acceptable
Unplanned Events (Accidents / Incidents) - MEEs								
Unplanned hydrocarbon release: Loss of well containment (MEE-01)	**6.8.3**	Release of hydrocarbons resulting from loss of platform well containment.	Potential significant impacts to the marine environment: Long-term impacts to sensitive nearshore areas of offshore islands and coastal shorelines. Disruption to marine fauna, including protected species.	B	Environment – Major, long-term impact (10-50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	1	M	Acceptable if ALARP
		Release of hydrocarbons resulting from loss of subsea well containment.		B	Environment – Major, long-term impact (10-50 years) on highly valued	1	M	Acceptable if ALARP

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			Potential medium-term interference with or displacement of other sea users.		ecosystems, species, habitats or physical or biological attributes			
Unplanned hydrocarbon release: Subsea loss of containment (MEE-02)	**6.8.4**	Release of hydrocarbons resulting from loss of containment of subsea flowlines and infrastructure (GWF-1, GWF-2, PoG).	Potential moderate short term impacts to the marine environment: Including disruption to marine fauna, including protected species and/or impacts to water quality.	C	Environment – Moderate, medium-term impact (2-10 years) on ecosystems, species, habitat or physical or biological attributes	0	M	Acceptable if ALARP
		Release of hydrocarbons resulting from loss of export pipeline containment (IFL, including 2TL inventory)	Potential significant impacts to the marine environment: Long-term impacts to sensitive nearshore areas of offshore islands and coastal shorelines. Disruption to marine fauna, including protected species. Potential medium-term interference with or displacement of other sea users.	B	Environment – Major, long-term impact (10-50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	1	M	Acceptable if ALARP
Unplanned hydrocarbon release: Topsides loss of containment (MEE-03)[6]	**6.8.5**	Hydrocarbon release from topside process equipment to the marine environment and atmosphere	Potential moderate short term impacts to the marine environment: Including disruption to marine fauna, including protected species and/or impacts to water quality.	C	Environment – Moderate, medium-term impact (< 1 year) on ecosystems, species, habitat or physical or biological attributes	1	M	Acceptable if ALARP
		Hydrocarbon release from topsides non-process equipment to the marine environment	Potential minor short term impacts to the marine environment: Including disruption to marine fauna, including protected species and/or temporary impacts to water quality.	D	Environment – Minor short-term impact (1-2 years) on species, habitat (but not affecting ecosystem function), physical or biological attributes.	1	M	Acceptable if ALARP
Unplanned hydrocarbon release: Loss of structural integrity (MEE-04)	**6.8.6**	Hydrocarbon release from platform well to the marine environment and atmosphere.	Potential significant impacts to the marine environment: Short to medium term impacts to the offshore marine environment. Long-term impacts to sensitive nearshore areas of offshore islands and coastal shorelines. Disruption to marine fauna, including protected species. Potential medium-term interference with or displacement of other sea users	B	Environment – Major, long-term impact (10-50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	1	M	Acceptable if ALARP
		Hydrocarbon release from pipeline and riser to the marine environment and atmosphere.		B	Environment – Major, long-term impact (10-50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	0	M	Acceptable if ALARP
		Hydrocarbon release from topsides equipment to the marine environment and atmosphere.	Potential moderate short term impacts to the marine environment: Including disruption to marine fauna, including protected species and/or impacts to water quality.	C	Environment – Moderate, medium-term impact (2-10 years) on ecosystems, species, habitat or physical or biological attributes	1	M	Acceptable if ALARP
		Marine environment footprint and associated hydrocarbon and chemical release associated with structural collapse of GWA.		C	Environment – Moderate, medium-term impact (2-10 years) on ecosystems, species, habitat or physical or biological attributes	0	M	Acceptable if ALARP
Unplanned hydrocarbon release: Loss of marine vessel separation (MEE-05)	**6.8.7**	Hydrocarbon release from platform well to the marine environment and atmosphere	Potential significant impacts to the marine environment: Short to medium term impacts to the offshore marine environment. Long-term impacts to sensitive nearshore areas of offshore islands and coastal shorelines. Disruption to marine fauna, including protected species. Potential medium-term interference with or displacement of other sea users	B	Environment – Major, long-term impact (10-50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	1	M	Acceptable if ALARP
		Hydrocarbon release from pipeline and riser to the marine environment and atmosphere		B	Environment – Major, long-term impact (10-50 years) on highly valued ecosystems, species, habitat or physical or biological attributes	0	M	Acceptable if ALARP
		Hydrocarbon release from topsides equipment to the marine environment and atmosphere	Potential moderate short term impacts to the marine environment: Including disruption to	C	Environment – Moderate, medium-term impact (2-10 years) on ecosystems,	1	M	Acceptable if ALARP

[6] MEE classification based on reputational risk

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			marine fauna, including protected species and/or impacts to water quality.		species, habitat or physical or biological attributes			
		Marine environment footprint and associated hydrocarbon and chemical release associated with structural collapse of GWA.		C	Environment – Moderate, medium-term impact (2-10 years) on ecosystems, species, habitat or physical or biological attributes	0	M	Acceptable if ALARP
		Loss of marine diesel from a vessel	Potential moderate short term impacts to the marine environment: Including disruption to marine fauna, including protected species and/or impacts to water quality.	C	Environment – Moderate, medium-term impact (2-10 years) on ecosystems, species, habitat or physical or biological attributes	0	M	Acceptable if ALARP
Unplanned hydrocarbon release: Loss of suspended load (MEE-06)[7]	**6.8.8**	Hydrocarbon release from pipeline and riser to the marine environment and atmosphere	Potential moderate short term impacts to the marine environment: Including disruption to marine fauna, including protected species and/or impacts to water quality.	C	Environment – Moderate, medium-term impact (2-10 years) on ecosystems, species, habitat or physical or biological attributes	1	M	Acceptable if ALARP
		Hydrocarbon release from topsides equipment to the marine environment and atmosphere		C	Environment – Moderate, medium-term impact (2-10 years) on ecosystems, species, habitat or physical or biological attributes	1	M	Acceptable if ALARP

[7] MEE classification based on reputational risk

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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. Other facilities located in close proximity to the Operational Area consist of NRC, which lies at the eastern end of the IFL and the Wheatstone platform, which lies approximately 30 km west of the Operational Area. However, given the concentration of sources of environmental risks and impacts from the Petroleum Activities Program are concentrated around the GWA platform, the potential for cumulative impacts is considered to be low. Cumulative impacts are discussed for sources of risk and impacts where such impacts were deemed to be credible.

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 judgment outlined in **Sections 2.6.1.4** and **Section 2.8**, 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 7.8.4**).

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.

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Context *Description of the context for the impact/risk. Regulation 13(1, 13(2) and 13(3)*															
Description of the Activity – Regulation 13(1)	*Description of the Environment – Regulations 13(2)(3)*							*Consultation – Regulation 11A*							
Impacts and Risks Evaluation Summary *Summary of ENVID outcomes*															
Source of Risk *Regulation 13(1)*	***Environmental Value Potentially Impacted*** *Regulations 13(2)(3)*							***Evaluation*** *Section 2*							
	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems / Habitat	Species	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome	
Summary of source of risk / impact															
Description of Source of Risk or Impact															
Description of the identified risk/impact including sources or threats that may lead to the impact/risk or identified event. Regulation 13(1).															
Impact or Consequence Assessment															
Environmental Value/s Potentially Impacted															
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.															

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[8]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
ALARP/Hierarchy of Control Tools Used – Section 2.6.2				
Summary of control considered to ensure the impacts and risks are continuously reduced to ALARP. *Regulation 13(5)(c).*	*Technical/logistical feasibility of the control.* *Cost/sacrifice required to implement the control (qualitative measure).*	*Qualitative commentary of impact/risk that could be averted/ environmental benefit gained if the cost/ sacrifice is made and the control is adopted.*	*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.*	*If control is adopted, reference to Control No. provided.*
Major Environmental Events				

[8] *Qualitative measure*

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Demonstration of ALARP
MEEs are subject to additional analysis and evaluation as outlined in **Sections 2.7** and **6.8.2**. ALARP is demonstrated through controls being analysed for selection, based on their independence, and prioritised in accordance with hierarchy of controls, and further analysed to consider the type of effect the control provides.
ALARP Statement Made on the basis of the environmental risk/impact assessment outcomes, use of the relevant tools appropriate to the Decision Type (**Section 2.6.1**) and a proportionality assessment. Regulation 10A (b).

Demonstration of Acceptability
Acceptability Statement Made on the basis of applying the process described in **Section 2.8** and 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[9].* **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.** *MC for determining whether the outcomes and standards have been met. Regulation 13(7)(c).*

6.5 Environment Risk/Impacts not Deemed Credible

The ENVID identified a source of environmental risk / impact that was assessed as not being applicable (not credible) within or outside the Operational Area as a result of the Petroleum Activities Program, and therefore, which were determined to not form part of this EP. This is described in the following sections for information only.

Shallow/Near-shore Activities

[9] *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 2.6.3**).*

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The Petroleum Activities Program is located in water depths of approximately between 77 and 200 m and at a distance approximately 53 km from nearest landfall (Montebello Islands), consequently risks / impacts associated with shallow / near-shore activities such as anchoring and vessel grounding were assessed as not credible. Rankin Bank, a relatively shallow feature in close proximity to the Operational Area (3 km from the Operational Area at the closest point and 33 km from the GWA facility) will not credibly be impacted by shallow / near-shore activities.

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6.6 Planned Activities

6.6.1 Physical Presence: Disturbance to Marine Users

Context		
Facility layout and description – **Section 3.5** Vessels – **Section 3.7** Subsea Inspection, Monitoring, Maintenance and Repair Activities – **Section 3.10**	Socio-economic Environment – **Section 4.9**	Stakeholder Consultation – **Section 5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Presence of GWA platform and subsea infrastructure excluding and/or displacing other users from PSZ and Operational Area, respectively.							✓	A	F	N/A	N/A	LCS GP PJ	Broadly Acceptable	**EPO 1**

Description of Source of Impact

The GWA facility commenced operation in 1995 and has been marked on nautical charts since that time. The GWA facility is surrounded by a 500 m radius PSZ, which non project vessels are prohibited from entering, unless authorised by Woodside. The PSZ is a critical safety control intended to reduce the likelihood of interactions between vessels and the platform, subsequently increasing safety for both vessels and the GWA facility. Implementation of the PSZ excludes other users from a small area of the sea (approximately 0.79 km^2).

Notably, the GWA platform is clearly visible under most conditions and is well lit. The nature of the GWA facility (e.g. a large steel structure) also ensures a clear radar return to alert ships fitted with anti-collision radars.

Routine vessel activities associated with the Petroleum Activities Program are concentrated within the PSZ (e.g. activities performed by platform support vessels at the GWA facility). Subsea support vessels and HLV may undertake activities (e.g. IMR activities, removing redundant equipment) within the Operational Area at any time, including within parts of the Operational Area which are beyond the PSZ. The duration and location of these activities varies depending on the activity being undertaken.

The Australian Hydrographic Office (AHO) has been notified of the location of subsea infrastructure, including infrastructure maintained for decommissioning and not normally producing, for marking on nautical charts. Water depths of subsea infrastructure range between 77 and 220 m.

Impact Assessment

Exclusion and Displacement of Other Users

Commercial Fishing: A number of commercial fisheries overlap the Operational Area (**Section 4.9.2**). Commercial fishing vessels in the vicinity of the Operational Area are most likely to be licenced under the Pilbara demersal scalefish fishery and may employ several gear types (including trap and line). A small area of the Operational Area lies within Zone 2 of the fishery which allows Pilbara Trap Fishing only. This region of the Operational Area is approximately 90 km^2, or less than 0.4% of the total 'Zone 2' fishery area (approximately 24,580 km^2). As such,

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impacts from the physical presence of the GWA facility and subsea infrastructure to this fishery are expected to be confined to localised displacement of fishing effort from the Operational Area.

Tourism and Recreation: Tourism and recreation activity in the Operational Area is expected to be infrequent, with recreational and charter fishing from vessels the only tourism and recreation activities identified as potentially occurring in the Operational Area. Consultation outcomes did not indicate any recreational fishing occurs within the Operational Area (**Section 5**). Any recreational and charter fishing from vessels is largely undertaken using lines.

Given the distance from boating facilities, lack of natural attractions (e.g. reefs or shoals) and the water depth of the Operational Area, very little recreational or charter fishing is expected to occur within the Operational Area. As such, impacts to recreational and charter fishing are expected to be localised and of no lasting effect.

It is noted that some recreational fishing may occur at Rankin Bank, which lies in close proximity to the Operational Area (3 km from the Operational Area at the closest point).

Shipping: Significant commercial shipping occurs in the region, with commercial shipping traffic comprising vessels such as:

- bulk carriers (e.g. mineral ore, salt etc.) from Port Hedland and Dampier;
- offtake tankers;
- support vessels for offshore oil and gas activities; and
- LNG carriers from Dampier, Barrow Island and Ashburton North.

To reduce the likelihood of interactions between commercial vessels and offshore facilities, AMSA have introduced a series of shipping fairways within which commercial vessels are advised to navigate. The fairways are not mandatory, however, AMSA strongly recommends commercial vessels remain within the fairway when transiting the region. The use of shipping fairways is considered to be good seafaring practice, with AUSREP data from AMSA indicating cargo ships and tankers routinely navigate within the established fairways.

The fairway intended to direct north- / south-bound vessel traffic from Barrow Island and the southern Montebello Islands overlaps the Operational Area, including the GWF-2 subsea infrastructure. Operational history of the GWA facility indicates that commercial vessels enter the PSZ very rarely.

The presence of the GWA platform, vessels and subsea infrastructure will not result in impacts to commercial shipping beyond a localised exclusion of shipping traffic from the PSZ and the temporary displacement of commercial shipping due to the presence of subsea support vessels undertaking activities in the Operational Area.

Oil and Gas: The nearest oil and gas platform to the GWA platform is the NRC which is connected to the GWA facility by the IFL. NRC is operated by Woodside and any impacts from the Petroleum Activities Program to NRC will not affect third parties.

The nearest facility not operated by Woodside is the Chevron-operated Wheatstone platform, which lies approximately 26 km south west of the Operational Area. Given the distance between the Operational Area and petroleum activities undertaken by other operators, no impacts to other operators will occur as a result of the presence of the GWA platform, subsea infrastructure or project vessels.

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Vessels compliant with Marine Orders for safe vessel operations: • Marine Order 21 (Safety and emergency procedures) 2016 • Marine Order 27 (Safety of navigation and radio equipment) 2016 • Marine Orders 30 (Prevention of Collisions) 2016 Compliance with Marine Order 21, 27 and 30 reduces the likelihood of adverse interaction of vessels with other marine users.	F: Yes CS: Minimal cost. Standard practice.	Marine Orders 21, 27 and 30 are required under Australian regulations; implementation is standard practice for commercial vessels as applicable to vessel size, type and class.	Control based on legislative requirement – must be adopted.	Yes **C 1.1**
Establishment of a 500 m PSZ around the platform reduces the likelihood of interaction of vessels with the platform.	F: Yes CS: Minimal cost. Standard practice	The PSZ is a requirement under Australian regulations and reduces the likelihood of interaction of vessels with the platform.	Control based on legislative requirement – must be adopted.	Yes **C 1.2**
Good Practice				
Notify AHO of location of permanent new GWA infrastructure to enable update of maritime charts, thereby reducing the likelihood of unplanned interactions with GWA infrastructure.	F: Yes CS: Minimal cost. Standard practice.	Notification of AHO will enable them to update maritime charts, thereby reducing the likelihood of unplanned interactions with GWA infrastructure.	Benefits outweigh cost sacrifice.	Yes **C 1.3**

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Stakeholder consultation undertaken in support of the Petroleum Activities Program, to ensure marine users are informed and aware, thereby reducing the likelihood of unplanned interactions with GWA infrastructure.	F: Yes CS: Minimal cost. Standard practice.	Stakeholder consultation keeps marine users ensures they are informed and aware, thereby reducing the likelihood of unplanned interactions with GWA infrastructure.	Benefits outweigh cost sacrifice.	Yes **C 1.4**
Notify AHO of where vessels will be in field >3 weeks, no less than four working weeks prior to scheduled activity commencement date.	F: Yes CS: Minimal cost. Standard practice.	Notification of AHO will enable them to issue a Maritime Safety Information Notifications (MSIN) and Notice to Mariners (NTM) thereby reducing the likelihood of unplanned interactions with other vessels.	Benefits outweigh cost sacrifice.	Yes **C 1.5**
Notify AMSA Joint Rescue Coordination Centre (JRCC) of activities and movements.	F: Yes CS: Minimal. Standard Practice	Communicating the Petroleum Activities Program to other marine users ensures that are informed and aware should emergency response be required.	Benefits outweigh cost sacrifice.	Yes **C 1.6**
Professional Judgement – Eliminate				
Reduce the PSZ	F: No. The PSZ is mandated by the OPGGS Act and is a safety and environment critical element; it cannot be reduced. CS: Not assessed, control not feasible.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Professional Judgement – Substitute				
None identified.				
Professional Judgement – Engineered Solution				

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
GWA's collision prevention system is implemented to alert marine vessels of the facility location which reduces the likelihood of adverse interaction with other marine users.	F: Yes CS: Minimal cost. Standard practice.	GWA's collision prevention system equipment has the ability to alert marine vessels of the facility location which reduces the likelihood of adverse interaction with other marine users.	Control is WMS requirement – must be adopted.	Yes **C 1.7**
Over-trawl protection on subsea infrastructure.	F: Yes. Over-trawl protection on subsea infrastructure could be fitted to GWA subsea infrastructure. CS: Significant additional cost associated with the design and installation of trawl protection on subsea infrastructure.	Over-trawl protection on subsea infrastructure could mitigate against the potential for commercial fishing trawl gear to damage infrastructure or result in gear loss.	Given the limited portion of the Operational Area lies within the area open to trawl fishing, the cost of installing over-trawl protection is considered to be grossly disproportionate to the environmental benefit.	No

ALARP Statement:

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the potential impacts of the physical presence of the GWA facility, subsea infrastructure and vessels on other users. 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, the physical presence of the GWA facility, subsea infrastructure and vessels represents a negligible impact that is unlikely to result in a potential impact greater than an isolated social impact to commercial fishing, recreational fishing and/or shipping. The adopted controls are considered good oil-field practice/industry best practice and meet requirements of Australian Marine Orders, and expectations of AMSA and AHO provided in consultation with stakeholders. Further opportunities to reduce the impacts and risks have been investigated above.

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 GWA facilities and support vessels to a level that is broadly acceptable.

EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***

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EPOs, EPSs and MC			
EPO 1 Prevent adverse interactions between vessels/platform and other marine users during the Petroleum Activities Program.	**C 1.1** Contract vessels compliant with Marine Orders for safe vessel operations: • Marine Orders 21 (Safety of navigation and emergency procedures) 2016; • Marine Order 27 (Safety of navigation and radio equipment) 2016 • Marine Orders 30 (Prevention of Collisions) 2016.	**PS 1.1** Vessels contracted whose practices comply with Marine Orders as applicable to vessel size, type and class.	**MC 1.1.1** Marine verification records demonstrate compliance with standard maritime safety procedures (Marine Orders 21, 27 and 30).
	C 1.2 Implementation of a 500 m PSZ around GWA platform.	**PS 1.2** Exclusion zone maintained and monitored for incursions.	**MC 1.2.1** Records of adverse interactions in 500 m PSZ with other marine users entered into Incident database.
	C 1.3 Notify AHO of location of new permanent GWA infrastructure to enable update of maritime charts.	**PS 1.3** Woodside will notify AHO of location of new permanent GWA infrastructure.	**MC 1.3.1** Records demonstrate AHO has been notified of location of new permanent GWA infrastructure.
	C 1.4 Undertake consultation program to advise relevant persons of the Petroleum Activities Program and provide opportunity to raise objections or claims.	**PS 1.4** Implement a consultation process that conforms to the requirements of the Environment Regulations.	**MC 1.4.1** Records demonstrate a consultation program that conforms to the requirements of the Environment Regulations has been undertaken (refer to **Section 5**).
	C1.5 Notify AHO, where vessels will be in field >3 weeks, no less than four working weeks prior to scheduled activity commencement date.	**PS 1.5** Woodside to notify AHO of activities where vessels will be in field >3 weeks.	**MC 1.5.1** Records demonstrate that AHO notifications complete.

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EPOs, EPSs and MC			
	C 1.6 In order to prevent activities interfering with other marine users, AMSA RCC is notified of the activity 24-48 hours before commencement.	**PS 1.6** AMSA's JRCC is notified 24 to 48 hrs before mobilisation • for activities in the field >3 weeks; or • if activities occur in a shipping lane; or • activities are undertaken in close proximity (within 1 km) of a shipping lane for awareness should emergency response be required.	**MC 1.6.1** Records demonstrate that AMSA RCC has been notified prior to commencement of the activity.
	C 1.7 Other vessels aware of the presence of the GWA facility.	**PS 1.7** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5)** and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P34 Collision Prevention Systems to; - alert facility of a potential collision with marine vessels; and - alert marine vessels of facility location so that they may take timely action to avoid the facility and hence reduce likelihood of collision	**MC 1.76.1** Records demonstrate implementation of SCE technical Performance Standard(s) and Safety Critical Element Management Procedure

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6.6.2 Physical Presence: Disturbance to the Seabed

Context		
Facility layout and description – **Section 3.5** Vessels – **Section 3.7** Subsea Inspection, Monitoring, Maintenance and Repair Activities – **Section 3.10** Maintaining for decommissioning – **Section 3.5.2.1**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**	Stakeholder Consultation – **Section 5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Presence of GWA facility and subsea infrastructure modifying marine habitats.		✓	✓		✓			A	E	-	-	LCS GP PJ	Broadly Acceptable	**EPO 2**
Subsea operations, inspection, maintenance and repair activities resulting in disturbance to seabed.		✓	✓		✓			A	E	-	-			
Presence of redundant infrastructure remaining infield until Facility EOFL		✓			✓			A	F	-	-			

Description of Source of Impact

Seabed disturbance associated with the Petroleum Activities Program can occur during operations and other activities, including from:

- physical presence of the GWA facility and subsea infrastructure (operational and redundant)
- scour, spans, and flowline movement inherent in design
- subsea IMR activities (**Section 3.10**).

Specifically, the presence of subsea infrastructure may result in localised scouring around the infrastructure due to currents, subsurface waves, and seabed sediment fluid dynamics. Operational experience indicates scour around subsea infrastructure associated with the Petroleum Activities Program is localised with negligible impact to environmental receptors. Scour around subsea infrastructure may necessitate IMR activities as part of integrity management practices.

Flowline movement may occur as per design and within integrity margins along the flowline corridor. Normal flowline operational movement occurs due to factors such as flowline buckling, walking and varying metocean conditions. Lateral movement can occur within the flowline corridor. Management of flowline buckling and walking may necessitate IMR activities. Refer also to MEE-02 Pipeline and Riser Loss of Containment in **Section 6.8.4** which includes controls to limit scour and flowline movement within integrity requirements.

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In order to maintain the integrity of subsea infrastructure, Woodside may be required to undertake routine subsea IMR activities, as described in **Section 3.10**. Activities that constitute IMR may impact upon the benthic environment in the vicinity of the activity. IMR activities identified as impacting the benthic environment include (but are not limited to):

- inspections – minor, localised sediment resuspension by ROV
- marine growth removal – minor, localised resuspension of sediment; removal of marine biota from subsea infrastructure
- sediment relocation – minor, localised modification of benthic habitat and sediment resuspension
- span rectification, pipeline protection and stabilisation – minor, localised modification of benthic habitat within footprint of area subject to rectification / protection / stabilisation;
- jumper and umbilical replacement – minor, localised modification of benthic habitat in the vicinity of the jumper / umbilical
- spool repair / replacement – minor, localised modification of benthic habitat in the vicinity of the spool.
- temporary laying of tools on seabed (e.g. seabed baskets) – minor, localised modification of benthic habitat in the vicinity of the basket

The area of benthic habitat predicted to be impacted varies depending on the nature and scale of the IMR activity. Span rectification activities are IMR activities with the greatest potential to modify benthic habitats, due to the alteration of the existing soft sediment habitat to hard substrate. Woodside's operational experience on the NWS indicates these activities are typically restricted to relatively short (tens of meters) linear sections of pipeline, with areas of up to approximately 100 m^2 impacted.

Notably, the GWA facility provides hard substrate habitat for benthic fauna, both within the water column (e.g. jackets and risers) and along the seabed (e.g. pipelines, flowlines, manifolds etc.).

Impact Assessment

Soft sediment benthic habitats are widely represented in the Operational Area and the NWS Province more broadly. Scour may result in localised impact to soft sediment benthic habitats, typically on the scales of meters to tens of meters. Subsequently, any impacts to benthos from scour around subsea infrastructure are expected to be localised, with no significant impacts to benthic habitats within the Operational Area.

As mentioned, flowline movement is limited to within design and integrity envelopes and may result in slight, localised impact to soft sediment benthic habitats, typically on the scales varying between meters to tens of meters laterally along the flowline corridors.

IMR activities may result in potential impacts that may be categorised as:

- direct physical disturbance of benthic habitat; and
- indirect disturbance to benthic habitats from sedimentation.

An assessment of these impacts to relevant receptors is provided below.

Water and Sediment Quality: Seabed disturbance may include localised and temporary decline in water quality due to an increase in suspended sediment concentrations and sediment deposition caused by IMM activities. However, sediment loads are not expected to be significant due to the relatively small footprint for each activity (IMR activities described above, and in **Section 3.10**). Each discrete IMR activity near the seabed is likely to cause a single brief disturbance resulting in a transient plume of suspended sediment.

Benthic Habitats: The benthic habitat within the Operational Area is predominately soft sediment with sparsely associated epifauna which is broadly represented throughout the NWS Province and wider NWS (**Section 4.5)**. Benthic communities of the soft sediment seabed are characterised by burrowing infauna such as polychaetes, with biota such as sessile filter feeders occurring on areas of hard substrate (such as subsea infrastructure). The infauna communities are also representative of the NWS province; being of low abundance and dominated by polychaetes and crustaceans (RPS Environment and Planning 2012).

Direct seabed disturbance, including permanent modification of benthic communities, may result as a consequence of IMR activities such as span rectification, pipeline protection and stabilisation. These activities will typically disturb a small area (typically < 100 m^2) of soft sediment habitat, which is broadly represented in the Operational Area and wider NWS region. This habitat will be replaced by hard substrate (e.g. concrete mattresses, rocks etc.) which is generally uncommon in the middle and outer NWS region. Over time, this hard substrate is expected to be colonised by sessile benthic biota (e.g. sponges, gorgonians etc.), which may support higher biodiversity benthic fauna than soft sediment habitats. The estimated overall extent of such direct seabed disturbance is extremely small in relation to the extent of the soft sediment habitats which are broadly represented within the Operational Area and the wider NWS province.

Ancient Coastline at 125 m depth contour: The Operational Area overlaps approximately 247 km^2 of the 16,190 km^2 Ancient Coastline, which is approximately 1.5% of the KEF. The Operational Area represents a 1,500 m^2 buffer around the GWA subsea infrastructure to facilitate vessel operations; the potential for seabed disturbance is much more localised (i.e. within 10's of metres is the subsea infrastructure).

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Benthic habitat surveys in the region (including within the Ancient Coastline at 125 m depth contour KEF) indicate that benthic habitats within the KEF are characterized by sand interspersed with areas of rubble and outcroppings of limestone pavement (AIMS 2014a, RPS 2011). Such habitats are widely distributed in the NWS Province. As noted in **Appendix C, Section 9**, the geomorphic feature the KEF is associated with is represented worldwide and represents the coastline during a previous glacial period. Therefore, potential impacts to this regional-scale KEF are expected to be negligible. **Rankin Bank:** Any resuspended sediments from IMR activities are expected to remain localised. Given the distance of Rankin Bank (see **Section 4.5**) from the Operational Area (approximately 3 km at the closest point and approximately 33 km from the GWA platform), any sediment is expected to be deposited prior to reaching Rankin Bank. The NWS region experiences naturally high episodic sediment resuspension due events such as tidal movements and cyclones, and the biota in the region are adapted to such conditions. Additionally, environmental surveys of Rankin Bank (AIMS 2014b) did not indicate that the biota at Rankin Bank was subject to turbidity arising from the operation of the GWA facility and associated subsea infrastructure. As such, no impacts to the environmental sensitivities at Rankin Bank are expected to occur due to seabed disturbance during the Petroleum Activities Program. **Artificial Habitat:** The presence of the GWA platform and subsea infrastructure provides hard substrate for the settlement of marine organisms; the availability of hard substrate is often a limiting factor in benthic communities. As such, the presence of the GWA facility and subsea infrastructure has led to the establishment of ecological communities which would not have existed in this area otherwise. For example, pipeline infrastructure has been shown to support more diverse fish assemblages and benthic biota (McLean et al. 2017); these communities are relatively diverse compared to the open water and soft sediment habitats in the broader Operational Area. Although the relatively high diversity of Rankin Bank is noted. The provision of artificial habitat associated with the GWA facility and subsea infrastructure will subsequently have either no adverse environmental impact or a low level of positive environmental impact through increasing biological diversity.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[10]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
A ROV as left survey is undertaken, to confirm all temporary equipment has been removed and to record location of new subsea infrastructure	F: Yes CS: Minimal cost ROV as left survey is standard practice	In accordance with OPGGS Act Section 572 (3) all temporary equipment is removed when no longer in use.	Legislative requirement	Yes **C 2.1**

[10] *Qualitative measure*

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[10]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Remove redundant production infrastructure as soon as it's no longer used, nor to be used.	F: Yes. CS: Removal of property throughout the operational life where it is incorporated within or located close to live infrastructure introduces additional complexities and HSE risk that can be avoided if removed during EOFL decommissioning.	While subsea equipment is *in-situ*, risks and impacts to the seabed are considered to be low, so only a minor reduction in sediment disturbance from less infrastructure in the Operational Area if removal occurred immediately.	Cost of standalone retrieval work scopes are considered disproportionate to the benefit gained when considering the risks of retrieval during current operations versus risk of extending duration *in-situ*. Wet stored subsea infrastructure is also RBI assessed and managed while preserved to ensure integrity and retrieval options are maintained for removal.	No
Monitoring and maintenance of redundant infrastructure is undertaken in accordance with the IMMR/RBI process.	F: Yes. CS: Minimal cost. Standard practice.	Undertaken to enable removal of redundant infrastructure in accordance with Section 572(2) and (3) of the OPGGS Act.	Legislative requirement.	Yes **C 2.6**
Good Practice				
Anchoring in the GWA facility PSZ is prohibited, except in emergency situations or under issuing of a specific permit.	F: Yes CS: Minimal cost	By minimising anchoring the potential impacts to benthic habitat is reduced.	Benefits outweigh cost sacrifice.	Yes **C 2.2**
Location of subsea infrastructure brought into the Operational Area, is tracked and recorded.	F: Yes. CS: Minimal cost. Standard Practice.	In accordance with OPGGS Act Section 572 (3) the location of equipment is tracked to enable future removal.	Benefits outweigh cost sacrifice.	Yes **C 2.3**
Professional Judgement – Eliminate				
All vessels used for IMR activities will not anchor	F: Yes. CS: Minimal. Subsea support vessels undertaking IMR activities typically do not anchor.	By not anchoring, the potential impacts to benthic habitat are reduced.	Benefits outweigh cost sacrifice.	Yes **C 2.4**

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[10]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
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 an integral part of IMR activities. CS: Not assessed, control not feasible	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Professional Judgement – Substitute				
None identified.				
Professional Judgement – Engineered Solution				
Monitoring and maintenance of subsea infrastructure to manage scour and flowline movement to within integrity envelope.	F: Yes, subsea inspection maintenance and integrity monitoring is undertaken which inherently controls extent of scour and flowline movement CS: Minimal cost. Standard practice	Monitoring and maintenance of subsea infrastructure confirms benthic seabed disturbance is limited to design flowline corridor.	Control is WMS requirement – must be adopted.	Yes **C 2.5** Refer also MEE-02
Monitoring of seabed surrounding GWA and subsea infrastructure.	F: Yes. ROV footage collected as part of subsea integrity surveys could be reviewed to observe and detect changed in benthic habitats. CS: Costs associated with the review of collected footage.	Limited environmental benefit (information) gained from monitoring benthic habitats.	Given the low sensitivity of the environment surrounding the GWA facility and associated subsea infrastructure. Any environmental benefit gained is outweighed by costs associated with implementing control.	No
ALARP Statement: On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of seabed disturbance from subsea activities. 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, seabed disturbance from subsea activities represents a slight short-term impact to benthic habitats. Further opportunities to reduce the impacts have been investigated above. The adopted controls are considered good oil-field practice/industry best practice. The potential impacts are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of subsea activities to a level that is broadly acceptable.

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 2 Limit adverse impacts to benthic habitats to Slight (E) beyond the physical footprint of the facility infrastructure during the Petroleum Activities Program.	**C 2.1** A ROV survey is undertaken post maintenance or repair activity to confirm temporary equipment has been removed and to record location of new subsea infrastructure.	**PS 2.1** Temporary equipment is removed.	**MC 2.1.1** As left survey confirms temporary equipment is removed
	C 2.2 Anchoring in the GWA facility PSZ is prohibited except in emergency situations or under issuing of a specific permit.	**PS 2.2** No anchoring within GWA facility PSZ unless in an emergency or Woodside authorisation provided.	**MC 2.2.1** Records demonstrate that any anchoring in the GWA facility PSZ was in an emergency or approved by Woodside.
	C 2.3 Location of subsea infrastructure, brought into the Operational Area is tracked and recorded.	**PS 2.3** Location of equipment, including those made redundant by the installation of a replacement, are recorded and updated in the inventory.	**MC 2.3.1** Records confirm location of replacement equipment and remaining redundant equipment.
	C 2.4 All vessels used for IMR activities will not anchor.	**PS 2.4** All vessels used for IMR activities will not anchor.	**MC 2.4.1** Records demonstrate no anchoring during IMR activities
	C 2.5 Monitoring and maintenance of subsea infrastructure to manage scour and flowline movement within integrity envelope.	**PS 2.5** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5**) and SCE technical Performance Standard(s) to prevent environment risk related damage to SCEs for: • P09 – Pipeline Systems to; - maintain the minimum required mechanical integrity to prevent loss of containment due to scour/flowline movement.	Refer to **MC 1.6.1**
	C 2.6 Risk based IMMR process for redundant infrastructure	**PS 2.6** IMMR/RBI process is applied to redundant equipment.	**MC 2.6.1** Records demonstrate that the IMMR/RBI process has been applied to redundant infrastructure.

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EPOs, EPSs and MC			
			MC 2.6.2 Inspections and maintenance activities have been completed in accordance with the IMMR/RBI process.

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6.6.3 Routine Acoustic Emissions: Generation of Noise during Routine Operations

Context	
Facility Layout and Description – **Section 3.5** Facility Operations – **Section 3.6** Process Description – **Section 3.6.2** Vessels – **Section 3.7** Helicopter Operations – **Section 3.8** Subsea Inspection, Monitoring, Maintenance and Repair Activities – **Section 3.10**	Protected Species – **Section 4.6**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Noise generated within the Operational Area from: • GWA facility and associated infrastructure • vessels • helicopters • IMR activities						✓		A	F	-	-	GP PJ	Broadly Acceptable	**EPO 3**

Description of Source of Impact

The GWA facility, vessels and helicopters generate noise both in the air and underwater, due to the operation of machinery noise, propeller movement, etc. These noises contribute to and can exceed ambient noise levels, which range from around 90 dB re 1 µPa (root square mean sound pressure level [rms SPL]) under very calm, low wind conditions, to 120 dB re 1µPa (rms SPL) under windy conditions (McCauley. 2005).

Continuous Sources

Platform Machinery

Production platforms have machinery mounted on decks raised above the sea, hence, most noise is transmitted to the marine environment from air. Normal platform operations generate sound at 162 dB RMS (Hannay. et al. 2004). Machinery noise onboard the GWA platform may be radiated into the underwater environment via the jacket legs and risers, which may act as transducers. Underwater noise generated by the GWA facility is expected to be minimal, with monitoring programs indicating that underwater noise from platforms is typically very low or not detectable (McCauley. 2002).

Flaring

The HP and LP flare system generate noise from combustion. Noise from flaring is emitted at the top of the flare tower, which is approximately 175 m above sea level. Noise from the tip of the flare is not constrained and spreads spherically in all directions.

Received levels from airborne propagation modelling were used to ascertain the underwater received levels during flaring activities for theWA-34-L Pyxis Drilling and Subsea Installation EP. Only a very small fraction of the acoustic energy produced from flaring transmits 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. While underwater received sound pressure level during flaring is estimated to be 136 dB re 1µPa at 1m below the sea surface it is estimated to attenuate to ambient levels within a very short distance (e.g. metres) and therefore is not considered further in the impact assessment.

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Wellhead, Pipelines and Subsea infrastructure

The noise produced by an operational wellhead was measured by McCauley (2002). The broadband noise level was very low, 113 dB re 1 µPa, which is only marginally above rough sea condition ambient noise. For a number of nearby wellheads, the sources would have to be in very close proximity (< 50 m apart) before their signals summed to increase the total noise field (with two adjacent sources only increasing the total noise field by three dB). Hence for multiple wellheads in an area, the broadband noise level in the vicinity of the wellheads would be expected to be of the order of 113 dB re 1 µPa and this would drop very quickly to ambient conditions on moving away from the wellhead, falling to background levels within < 200 m from the wellhead.

Based on the measurements of wellhead noise discussed in McCauley (2002), which included flow noise in pipelines, noise produced along a pipeline may be expected to be similar to that described for wellheads, with the radiated noise field falling to ambient levels within a hundred meters of the pipeline.

Woodside has undertaken acoustic measurements on the noise generated by the operation of choke valves associated with the Angel facility (JASCO. 2015) similar to the design employed across GWA subsea valves. These measurements indicated choke valve noise is continuous, and the frequency and intensity of noise emitted is dependent on the rate of production from the well. Noise intensity at low production rates (16% and 30% choke positions) were approximately 154-155 dB re 1 µPa, with higher production rates (85% and 74% choke positions) resulting in lower noise levels (141-144 dB re 1 µPa). Noise from choke valve operation was broadband in nature, with the majority of noise energy concentrated above 1 kHz. Noise from choke valve operation was considered minor compared to noise generated by vessels using thrusters in the area.

Given the low levels of noise emitted by subsea infrastructure such as wellheads, choke valves and flowlines, no impacts to marine fauna from these noise sources are expected. Measurements of noise generated by choke valves indicated it is relatively high frequency (>1 kHz), and hence will attenuate over relatively short distances in the water column; significant impacts to marine fauna are not considered credible and therefore not considered further in the impact assessment.

Periodic Sources

Vessels and Operation of Dynamic Positioning Systems

Thruster noise (from cavitation caused by propellers) is typically the most significant noise source for vessels holding station, with other noise sources typically relatively minor (McCauley. 1998).

Thruster noise is typically high intensity and broadband in nature. McCauley (1998) measured underwater broadband noise up to approximately 182 dB re 1 µPa at 1 m (rms SPL) from a support vessel holding station in the Timor Sea; it is expected that noise levels up to this this level may be generated by vessels using DP during the Petroleum Activities Program. Sound levels of 137 dB re 1 µPa at 405 m were recorded from a typical offshore support vessel holding station in strong currents (McCauley. 1998).

Helicopter Transfers

Helicopter activities may occur in the Operational Area, including the landing and take-off of helicopters on the platform or vessel helidecks. Sound emitted from helicopter operations is typically below 500 Hz (Richardson et al., 1995). The peak received level diminishes with increasing helicopter altitude, but the duration of audibility often increases with increasing altitude. Richardson et al. (1995) reports that helicopter sound is audible in air for four minutes before it passed over underwater hydrophones, but detectable underwater for only 38 seconds at 3 m depth and 11 seconds at 18 m depth. Noise levels reported for a Bell 212 helicopter during fly-over was reported at 162 dB re 1 µPa and for Sikorsky-61 is 108 dB re 1 µPa at 305 m (Simmonds et al. 2004). 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 to exceed the behavioural thresholds is not considered credible and is not assessed further.

Impulsive Sources

Subsea IMR Activities

MBES may be required for IMR to identify buckling, movement, scour and seabed features. The MBES proposed have a frequency range from 12 to 700 kHz. In general, MBES generate a higher frequency acoustic signal, which attenuates more rapidly underwater compared to lower frequencies. Additionally, sound sources generated closer to the seabed have a lower received noise level in the horizontal direction due to seafloor scattering and absorption.

Positioning Equipment

An array of long baseline (LBL) and/or ultra-short baseline (USBL) transponders may be used for positioning during IMR activities. Transponders typically emit pulses of medium frequency sound, generally within the range 21 to 31 kHz. The estimated SPL at source ranges from 180 to 206 dB re 1 µPa at 1 m (Jiménez-Arranz et al. 2017).

Impact Assessment

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Receptors

The Operational Area is located in waters about 77 m to 200 m deep. The fauna associated with this area is predominantly pelagic species of fish, with migratory species such as turtles, whale sharks and cetaceans potentially present in the area seasonally. Noise interference is a key threat to a number of migratory and threatened cetaceans and marine turtles identified as occurring within the Operational Area (**Section 4.6**).

The Operational Area overlaps BIAs for flatback turtles (internesting), whale sharks (foraging) and wedge-tailed shearwaters (breeding). Flatback turtles nest in the region between October and March, however, given water depths and distance from shore, the area does not constitute foraging or important internesting habitat. Satellite tracking of flatback turtle nesting populations (Barrow Island and mainland sites) indicates this species travels to the east of Barrow Island between nesting events, within WA mainland coastal waters less than 70 m deep (Chevron Australia Pty Ltd, 2015). Whale sharks will be present between March and November and wedge-tailed shearwaters between August and April. Due to the lack of roosting or nesting habitat for wedge-tailed shearwaters in proximity to the Operational Area, only a low density is expected even during peak nesting periods. Cetaceans, such as blue whales and humpback whales, and other marine turtle species may also be present within the Operational Area seasonally; however, no BIAs or other important areas for these species overlap the Operational Area. While the Ancient Coastline KEF may be associated with outcroppings of hard substrate, no evidence of significant reefs associated with such outcroppings has been found in the Operational Area. Note some demersal fish are likely to be associated with subsea infrastructure such as pipelines (McLean et al. 2017). Rankin Bank hosts marine fauna such as fishes, and is located approximately 3 km from the Operational Area (at the closest point), and 33 km from the GWA Platform.

Potential Impacts of Noise

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):

1. by causing direct physical effects on hearing or other organs. Hearing loss may be temporary (temporary threshold shift (TTS) referred to as auditory fatigue), or permanent threshold shift (PTS) (injury);
2. by masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey); and
3. through disturbance leading to behavioural changes or displacement from important areas (e.g. BIAs). The occurrence and intensity of disturbance is highly variable and depends on a range of factors relating to the animal and situation.

Sound Propagation Calculations

Increasing the distance from the noise source usually results in the level of noise reducing, due primarily to the spreading of the sound energy with distance. The way that the noise spreads (geometrical divergence) will depend upon several factors such as water column depth, pressure, temperature gradients, and salinity, as well as surface and bottom conditions.

Cetaceans

Species Sensitivity and Exposure Thresholds

Marine mammals and especially cetaceans rely on sound for important life functions including individual recognition, socialising, detecting predators and prey, navigation and reproduction (Weilgart. 2007; Erbe et al. 2015; Erbe et al. 2018). Underwater noise can affect marine mammals in various ways including interfering with communication (masking), behavioural changes, a shift in the hearing threshold (PTS and TTS), physical damage and stress (Erbe, 2012; Rolland et al. 2012).

The thresholds that could result in behavioural response for cetaceans is expected to be 120 dB re 1 µPa (SPL) for continuous noise sources, and 160 dB re 1 µPa (SPL) for impulsive noise sources (**Table 6-3**). These thresholds have been adopted by the United States National Oceanic and Atmospheric Administration (NOAA) (National Marine Fisheries Service [NMFS], 2014, 2018; Southall et al. 2019; NOAA, 2019).

Table 6-3: PTS, TTS and behavioural response onset thresholds for LF and HF cetaceans

Hearing group	PTS onset thresholds (received level)		TTS onset thresholds (received level)		Behavioural response	
	Impulsive	***Non-impulsive***	***Impulsive***	***Non-impulsive***	***Impulsive***	***Non-impulsive***
Low-frequency cetaceans	183 dB re 1 µPa^2 s (SEL weighted) 219 dB re 1 µPa (peak SPL)	199 dB re 1 µPa^2 s (SEL weighted)	168 dB re 1 µPa^2 s (SEL weighted) 213 dB re 1 µPa (peak SPL)	179 dB re 1 µPa^2 s (SEL weighted)	160 dB re 1 µPa (SPL)	120 dB re 1 µPa (SPL)

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High-frequency cetaceans	185 dB re 1 µPa² s (SEL weighted) 230 dB re 1 µPa (peak SPL)	198 dB re 1 µPa² s (SEL weighted)	170 dB re 1 µPa² s (SEL weighted) 224 dB re 1 µPa (peak SPL)	178 dB re 1 µPa² s (SEL weighted)		

Source: NMFS (2014, 2018); Southall et al. (2019); NOAA (2019).

Marine Turtles

Species Sensitivity and Exposure Thresholds

There is a paucity of data regarding responses of marine turtles to underwater noise. However, turtles have been shown to respond to low frequency sound, with indications that they have the highest hearing sensitivity in the frequency range 100–700 Hz (Bartol and Musick. 2003). Lenhardt (1994) observed marine turtles avoiding low-frequency sound.

The Recovery Plan for Marine Turtles (Commonwealth of Australia, 2017) notes there is limited information available on the impact of noise on marine turtles and that the impact of noise on turtle stocks may vary depending on whether exposure is short (acute) or long-term (chronic). Turtles have been shown to respond to low frequency sound, with indications that they have the highest hearing sensitivity in the frequency range 100–700 Hz (Bartol and Musick, 2003).

A Popper et al. (2014) review assessed thresholds for marine turtles and found qualitative results that TTS was only moderate for near field exposure, and low for both intermediate and far field exposure (Popper et al. 2014). McCauley et al. (2000) noted that sea turtles exhibit increased swimming activity at 166 dB re 1 µPa. No quantitative (numerical) thresholds have been developed for impacts of continuous sources (e.g. vessel noise) on marine turtles.

The thresholds listed in **Table 6-4** are considered appropriate for the assessment of impacts from continuous acoustic discharges to marine turtles from the Petroleum Activities Program.

Table 6-4: Impact thresholds to marine turtles for continuous noise

Mortality and potential mortal injury	PTS	TTS	Masking	Behaviour
(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) High (I) Moderate (F) Low

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

Platform and Support Vessel Noise Impacts

Vessels holding station are considered to be the predominant noise source related to the Petroleum Activities Program. McCauley (1998) measured underwater broadband noise equivalent to about 182 dB re 1 µPa SPL (rms) at 1 m from a support vessel holding station in the Timor Sea. Similar noise levels are expected to be generated by vessels used for the Petroleum Activities Program

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 (refer **Table 6-3**). PTS and TTS onset in LF cetaceans would be expected to occur at 199 dB re 1 µPa² s (SEL weighted) and 178 dB re 1 µPa² s (SEL weighted), respectively (refer **Table 6-3**). Typical noise levels generated by the platform and a support vessel using DP will not exceed these levels (except at extremely close ranges to the source), so injury to LF cetaceans is not anticipated.

Potential behavioural response impacts may include:

- Cetaceans: Potential behavioural disturbance from the DP vessel for cetaceans at intermediate range, likelihood of PTS or TTS is not considered credible, given individuals would need to be directly next to the noise source for prolonged duration and vessels are not point sources (i.e. sound is distributed from multiple locations of the vessel over a large area).
- Fish: Potential masking and behavioural disturbance at near and intermediate range; likelihood of PTS or TTS is considered not to be credible given fish would move away from the source. Site attached fish (e.g. some species of demersal fish) are not expected to be exposed to underwater noise above impact thresholds given water depths in the area where these fish may be more prevalent (i.e. the Ancient Coastline at 125 m KEF).
- Marine turtles: Potential masking and behavioural disturbance at intermediate and far range, likelihood of PTS or TTS is considered not to be credible given turtles would need to be directly next to the noise source.

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Fauna such as cetaceans, fish, and turtles are capable of moving away from potential noise sources, and there are no constraints to the movement of these fauna within the Operational Area.

Considering the overlap of the whale shark foraging BIAs with the Operational Area, it is likely there may be increased numbers of individuals of during migratory periods. Currently, there are no quantitative sound exposure thresholds relevant to whale sharks. It is expected that the potential effects of noise on whale sharks will be the same as for other pelagic fish species, resulting in minor and temporary behavioural change such as avoidance.

Despite the overlap with the flatback turtle internesting BIA only transient individuals of flatback turtles are expected, even during internesting periods. Currently, there are no quantitative sound exposure thresholds for behavioural responses in marine turtles resulting from continuous noise sources. As outlined above, marine turtles are not expected to be in the area in high numbers even during nesting and internesting periods.

Therefore, impacts to marine turtles and whale sharks from project vessels or the platform are expected to be negligible or of no lasting effect.

Cetaceans may be seasonally present in the Operational Area, though limited to individuals infrequently transiting through the area. Interactions between blue whales and humpback whales with vessels typically results in avoidance behaviour, with whales generally moving away from vessels (Bauer 1986; Stamation et al. 2010). Because the Operational Area is about 26 km from the blue whale migration BIA and 22 km from the humpback whale migration BIA, no impacts are predicted to occur from project vessel noise on individuals using these areas. In summary, potential impacts to blue whales, humpback whales and other cetaceans from predicted noise levels are expected to be limited to behavioural impacts within a localised area around vessels with no lasting effect.

Other fauna associated with the Operational Area will be predominantly pelagic species of fish, with migratory species such as rays transiting through the Operational Area; these species may be similarly affected by noise from project vessels/platform.

IMR Activities

JASCO (2013) conducted noise modelling for five low energy survey instruments off the coast of California. One of these instrument types are comparable to MBES. All equipment types were modelled in the sandy bottom environment, similar to that of the Operational Area. Although the bathymetry, salinity, water temperature and sub-seafloor sediment type may differ, given the similarities in equipment type and seafloor habitat, the modelling is considered comparable for the nature and scale of the low energy IMR survey equipment.

The modelling reported distances to specific threshold levels for different types of marine mammals. Where applicable M-weighted R_{max} (the distance to the farthest occurrence of the threshold level) estimates were used. Since receptors identified in **Section 4.6** include a greater range of species, unweighted R_{max}, was used for species where M-weighted estimates were not appropriate, which is considered conservative. The distance at which the 160 dB re 1 µPa (rms SPL) behavioural threshold was reached was 290 m.

Potential behavioural response impacts may include:

- Cetaceans: Potential behavioural disturbance from the IMR activities for cetaceans, likelihood of PTS or TTS is not considered credible, given individuals would need to be directly next to the noise source for prolonged duration and vessels are not point sources (i.e. sound is distributed from multiple locations of the vessel over a large area).
- Fish: Potential masking and behavioural disturbance at near and intermediate range; likelihood of PTS or TTS is considered not to be credible given fish would move away from the source and the IMR activities noise sources are all higher in frequency (12 - 700 kHz) therefore they are outside the range of fish hearing (2-4 kHz). Site attached fish (e.g. some species of demersal fish) are not expected to be exposed to underwater noise above impact thresholds given water depths in the area where these fish may be more prevalent (i.e. the Ancient Coastline at 125 m KEF).
- Marine turtles: Likelihood of potential masking and behavioural disturbance or PTS or TTS is considered not to be credible given the source frequency of proposed equipment (12 -700 kHz) is well outside the known hearing frequency range of turtles (0.1 - 0.7 kHz). frequency of the noise source.

Positioning Equipment Noise Impacts

Transponders used for positioning during IMR activities have the potential to cause some temporary behavioural disturbance to marine fauna; however, noise levels are generally well below injury thresholds. Based on empirical spreading loss estimate measured by Warner and McCrodan (2011), received levels from USBL transponders are expected to exceed the cetacean behavioural response threshold for impulsive sources out to about 42 m. Transmissions are not continuous but consist of short ‘chirps’ with a duration that ranges from three to 40 milliseconds. Transponders will not emit any sound when on standby. When required for general positioning, they emit one chirp every five seconds (estimated to be required for 4 hrs at a time). When required for precise positioning, they emit one chirp every second (estimated to be required for 2 hrs at a time). 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.

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***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[11]: • Support 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. • Support 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, support vessels will immediately withdraw from the caution zone at a constant speed of less than 6 knots. • Support 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.	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.	Controls based on legislative requirements – must be adopted.	Yes **C 3.1**

[11] 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.

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Good Practice				
Vary the timing of the Petroleum Activities Program to avoid migration periods.	F: No. The Petroleum Activities Program occurs continuously over a 5 year period, modifying the timing of the Petroleum Activities Program is not feasible. CS: Not considered, control not feasible.	Not considered, control not feasible.	Not considered, control not feasible.	No
Implementing a shutdown zone around MBES for the following fauna: • whales • marine turtles • whale sharks.	F: Yes. However, as equipment is underwater, effective implementation of zones is challenging from topside observation. CS: Moderate. Requires the provision of a dedicated suitably trained crew member to undertake Marine Fauna Observations.	Limited. The areas of disturbance for these devices are limited to within about 290 m of the source. In addition, it is noted that for MBES, the frequency range of these devices are outside the estimated frequency hearing range of identified protected species (whales, turtles and whale sharks).	The source levels and frequency range of these devices are outside the estimated frequency hearing range of identified protected species (whales, turtles and whale sharks), so costs are considered disproportionate to benefits.	No
Have a dedicated experienced and trained Marine Fauna Observer (MFO) onboard vessels to undertake marine fauna observations.	F: Yes, however additional cost for dedicated and experienced MFO to be present during IMR CS: Moderate, requires the provision of a dedicated experienced MFO to undertake Marine Fauna Observations.	Use of an MFO may detect fauna in the area, however control provides limited benefit when managing impacts associated with vessel noise alone.	Given limited benefit associated with the management of vessel noise impacts and costs associated with control implementation an experienced MFO is not considered necessary.	No

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Eliminate				
Eliminate the use of DP on vessels during the Petroleum Activities Program.	F: No. Both platform and subsea support vessels are required to reliably hold station during the Petroleum Activities Program. Failure to do so may lead to loss of separation between vessels and infrastructure. This would result in unacceptable safety and environmental risk (loss of vessel separation has been identified as a MEE – **Section 6.8.7)**. CS: Not considered, control not feasible.	Not considered, control not feasible.	Not considered, control not feasible.	No
Professional Judgement – Substitute				
None identified.				
Professional Judgement – Engineered Solution				
Application of bubble curtains to reduce noise propagation.	F: No, Bubble curtain installation and operation in offshore open water not feasible due to technical operation constraints i.e. water depth/current.	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, Woodside considers the impacts from routine acoustic emissions from vessels, helicopters, wellheads, pipelines and the GWA platform (including machinery) to be ALARP in its risk state. 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, in its current state, impacts from routine acoustic emissions from the Petroleum Activities Program represent a negligible impact /disturbance to marine fauna within the Operational Area. Further opportunities to reduce the impacts and risks have been investigated above. The impacts are consistent with good oil-field practice/industry best practice and are considered to be broadly acceptable in its current state. Therefore, Woodside considers standard operations appropriate to manage the impacts of acoustic emissions to a level that is broadly acceptable.

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 3 Limit adverse impacts on fauna from noise emissions during the Petroleum Activities Program.	**C 3.1** EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, which include the following measures[12]: • 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; • 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, activity support vessels will immediately withdraw from the caution zone at a constant speed of less than 6 knots; and • 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 3.1** Vessels will comply with the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05 and 8.06) Interacting with cetaceans to manage the risk of fauna collision.	**MC 3.1.1** Records demonstrate no breaches with EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans and Woodside Marine Charterers Instructions.
			MC 3.1.2 Records demonstrate reporting cetacean ship strike incidents to the National Ship Strike Database.

[12] *For safety reasons, the specified distances requirements are not applied for a vessel holding station or with limited manoeuvrability (e.g. loading, back-loading, close standby cover for overside working and emergency situations).*

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6.6.4 Routine and Non-routine Discharges: Discharge of Hydrocarbons and Chemicals During Subsea Operations and Activities

Context		
Platform Well Management and Maintenance– **Section 3.11** Subsea Infrastructure – **Section 3.5.2** Hydrocarbon and Chemical Inventories and Selection – **Section 3.9.3** Subsea Inspection, Monitoring, Maintenance and Repair Activities – **Section 3.10**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**	Stakeholder Consultation – **Section 5**

Impacts and Risks Evaluation Summary														
	Environmental Value Potentially Impacted							***Evaluation***						
Source of Risk	Soil and Groundwater	Marine Sediment	Water Quality	Air Quality (incl Odour)	Ecosystems / Habitat	Species	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Discharge of subsea control fluids.		✓	✓		✓			A	F	-	-	GP	Broadly Acceptable	**EPO 4**
Discharge of hydrocarbons remaining in subsea pipeworks and equipment as a result of subsea intervention works.		✓	✓		✓			A	F	-	-			
Discharge of chemicals remaining in subsea pipeworks and equipment or the use of chemicals for subsea inspection, maintenance and repair (IMR) activities.		✓	✓		✓			A	F	-	-			

Description of Source of Impact
Hydrocarbons and chemicals may be discharged as a result of planned routine and non-routine operations and activities, as follows: • Operational discharge of control fluids, including: – discharge of subsea control fluids – subsea control fluid is used to control valves remotely from the facility. It is an open-loop system, designed to release control fluid from the control system during valve operations (e.g. up to about 6 L per valve actuation) – potential non-routine hydraulic fluid discharge associated with umbilical system losses/weeps – discharge of minor fugitive hydrocarbon from wells and subsea equipment (e.g. weeps/seeps/bubbles)

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- discharge of chemicals introduced into subsea infrastructure and the production stream, either as process or non-process chemicals (e.g. corrosion inhibitors, biocides, scale inhibitors). Chemicals flow through the production process, with residual chemicals produced as a component of the PW discharged overboard

- IMR activities (nominal discharges described in **Section 3.10.6**), including:
  - discharge of residual hydrocarbons in subsea lines and equipment and small gas releases associated with isolation testing and breaking containment
  - discharge of residual chemicals in subsea lines and equipment, or the use of chemicals including pigging). These chemicals are used and discharged intermittently in small volumes. Small quantities of chemicals may remain in the flushed infrastructure, which may be released to the environment after disconnection.

Impact Assessment

There is potential for localised water column pollution and adverse effects on marine biota as a result of planned routine and non-routine hydrocarbon and chemical discharges. However, planned discharges of hydrocarbons and chemicals are minor and are minimised as far as practicable via flushing off the lines back to the facility. Discharge locations are either the PW stream, subsea valves (subsea control fluid) or at disconnection points in subsea infrastructure.

Water Quality

Subsea control fluids are discharged at relatively small volumes during valve actuations and IMR activities at or near the seabed. On release the subsea control fluids are expected to mix rapidly and dilute in the water column. The small quantities of hydrocarbons (liquid and gas) that may be released during operational and IMR activities (including pigging) that break containment of isolated subsea infrastructure will be buoyant and float upwards towards the surface. Given the water depth, pressure, and the small volumes released, these hydrocarbons are not expected to reach the sea surface. Rather, the release will disperse and dissolve within the water column. Chemicals may be discharged intermittently and in small volumes.

There is potential for slight, localised decrease in water quality at planned discharge locations and potential impacts on marine biota. Within the mixing zone impacts to pelagic fish are expected to be limited to avoidance of the localised area of the discharge and short-term, localised decline in planktonic organisms in the immediate vicinity of the discharge plume.

Sediment Quality

Accumulation of contaminants in sediments depends primarily on the volume/concentration of particulates in discharges or constituents that adsorb onto seawater particulates, the area over which those particulates could settle onto the seabed (dominated by current speeds and water depths), and the resuspension, bioturbation and microbial decay of those particulates in the water column and on the seabed. Valve actuation discharges are frequent but low in volume (typically <6 L). The subsea control fluid used in the open loop system (HW443) is water-based and has an OCNS rating of D with a substitution warning. The substitution warning is for the fluorescein dye which is approximately 150 ppm within the product, due to its low biodegradability. However, the product is non-toxic and does not have a potential to bioaccumulate. Once released the control fluid is expected to mix rapidly in the water column and become diluted, accumulation in sediments is not considered likely.

Given the frequency and volumes of hydrocarbon releases and its buoyancy, accumulation in sediments is not considered likely.

Ecosystem / Habitats

Sediments in the Operational Area are expected to be broadly consistent with those in the NWS Province such as sparsely populated silty/sandy sediment habitats (as described in **Section 4.5**), with filter feeders such as sponges, ascidians, soft corals and gorgonians associated with areas of hard substrate. The only areas of hard substrate expected in the vicinity are artificial habitat associated with subsea infrastructure. Impacts to ecosystems are not expected due to the localised nature of discharge plumes and potential for sediment quality impacts. Given the nature and scale of planned discharges, potential impacts are considered to be localised and negligible.

Values and Sensitivities

<u>KEFs</u>

One KEF overlaps the Operational Area—Ancient Coastline at 125 m Depth Contour. No significant escarpments, species of conservation significance, emergent features or areas of high biological productivity characteristically associated with the Ancient Coastline KEF have been observed in the Operational Area (**Section 4.4**). Therefore, potential impacts to this regional-scale KEF is expected to be negligible.

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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				
None identified.				
Good Practice				
Implement Woodside's Chemical Selection and Assessment Environment Guideline: • Where Gold/Silver/E/D OCNS rating (and no OCNS substitution or product warning), chemicals are selected – no further control required; and • If chemicals with a different OCNS rating, sub warning or non-OCNS rated chemicals are required chemicals will be assessed in accordance with the guideline prior to use.	F: Yes. Routinely implemented to the chemical selection process for Woodside facilities. CS: Minimal cost. Standard practice.	Selection and assessment of chemicals in accordance with the Woodside process, reduces environmental impacts associated with planned chemical discharge.	Benefits outweigh cost/sacrifice.	Yes **C 4.1**
Subsea infrastructure flushed and appropriately isolated where practicable during IMR disconnection activities to reduce volume/ concentration of hydrocarbons released to the environment.	F: Yes. The subsea infrastructure has been designed such that much of the hydrocarbon-containing elements can be flushed back to the GWA facility. CS: Minor. Flushing may prolong the cessation of production required for subsea IMR activities, leading to reduced production.	Flushing reduces the volumes/concentration of hydrocarbons released to the environment.	Benefit outweighs cost sacrifice	Yes **C 4.2**

[13] *Qualitative measure*

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[13]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Implement Woodside Engineering Operating Standard (Subsea Isolation). Proven isolation in place for relevant IMR activities	F: Yes CS Minimal cost. Standard practice	Maintaining and testing the ability to isolate wells and pipelines will ensure barriers are in place and verified limiting the volume of hydrocarbon released	Control is WMS requirement – must be adopted.	Yes **C 4.3**
Limit volume of subsea control fluid discharged to the marine environment through monitoring subsea control fluid use, investigating material discrepancies, and using control fluid with dye marker to support identification of potential integrity failures.	F: Yes. The use of control fluid is monitored to maintain adequate fluid in the system. CS: Minimal cost.	Limits the volumes of subsea control fluid discharge to the marine environment	Benefit outweighs cost sacrifice	Yes **C 4.4**
Professional Judgement – Eliminate				
None identified.				
Professional Judgement – Substitute				
Install closed-loop subsea valve control system.	F: Yes. Closed-loop subsea valve control systems can be installed, however, they may not perform as quickly / reliably as open-loop systems. CS: Significant. The design, procurement and retrofitting of a closed-loop valve control system would result in considerable offshore logistics, exposure to safety hazards during installation, and significant financial burden through direct costs and lost production.	The potential consequence of the discharges is ranked as incidental, based on the volume, frequency, location, and types of fluid discharged in an open-ocean environment, and avoiding the discharges would provide little or no environmental benefit.	When considering the negligible effect from the release of control fluids, the risk and costs of retrofitting a closed-loop subsea valve control system is considered to be grossly disproportionate to the environmental benefit.	No

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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				
Route hydrocarbons to vessel during disconnection of subsea infrastructure.	F: Yes. However, to do so would introduce significant safety risks to the vessel crew (fire, explosion, asphyxiation). CS: Significant. Equipping and training crew onboard subsea support vessels to safely route hydrocarbons to the vessel would result in significant additional costs (in addition to the increased safety risk identified above).	Small environmental benefit from preventing low concentration hydrocarbon discharge.	Given the increased safety risk and the very low environmental impact from hydrocarbon releases during subsea IMR activities, the cost of routing hydrocarbons to the vessel is grossly disproportionate to the environmental benefit	No
Decrease frequency of valve actuation.	F: Yes. However, decreasing the frequency of valve may adversely impact the safe functionality and reliability of valves. Reducing the performance of subsea valves may introduce operability impacts, and increased safety and environmental risk associated with loss of containment events. CS: Minimal cost.	The potential consequence of the discharges is ranked as incidental, based on the volume, frequency, location, and types of fluid discharged in an open-ocean environment, and reducing the number of discharges would provide little or no environmental benefit.	Decreasing the frequency of valve actuations would lead to a potential decrease in safe functionality and reliability of valves. When considering the potential safety and environmental risks from such a performance degradation, along with the minor impact from the release of control fluids, the cost of decreasing the frequency of valve actuations is considered to be grossly disproportionate to the environmental benefit.	No
ALARP Statement: On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of planned routine and non-routine hydrocarbon and chemical discharges. 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.				

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Demonstration of Acceptability
Acceptability Statement: The impact assessment has determined that, given the adopted controls, planned routine and non-routine hydrocarbon and chemical discharges represents a localised impact that is unlikely to result in a lasting potential impact on water quality, marine sediment or ecosystem habitat. Further opportunities to reduce the impacts have been investigated above. Fluid discharges from the subsea system during operations and IMR activities are routine in the oil and gas industry. The adopted controls are considered good oil-field practice/industry best practice. The potential impacts are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of planned routine and non-routine hydrocarbon and chemical discharges to a level that is broadly acceptable.

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 4 Limit adverse water quality impacts to localised (F) short-term effects from hydrocarbons and chemicals used in subsea activities during the Petroleum Activities Program.	**C 4.1** Chemical Selection and Assessment Environment Guideline: • Where Gold/Silver/E/D OCNS rating (and no OCNS substitution or product warning), chemicals are selected – no further control required; and • If chemicals with a different OCNS rating, sub warning or non-OCNS rated chemicals are required chemicals will be assessed in accordance with the guideline prior to use.	**PS 4.1** All operational chemicals intended or likely to be discharged to the marine environment will be assessed and approved prior to use in accordance with the Chemical Selection and Assessment Environment Guideline) (described in **Section 3.9.3**) to ensure the impacts associated with use are ALARP and acceptable.	**MC 4.1.1** Records demonstrate the chemical selection, assessment and approval process for operational chemicals is followed.
	C 4.2 Subsea infrastructure containing hydrocarbons flushed and appropriately isolated where practicable during IMR disconnection activities.	**PS 4.2** Subsea infrastructure containing hydrocarbons flushed to GWA facility (where practicable) to a hydrocarbon concentration which provides considered diminishing returns prior to disconnection. Appropriate isolations applied where practicable.	**MC 4.2.1** Records demonstrate subsea infrastructure flushing (to GWA facility) and isolations applied where practicable.
	C 4.3 Engineering Operating Standard - Subsea Isolation.	**PS 4.3** Proven isolation in place in compliance with Woodside Engineering Operating Standard - Subsea Isolation.	**MC 4.3.1** Records demonstrate that there was a proven isolation in place as required.
	C 4.4 Monitor subsea control fluid use, investigate material discrepancies, and use control fluid with dye marker to support identification of potential integrity failures.	**PS 4.4** Subsea control fluid use monitored and, where losses are unexplained, potential integrity issues are investigated.	**MC 4.4.1** Records demonstrate subsea control fluid use is documented, and unexplained discrepancies investigated.

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6.6.5 Routine and Non-routine Discharges: Produced Water

Context		
Produced Water System – **Section 3.6.2.3** GWF-3 Start-up **- Section 3.5.3** Production, Restarts and GWF-3 Well Commissioning Activities – **Section 3.6.1.3** Platform Well Management and Maintenance Activities – **Section 3.11**	Physical Environment – **Section 4.4** Habitats and Biological Communities **– Section 4.5**	Stakeholder Consultation – **Section 5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Discharge of PW from GWA platform.		✓	✓		✓	✓		B	E	N/A	N/A	GP	Acceptable if ALARP	**EPO 5**

Description of Source of Impact

Produced water (PW) is formation water (derived from a water reservoir below the hydrocarbon formation) or condensed water (water vapour present within gas/condensate that condenses when brought to the surface), or a combination of both. Separation of water from reservoir fluids is not 100% effective and separated PW often contains small amounts of naturally occurring contaminants including dispersed oil, dissolved organic compounds (aliphatic and aromatic hydrocarbons, organic acids and phenols), inorganic compounds (e.g. soluble inorganic chemicals, dissolved metals etc.) and residual process chemicals. A description of the PW system has been provided in **Section 3.6.3**.

PW discharge is expected to continue for the duration of this EP. In 2020, produced water discharge ranged from 339 – 2155 m^3/day, with the higher discharge rate reflective of high water cut well production. PW rates will increase as the field ages or as new fields are tied in. The maximum daily discharge is 7500 m^3/day (PW system integrity limit).

During high water cut well unloading in 2019 and 2020, temporary elevated OIW concentrations between 30 mg/L and 100 mg/L (rolling 24 hr average) lasted several days, before stabilising below 30 mg/L during ongoing production. Well shut in periods prior to unloading varied from weeks to years and EPS established for non-routine activities were met.

The GWF3 development is planned to bring three new wells online; tied into an existing manifold on the GWF1 flowline. During GWF3 well commissioning activities, flowline preservation fluid containing approximately 5-10 m^3 MEG will be produced back to the facility. MEG is known to have a ‘cleaning’ effect on the process vessels and equipment through which it travels, incorporating hydrocarbons that adhere to the flowlines and concentrating these in higher volumes, that are then required to be removed through the OIW treatment system. MEG is expected to be produced through GWA topsides within 24 – 48 hours of commissioning of each well, which may overwhelm the produced water condensate separator and other elements of the OIW treatment system. A temporary OIW polishing skid will be utilised during GWF3 commissioning to assist with OIW management. In addition, residual well completion fluids and condensed water potentially containing fines coated in condensate flow from each well on start up. This impact has been reduced by

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initially unloading the GWF3 wells to a MODU upon well completion. Remaining fines are captured in topsides separation equipment and the temporary OIW polishing skid.

Monitoring and Management Framework

This section describes the monitoring and management framework Woodside has developed to support the monitoring of PW discharges from offshore assets. In the absence of any Commonwealth guidelines, the State Waters Technical Guidance: Protecting the quality of Western Australia's marine environment (EPA, 2016) has been considered and is consistent with the principles of the National Water Quality Management Strategy.

Environmental values are defined as particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and which require protection from the effects of pollution, waste discharges and deposits (ANZG, 2018). The relevant environmental values considered are:

- Ecosystem Integrity– maintaining ecosystem processes (primary production, food chains) and the quality of water, biota and sediment.
- Cultural and spiritual - In the absence of any specific environmental quality requirements for protection of this value it is assumed that if water quality is managed to protect ecosystem integrity this value is achieved in line with the guideline.

The relationship between key elements of ecosystem integrity, indicators and relevant monitoring activities undertaken on a routine and non-routine basis are shown in Figure 6-1. As per EPA guideline (2016) key elements to maintain ecosystem integrity have been identified as water quality, sediment quality and biological indicators (biota). By limiting the changes to these key elements to acceptable levels there is high confidence ecosystem integrity is maintained. For each of these elements an indicator has been identified and monitoring designed to identify change. Monitoring change in water quality as well as investigating potential toxicity via whole effluent toxicity (WET) testing and implementing management to maintain acceptable levels of changes is standard industry practice in Commonwealth and State waters.

The relevant indicator to understand changes in key elements and therefore potential for impact to ecosystem integrity are physio-chemical stressors; toxicants in water and biological indicators. A number of trigger values for each indicator have been defined and are monitored to detect change. Trigger values serve as an early warning that potential changes beyond the acceptable limits may occur. The acceptable limits of change are no impacts from PW beyond the approved mixing zone. To determine if acceptable limits have been exceeded, routine monitoring of trigger values is undertaken. An approved mixing zone protects 99% of species, as calculated using the Warne et al. (2018) statistical distribution methodology on the results of direct toxicity assessment using sub-lethal chronic endpoints. The protection of 99% of species maintains a high level of ecological protection and represents no detectable change from natural variation (as per ANZG (2018)).

The approved mixing zone boundary for GWA is 1200 m. The justification for distance being "acceptable" is provided in the impact assessment section below.

Operational Monitoring

OIW monitoring is undertaken via an online analyser, or manual sampling when the analyser is not available. Online analyser information is sent via transmitter instantaneously and reported to the distributed control system (DCS) and is also captured within the process historian database (PHD). The DCS facilitates visibility in the control room, for manual or automated process control changes to be made, and/or annunciate alarms (e.g. high oil in water specification). PHD information is available onshore for analysis and trending. The results of manual sampling while the analyser is not available, are stored in a spreadsheet contained on the GWA server.

Routine Monitoring

The monitoring and management framework is implemented in accordance with the Offshore Marine Discharges Adaptive Management Plan (OMDAMP). The OMDAMP details trigger values, routine monitoring assessment against trigger values, analytical methods, and actions when a trigger value is exceeded.

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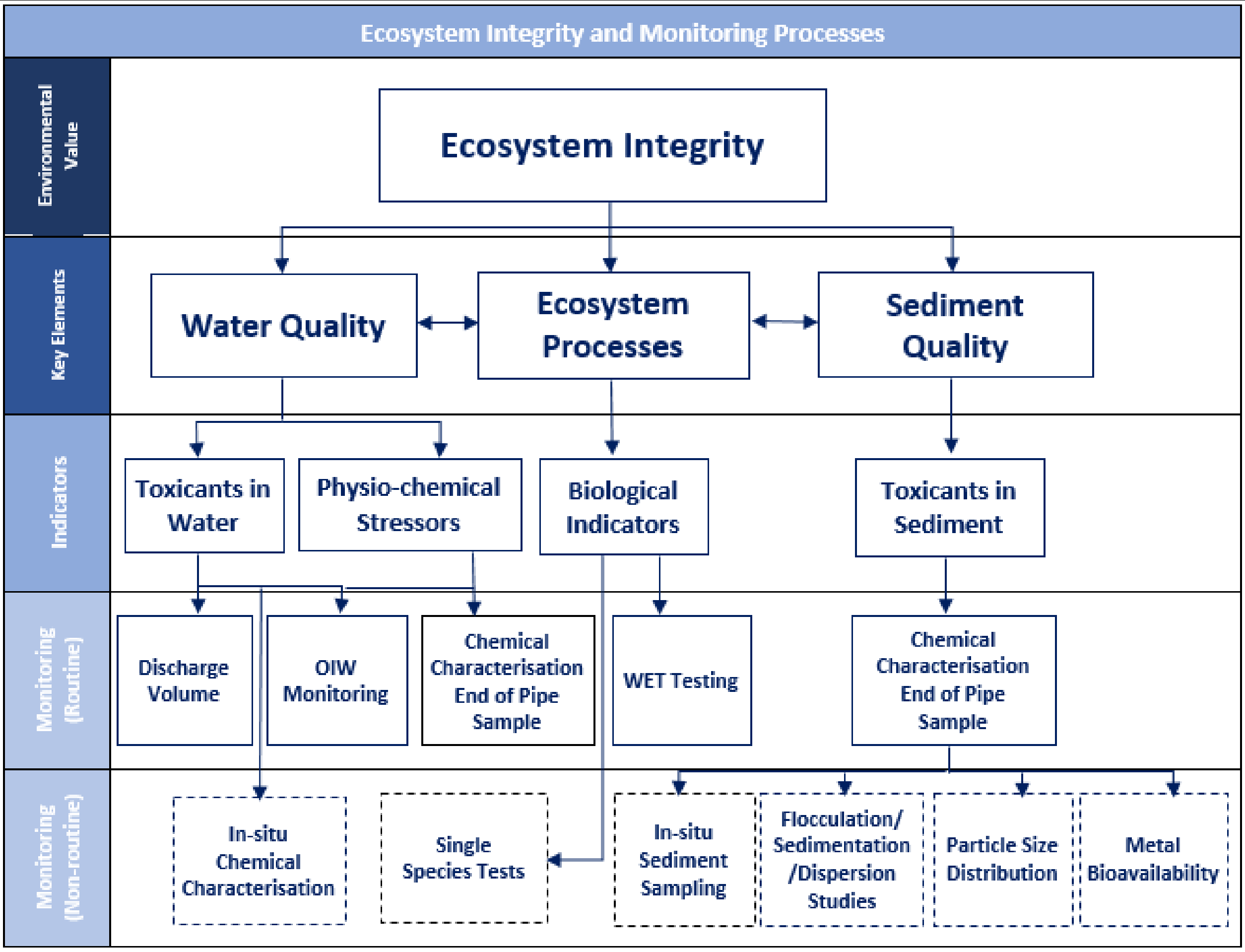

Figure 6-1: Ecosystem Integrity and Monitoring Process

The trigger values are applied through a risk-based approach that is intended to capture any uncertainty around the level of impact, by staging monitoring and management responses according to the degree of risk to ecosystem integrity. The approach provides a level of confidence that management responses are not triggered too early (i.e. when there is no actual impact) or too late after significant or irreversible damage to the surrounding ecosystem (EPA 2016). Routine monitoring applicable to the facility, is undertaken to compare against trigger values (described in **Table 6-1**). Changes in water quality and raw PW toxicity can be detected early and can indicate the potential for an impact prior to an impact occurring. WET testing confirms if there is a potential for impact on biota. It is not appropriate to monitor for changes in species composition, diversity, etc., as there are limited receptors in the approved mixing zone (a surface buoyant plume), and such changes may be detected after an impact occurs rather than providing early detection.

PW samples should represent normal operations and be undertaken during periods of normal production for the facility. Where practicable, samples are taken at a time when all (or as many as reasonably possible) PW-producing wells are online. WET tests are undertaken on a broad range of taxa of ecological relevance for which accepted standard test protocols are well established. WET tests mainly focus on the early life stages of test organisms, when organisms are typically most sensitive to contaminants; the tests are designed to represent local trophic level receptors. For WET testing, a range of tropical and temperate Australian marine species were selected based on their ecological relevance, known sensitivity to contaminants, availability of robust test protocols, and known reproducibility and sensitivity as test species. The dilutions required to protect 99% of species are calculated using the Warne et al. (2018) methodology. The protection of 99% of species maintains a high level of ecological protection at the boundary of the approved mixing zone.

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Table 6-1: Trigger values used during routine monitoring

Routine Monitoring	Trigger Value	Frequency
Chemical characterisation: end of pipe sample – physiochemical and toxicants	Results that are predicted to be higher than the 99% species protection guideline value at approved mixing zone boundary and are above the results from the earlier toxicity year[1] or above the toxicity year when no guideline was available.	Annual - timed to be representative aiming to detect change, considering when high water cut wells are producing and/or new reservoirs cut water.
WET testing	The 99% species protection safe dilutions derived from the WET testing species sensitivity distributions are not predicted to be achieved at the boundary of approved mixing zone and are higher than previous years.	Three yearly. Conducted in parallel with annual chemical characterisation where feasible.
Review of continuous operational OIW monitoring results	Increases in the average monthly OIW concentration by 5 mg/L for more than six consecutive months or by 10 mg/L for two consecutive months	Monthly review

Note:

1 – Earlier toxicity year means the year in which the most recent WET test occurred

If a trigger value is exceeded it raises uncertainty around whether the environmental value is being protected, and further investigation is required (**Figure 6-2**).

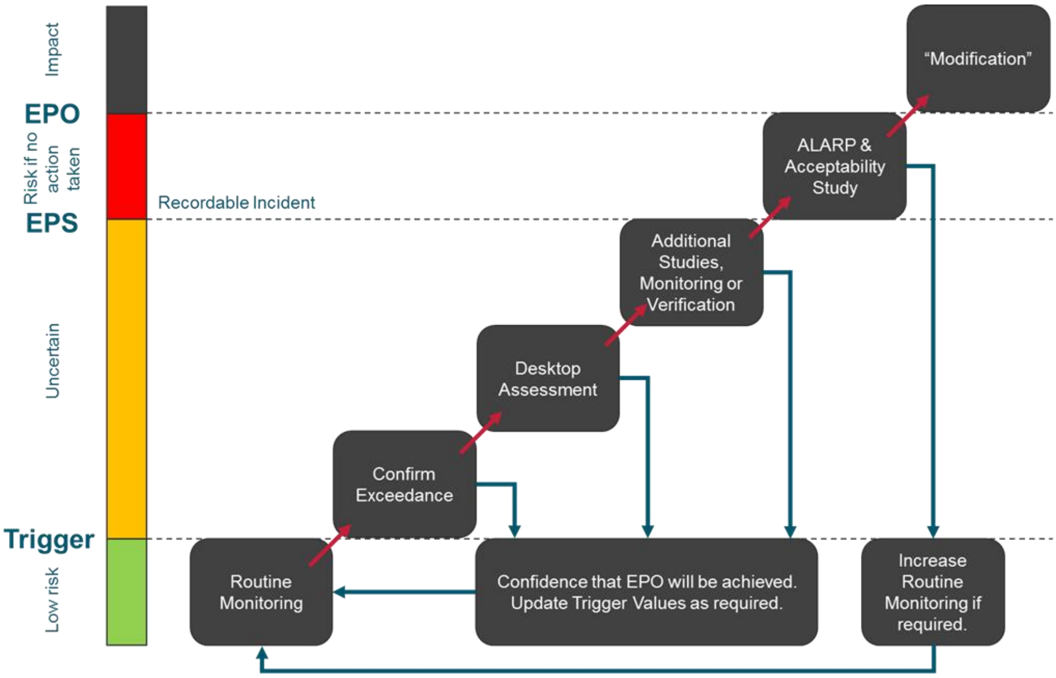

Figure 6-2: Routine Monitoring and Adaptive Management Framework for Produced Water

Further Investigations

Detectable exceedances in trigger values may occur without impacting ecosystem integrity. To provide confidence that ecosystem integrity has been maintained, further investigation (per the OMDAMP) is required in the form of a desktop study to initially assess the exceedance in context of available data (multiple lines of evidence) and confirm if there is potential for impact to the environmental value. A desktop assessment is necessary before undertaking any additional infield monitoring. This ensures monitoring programs are designed and implemented to provide robust findings based on good survey design.

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A range of methods can be used to detect trigger value exceedances (e.g. relative percentage difference, control charts, multivariate analysis etc,) depending on the data set available. An appropriate method is selected as described in the OMDAMP due to the variable nature of environmental data. If critical data are not available, the desktop study identifies potential data gaps and may recommend additional non-routine studies and/or monitoring to ensure the assessment is appropriately undertaken. The purpose of the further investigations step is to provide certainty that the EPS has been achieved, if a trigger value has been exceeded. The key investigation steps are described below:

1. **Confirm the trigger value has been exceeded** - Review quality assurance and quality control, methodology and possible sources of contamination to determine if the results are reliable, or if any factors have occurred that may compromise the integrity of the monitoring or data.
2. **Complete a desktop assessment to understand whether the EPS is at risk** - If a trigger value is confirmed to be exceeded, multiple lines of evidence are considered including historical and current data from routine and non-routine monitoring and studies. This assessment shall consider whether there is adequate evidence to demonstrate that acceptability criteria have been met and ecological integrity is not at risk (EPS not breached). If the desktop assessment determines that the existing body of evidence is insufficient, it shall outline what additional monitoring or studies are required. The desktop assessment ensures monitoring programs are designed and implemented to provide robust findings based on valid survey design. Potential additional monitoring/studies may include, but are not limited to:
    - single species test (collected annually in parallel with routine chemical characterisation if further investigation is required)
    - dilution modelling and/or studies
    - flocculation, sedimentation, settling velocity and/or dispersion analysis
    - metal bioavailability
    - scanning electron microscopy and particle size distribution analyses
    - *in-situ* monitoring (water quality and/or sediments).

    Routine monitoring activities may be required ahead of schedule; additional monitoring not listed may be undertaken as appropriate. *In-situ* monitoring is undertaken in accordance with a plan that details timing, locations and objectives of monitoring.
3. **Conduct additional studies to confirm the EPS is not at risk** - Monitoring results provide additional lines of evidence to determine whether there is a risk to ecosystem integrity due to changes in water quality, sediment, or biological indicators. Given the significant health, safety and technical risks, monitoring of the receiving environment is only considered when all other sources of evidence are insufficient to demonstrate that ecological integrity is not at risk. The OMDAMP provides detailed guidance on the steps and actions required to be undertaken if a trigger value is exceeded and this may include additional non-routine monitoring to verify that ecological integrity is maintained.

If environmental impact is deemed to be within acceptable limits of change, the desktop assessment may consider a review of trigger values to ensure they are appropriate. If the environmental impact is deemed to be outside of the acceptable limits of change, an ALARP/Acceptability study is required to determine what additional controls can be implemented to ensure the impacts are acceptable. An EPS breach is a Recordable Incident, which is reported and managed as outlined in **Section 7.8.5.**

In 2021 an *in-situ* sediment and water quality sampling program was completed at GWA, with the objective of verifying no impacts to water quality or sediments outside of the approved mixing zone, due to PW discharges. Analysis of the 2021 sampling program was pending at the time of this EP submission. In line with the adaptive management framework described above, 2021 sampling results will be compared against national guidelines to ascertain if triggers (**Table 6-2**) have been exceeded. Should a trigger value be exceeded, further investigations as described above and managed via the OMDAMP are implemented. Results of the 2021 sampling program will also be utilised to drive improvement and efficiencies to the monitoring and adaptive management framework (i.e. OMDAMP) described above.

Table 6-2: Trigger values used during non-routine in-situ water and sediment monitoring

Non-routine Monitoring	Trigger Value
In-situ water sampling	Results that are higher than the 99% species protection guideline value at the boundary of the approved mixing zone.
In-situ sediment sampling	Results that are higher than the ANZECC/ARMCANZ interim sediment quality guideline (ISQG) low trigger values[1] at the boundary of the approved mixing zone.

Note 1 - Where no guideline is specified for a contaminant of concern, derive a value on the basis of natural background (reference) concentration multiplied by an appropriate factor (2-3) as described by the ANZECC guidelines.

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ALARP/Acceptability Study

An ALARP/Acceptability study is conducted once it has been determined, as a result of further investigations, that there is potential to exceed the acceptable limits of change.

The ALARP/Acceptability study shall be conducted in accordance with the ALARP Demonstration Procedure, to determine additional controls that may be necessary to reduce potential impacts. Additional controls may include technology or process upgrades, or reservoir management. Woodside will implement relevant additional controls identified in the ALARP/Acceptability study to ensure impacts from PW discharge remain within the approved mixing zone boundary. Additional monitoring to assess whether impacts have been realised is considered.

Impact Assessment – Routine PW Discharge

Potential impacts of PW discharge include:

- changes to water quality
- toxicity to biota
- changes to sediment quality.

To understand potential impacts from PW discharges, Woodside has undertaken a suite of comprehensive *in-situ* testing and sampling related to PW discharges representing long-term operational periods from its offshore production facilities. The details of this testing and resultant understanding of potential environmental impacts are outlined below.

Potential Impacts to Water Quality

PW is discharged via a caisson 51 m below sea level and forms positively buoyant jets which rise towards the surface. As mixing increases and buoyancy of the plume erodes, the rise towards the surface slows. On reaching the surface the plume collapses and spreads horizontally whilst mixing vertically downwards. Potential impacts to water quality have been assessed through chemical characterisation of PW and potential discharge volumes.

Chemical Characterisation of PW (Physio-chemical Parameters and Toxicants)

Monitoring provides confidence that impacts from PW discharge are highly localised and pose negligible effects to environmental receptors. Samples of undiluted PW collected annually at the end of pipe between 2011 to 2020 were analysed for key physio-chemical parameters and toxicants. In most cases results are below guideline values, or similar to the results of chemical characterisation when the previous year's WET testing was undertaken (i.e. previous toxicity year) and resulting in below guideline values within the approved mixing zone of 1200m after taking into account modelled dilutions.

End of pipe PW analysis in 2020 confirmed chemical composition is similar to previous years. All constituents achieved 99% species protection guideline values within the approved mixing zone, with ammonia requiring the highest number of dilutions at 33 (BMT 2021). Modelling (RPC 2021) predicted 7,000 and 2,040 dilutions would be achieved within 200 m from the discharge point at the 2020 maximum discharge rate (2,155 m^3/day) and maximum design discharge rate (7,500 m^3/day) respectively. When compared to previous years, routine chemical characterisation undertaken in 2020, indicated a stable discharge with no additional non-routine monitoring triggered.

In 2015, *in-situ* water quality monitoring was conducted to coincide with routine end of pipe sampling, with results indicating the physical influence of the PW discharge could not be detected in the water column (to 50 m water depth) at ≥ 25 m from the discharge location (BMT Oceanica 2015), therefore verifying modelling predictions.

There is potential for a slight localised decrease in water quality at the discharge location within the mixing zone and adverse effects on marine biota. Within the approved mixing zone, impacts to pelagic fish are expected to be limited to avoidance of the localised area of the plume and short-term localised decline in planktonic organisms in the immediate vicinity of the discharge plume.

Discharge Volumes

In 2020, produced water discharge ranged from 339 - 2155 m^3/day, with the higher discharge rate occurring during a period whilst a high water cut well was producing. The maximum design capacity (7,500 m^3/day) of the PW system has been modelled and is used to assess environmental impacts. PW rates will increase as the field ages, as further high water cut wells are unloaded/cycled, or as new fields are tied into the facility.

Potential Impacts to Biota

Most treated PW has low to moderate toxicity (Neff et al. 2011), with actual toxicity of discharge dependant on the chemical constituents of the PW and any added process chemicals, the level of treatment and dilution with PW prior to release, and the dilution of the discharge as it mixes with sea water. Most hydrocarbons in PW are considered non-specific narcotic toxins with additive toxicities; therefore, the toxicity of a PW does, in part, depend on the total concentration and range of bioavailable hydrocarbons (Neff, 2002). Potential impacts of PW to biota have been assessed through WET testing and dilution modelling to verify the approved mixing zone is being achieved.

WET Testing

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WET testing has been undertaken to allow for interactions between toxicants and take into account toxicants which cannot readily be measured or are not known to be present in the sample. A range of mainly tropical Australian marine species were selected based on their ecological relevance, known sensitivity to contaminants, availability of robust test protocols and known reproducibility and sensitivity as test species. Upon completion of WET testing, the results are combined into safe dilution estimates for the protection of 99% species.

Routine WET testing has been completed in 2020, 2017, 2014 and 2011 (**Table 6-3**). The 2014 results required further investigation as an additional chronic toxicity test was included but concentrations of PW tested were not low enough to enable calculation of a reliable EC10 value. The test was repeated in 2015 and despite similar chemical characterisation data (physio-chemical and toxicant) the resulting safe dilutions were notably lower in 2015 than 2014 and more in keeping with results observed prior and since. Therefore, 2015 WET toxicity testing results (as credible worst case) are used to describe the ongoing impact of PW.

Table 6-3: PC99 concentrations and safe dilutions (PNEC) of the most recent studies

Species Protection Level	PNEC concentrations				
PCx	**2011**	**2014***	**2015**	**2017**	**2020**
99%	0.26 (1 in 390)	0.013 (1 in 714,000)	0.0085 (1 in 11,800)	0.05 (1 in 2,000)	0.15 (1 in 667)

*Addition of sensitive species to WET testing programme uncertainty in dilutions

Determination of Approved Mixing Zone

To determine the potential impact of the PW to the marine environment, modelling was conducted to predict the distance at which 99% species protection safe dilutions are achieved using the 2015 WET testing results to reflect the potential toxicity. This modelling remains valid, although conservative, as the 2020 WET testing results are less toxic than the 2015 WET testing results.

Model simulations of dilutions were undertaken for three main seasons prevalent on the NWS, based on measured current and wind data. Ocean current data was collected at multiple depths through the water column. As the modelling ocean current speed and direction varies substantially within each season, the full current records were analysed to select periods typical of the three seasons on the NWS, but erring on the side of low current speeds to give conservative model results (RPC 2016).

Further to these hydrodynamic inputs, the PW discharge model produced by Rob Phillips Consulting was validated in 2006 using the results from a dye dispersion study (Oceanic Field Services, 2006). The predicted PW plume dilutions reasonably matched those measured.

The 2015 WET testing results were used to develop PNEC values, that were inputs to the model. The 2015 WET testing results have been used as they are historically the most conservative, excluding the 2014 WET testing results due to uncertainties described above. The four-day PEC (Predicted Effects Concentration) value is used to determine the PEC/PNEC ratios and the distances from the discharge point at which 99% species protection safe dilutions (PC99) are achieved, based on a maximum discharge rate (7,500 m^3/day). The modelling shows a surface-buoyant plume that is readily diluted to 99% species protection safe dilution within 1200m of the discharge location under worst-case conditions at maximum discharge rates. In 2020, PW discharge was highest during high water cut well production (2,155 m^3/day). PW rates will increase as the field ages and as further high water cut wells are produced. Therefore, it is proposed to maintain a 1200 m approved mixing zone to reflect 99% species protection safe dilutions at the maximum expected discharge 7,500 m^3/day.

Impacts to AMPs, KEFS and BIAs

GWA sits within a KEF, the Ancient Coastline 125 m Depth Contour, however as PW forms a buoyant plume which does not reach the KEF depth, no contact and therefore no change in water quality at the KEF is expected from PW discharge.

The nearest sensitive receptors are Rankin Bank and the Montebello Marine Park. Rankin Bank is approximately 33 km away from the PW discharge location, and the Montebello Marine Park is located more than 45 km from the PW discharge location. Given the PW mixing zone is 1.2 km from the discharge location, no impacts to Rankin Bank or the Montebello Marine Park are anticipated.

Routine monitoring (end of pipe chemical characterisation and WET testing) detects changes at the approved mixing zone boundary. If trigger values are predicted to be exceeded at this distance, further investigation is required as described above. This may include a review of single species toxicity test results, additional WET testing or *in-situ* monitoring. If trigger values are not exceeded there can be high confidence that maximum ecological protection is achieved by Rankin Bank.

The approved mixing zone is within the foraging BIA for whale sharks; however, given the localised area of impact and that whale sharks are transiting the area, no impacts are expected.

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Bioaccumulation

Bioaccumulation refers to the amount of a substance taken up by an organism through all routes of exposure (water, diet, inhalation, epidermal). The Bioaccumulation Factor is the ratio of the steady-state tissue concentration and the steady-state environmental concentration (assuming uptake is from food and water). The test developed to measure the ability of a substance to bioaccumulate, namely, the octanol-water partition (Pow), is based on the preferential partitioning of lipophilic organic compounds into the octanol phase. Partitioning into octanol can be correlated with the attraction for such compounds to the fatty tissue (lipid) of organisms.

The average concentration of BTEX in PW discharged from the GWA facility is approximately 15 mg/L (BMT 2021). Bioaccumulation of BTEX compounds has been observed to occur in the laboratory but at concentrations far in excess of that discharged from the GWA facility (refer to Berry, 1980), hence it is unlikely that BTEX would bioaccumulate at the exposure concentrations that may be experienced by biota around the GWA facility.

In contrast to BTEX compounds, PAH compounds have high Pow values indicative of the potential for bioaccumulation (Vik et al, 1996). Neff and Sauer (1996) reviewed the available literature for laboratory and field studies investigating the bioaccumulation of PAHs. The bioaccumulation values for PAHs in marine organisms collected near PW discharges in the Gulf of Mexico reported by Neff and Saur (1996) indicate that the highest bioaccumulation factor were in the tissues of bivalve molluscs and the lowest in the muscle tissue of fish.

The most comprehensive field study assessing bioaccumulation of hydrocarbons and metals from PW discharged into offshore waters is that by Neff et al (2011). At the request of the U.S. Environmental Protection Agency (USEPA), the Gulf of Mexico Offshore Operators Committee sponsored a study of bioconcentration of selected PW chemicals by marine invertebrates and fish around several offshore production facilities discharging more than 731 m^3 per day of PW to outer continental shelf waters of the western Gulf of Mexico. The target chemicals identified by USEPA included five metals / metalloids (As, Cd, Hg, 226Ra and 228Ra), three volatile Monocyclic Aromatic Hydrocarbons (MAH), benzene, toluene, and ethylbenzene, and four semi-volatile organic chemicals (SVOC), phenol, fluorene, benzo(a)pyrene, and di (2-ethylhexyl) phthalate (DEHP). Additional MAH (m-, p-, and o-xylenes) and a full suite of 40 parent and alkyl-PAH and dibenzothiophenes were also analysed by Neff et al (2011) in PW, ambient water, and tissues at some facilities.

Concentrations of MAH, PAH, and phenol as determined by Neff et al were orders of magnitude higher in PW than in ambient seawater. There was no evidence of MAH or phenol being bioconcentrated. All MAH and phenol were either not detected (> 95% of tissue samples) or were present at trace concentrations in all invertebrate and fish tissue samples. Concentrations of several petrogenic PAHs, including alkyl naphthalenes and alkyl dibenzothiophenes, were slightly, but significantly higher in some bivalve molluscs, but not fish, from discharging than from non-discharging platforms. These PAH could have been derived from PW discharges or from tar balls or small fuel spills. Concentrations of individual and total PAH in mollusc, crab, and fish tissues were well below concentrations that might be harmful to the marine animals or to humans who might collect them for food at offshore platforms (Neff et. al., 2011).

Therefore, bioaccumulation is unlikely to result in increased levels of BTEX in biota surrounding the GWA, however, there may be an elevation in PAH levels. The results from Neff et al. (2011) can be used to infer the very low potential for adverse bioaccumulation effects to marine organisms, or to humans, if they were to consume any affected fish, molluscs or crabs found on upper near-surface legs of the facility. The potential environmental impact associated with bioaccumulation of PW constituents in the water column and in the sediments, is considered to be very low, and limited to a potential localised effect on a small number of non-threatened species in waters immediately surrounding the facility, as described below. Potential health risks are unlikely as a result of negligible exposure: the PSZ prohibits fishing from or near the facility as there is very little or no activity within the Operational Area. The findings of the sediment and water quality monitoring completed in 2015 at GWA (BMT Oceanica 2015) validated the conclusion that states, '*the potential environmental impact associated with bioaccumulation of PW constituents in the water column and in the sediments, is considered to be very low and limited to a potential localised effect on a small number of non-threated species in waters immediately surrounding each facility*'. Given the nature of the PW discharge from the GWA facility, the potential for bioaccumulation of PW contaminants (in particular BTEX) is considered to be highly localised with no lasting effect.

Potential Impacts to Sediment Quality

Potential impacts to sediment quality were assessed through sediment surveys and supported by the results of flocculation studies and potential impacts to water quality.

Toxicants in Sediments

Accumulation of PW contaminants in sediments depends primarily on the volume/concentration of particulates in PW discharges or constituents that adsorb onto seawater particulates, the area over which those particulates could settle onto the seabed (dominated by current speeds and water depths), and the re-suspension, bioturbation and microbial decay of those particulates in the water column and on the seabed. As described above, the potential for PW to impact sediment, based on chemical characterisation, is unlikely due to the concentrations observed.

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The plume is buoyant, due to lower salinity and/or higher temperature than surrounding sea water. Therefore, potential contaminants in the PW discharge may be introduced into sediments around the facility through precipitation of soluble contaminants and flocculation and sedimentation of the particles in the PW plume. Studies into potential sediment accumulation from PW discharge have been undertaken by Woodside, including analysis of a sample of PW from GWA (Jacobs 2016, BMT 2021). The Jacobs 2016 study found that the PW at GWA had very small amounts of solid material, with very little potential of settling out due to small particle sizes (100% particles <40 μm), and that it was unlikely to flocculate. The BMT 2021 study found that 95% of particles were <72 μm, with some settling and precipitation associated with bioavailable iron. Concentration of iron in raw PW in 2021 was consistent with previous years (BMT 2021) and 2015 sediment sampling indicated iron concentration in sediments in close proximity to the platform (i.e. within 100 m) were consistent with concentration found in sediments 5 km from the platform (i.e. background levels), indicating no impacts to sediment from iron concentrations in PW (BMT Oceanica 2015).

Dr Graeme Hubbert categorised particulate behaviour based on oceanographic experience and mathematical calculations using settling rates and resuspension velocities for various particle sizes. He determined that particles of a size 1 to 5 μm would never permanently settle out of the water column, and that particles from 5 to 40 μm would not permanently settle out of the water column, unless they were in very deep water (>5000 m) or in areas where hydrodynamic conditions were very weak and did not continuously resuspend the particles (SKM 2013).

In 2006 and 2014 sediment sampling was conducted at GWA to investigate impacts of historical water based and non-water-based drilling muds on sediment quality (SKM 2006, SKM 2014). Sampling found historical contamination with elevated levels of TPH, lead, zinc and mercury within 200m of the GWA platform. Beyond 200m from the GWA platform, TPH and metals concentrations were below ANZECC/ARMCANZ ISQG trigger values.

In 2015 sediment sampling was conducted at GWA to verify impacts to sediment were not observed from PW discharges (BMT Oceanica 2015). Sediment samples were collected both inside and outside the approved PW mixing zone (1200m) to a maximum distance of 5km from the platform. Beyond 400m from the GWA platform, metals and hydrocarbon concentrations were consistent with background concentrations and well below ANZECC/ARMCANZ ISQG trigger values, indicating no impacts to sediment due to PW discharges.

Impact Assessment – Non-Routine PW Discharge

High Water Cut Well Unloading/Cycling

Modelling was undertaken (RPC 2018) to predict where PEC/PNEC ratios are expected to be achieved during high water cut well unloading/cycling. In the model, OIW was discharged at 100 mg/L for 24 hours at a rate of 7,500 m^3/day. The modelling results demonstrated that the worst-case impact occurs during the transitional period, during which PEC:PNEC=1 is achieved in 210 m, well within the approved mixing zone boundary. Refer **Table 6-4** below for additional details.

Table 6-4: Modelled distance at which PNEC= 70 μg/L for PW discharged from GWA during well unloading/cycling is achieved (transitional period)

Discharge rate (m^3/day)	Peak OIW conc. at 200 m (ppm)	95%ile at 200 m (ppm)	24 hour average conc. at 200 m (ppm)	Maximum distance at which 70 μg/L PNEC achieved (i.e. PEC:PNEC = 1)
7,500	0.87	0.16	0.048	210 m

A PW sample collected during high water cut well unloading in 2019, while showing an increase in toxicity to previous samples, was considered to be within the range of the safe dilutions measured for the PW (Jacobs 2020), and not significantly different to previous years. The safe dilution estimate for protection of 99% of species (1 in 3,100) was within the predicted dilutions at the GWA approved mixing zone boundary (1200 m) for the modelled discharge rate of 7500 m^3/day (1 in 11,800), indicating impacts from PW discharge during high water cut well unloading remain within the approved mixing zone boundary.

Routine 2020 WET testing was undertaken whilst a high water cut well was producing. Results indicated PW toxicity was lower than previous years, with a safe dilution estimate for the protection of 99% species of 1 in 667 (BMT 2021) (**Table 6-3**) indicating the short-term elevation in PW toxicity observed in the 2019 high water cut well unloading trial PW sample, normalised following the initial unloading period, likely following the return to OIW rates <30 mg/L.

Based on modelling, OIW trends observed during high water cut well unloading, and WET testing results, the non-routine PW discharge associated with high water cut well unloading/cycling is considered to have a short term, temporary and localised impact to water quality, and not predicted to result in impacts beyond the approved mixing zone boundary.

GWF3 Commissioning (initial start-up)

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Modelling undertaken to predict where PEC/PNEC ratios are expected to be achieved during high water cut well unloading is considered a suitable analogue for predicting potential impacts from PW discharged during GWF3 commissioning. The modelling results demonstrated that the worst case impact occurs during the transitional period, during which PEC:PNEC=1 is achieved in 210 m (**Table 6-4**), well within the approved mixing zone boundary.

MEG from flowline preservation is miscible in water and considered PLONOR. Upon discharge via the produced water system, MEG is expected to mix with the receiving environment with no lasting environmental impact.

Based on modelling, and short duration of each well start-up, the non-routine discharge associated with GWF3 commissioning (initial start-up) is considered to have a short term, temporary and localised impact to water quality, and not predicted to result in impacts beyond the approved mixing zone boundary.

Production Restarts

There is the potential for the GWA facility to experience high OIW during production restarts, due to mobilisation of emulsions observed in the PW system after shutdowns. Production restarts after planned shutdown are expected to occur one to three times per year. The emulsions are thought to be caused by calcium carbonate scale and waxy hydrocarbons combining with water during shutdown periods when the topsides process trains have materially cooled down. Elevated OIW in PW discharge during production restarts is expected to be temporary and of short duration (up to three days).

Based on modelling described above, and short duration of elevated OIW, the non-routine discharge during production restarts is considered to have a short term, temporary and localised impact to water quality, and not predicted to result in impacts beyond the approved mixing zone boundary.

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[14]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
None identified.				
Good Practice				
Implement Woodside's Chemical Selection and Assessment Environment Guideline: • Where Gold/Silver/E/D OCNS rating (and no OCNS substitution or product warning), chemicals are selected – no further control required; and • If chemicals with a different OCNS rating, sub warning or non-OCNS rated chemicals are required chemicals will be assessed in accordance with the procedure prior to use.	F: Yes. Routinely implemented to the chemical selection process for Woodside facilities. CS: Minimal cost. Standard practice.	Selection and assessment of chemicals in accordance with the Woodside process, reduces environmental impacts associated with residual chemicals in PW discharge.	Benefits outweigh cost/sacrifice.	Yes **C 4.1**
Monitoring of OIW concentrations in accordance with PARCOM 1997/16 Annex 3 methodology. During routine operations limit average PW OIW to less than 30 mg/L 24 hr rolling average. During non-routine high water cut well unloading activities limit PW OIW to less than 100 mg/L	F: Yes CS: Monitoring and implementation costs. Standard practice. The 30 mg/L 24 hr rolling average limit proposed is a legacy of the former environment regulations 29 and 29A repealed in 2014.	Limiting OIW concentrations within PW reduces impacts to the environment.	The adoption of a limit ensures that PW OIW is controlled. A separate limit for non-routine activities provides a proportional approach to enable start up of wells, assist in ongoing OIW management while ensuring that impacts are of short duration, localised and temporary. PW WET testing and chemical characterisation data obtained during high water cut well unloading indicated no impact	Yes **C 5.1**

[14] *Qualitative measure*

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[14]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
24 hr rolling average, for up to 7 days. During non-routine high water cut well cycling activities limit PW OIW to less than 100 mg/L 24 hr rolling average, for up to 3 days. During non-routine GWF3 commissioning (initial start-up) activities, limit PW OIW to less than 100 mg/L 24 hr rolling average, for 48 hrs from well start up, for each well. During non-routine production restart activities, limit PW OIW to less than 100 mg/L 24 hr rolling average, for up to 3 days for the restart of each processing train (T100 and T200). PW OIW is limited to a 30 mg/L monthly rolling average at all times.	Reduction of this limit is not considered feasible or practicable. The current limit is effective in managing potential impact of PW discharge. The 100 mg/l limit for non-routine activities is consistent with the maximum permitted concentration under the *Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations (UK) 2005.* Based on benchmarking against other Australian operations 100 mg/L rolling 30-day averages have been used for periods of between 33 and 60 days during initial commissioning periods. The 30 mg/L monthly rolling average inherently limits the frequency and duration of non-routine activities.		to ecosystem integrity from PW outside of the approved mixing zone boundary.	
Continuous reservoir management during routine operations, i.e. changing the relative contribution to facility production of each well, including choking back high OIW wells, to maintain overall OIW concentration below Performance Standard.	F: Yes CS: Monitoring and implementation costs. Standard practice.	Continuous reservoir management is a contingency measure during routine operations to ensure that 24 hr rolling limits are not exceeded, even if a temporary spike in OIW concentration occurs.	If the facility exceeds 30 mg/L for a short period which places the rolling 24 hr period limit at risk, the facility is able to change the relative production from each well to ensure a breach of the OIW limit does not occur.	Yes **C 5.2**

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[14]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Monitoring routine PW discharges including: • Monitoring of PW discharge volume • Chemical characterisation • WET testing; and • Timing of annual / triennial sampling to be representative aiming to detect change, considering when high water cut wells are producing and/or new reservoirs cut water.	F: Yes CS: Monitoring costs. Standard practice	The OMDAMP provides for detection of significant changes to the PW discharge characteristics (i.e. volumes, OIW concentration, chemical characterisation) that may cause an increased impact or risk to the marine environment. Monitoring is designed to detect if 99% species protection is achieved at the approved mixing zone boundary. Through the implementation of the OMDAMP, potential risks to the environment are reduced.	Woodside has developed the OMDAMP based on operational experience from relevant offshore assets. The OMDAMP considers risk-based adaptive management measures.	Yes **C 5.3**
Online monitoring and/or procedural controls in place to monitor and control PW discharge volume and OIW concentrations; and prevent discharge of PW with high OIW concentrations: Process performance monitored by OIW concentration analyser and volume meter(s).	F: Yes CS: Minimal cost. Standard practice	The OIW analyser and flow meter provides optimal process control and safeguarding to monitor, control and prevent discharge of PW with high OIW concentration to the environment.	Control is WMS requirement – must be adopted	Yes **C 5.4**
Online monitoring and/or procedural controls in place to monitor and control PW discharge volume and OIW concentrations; and prevent discharge of PW with high OIW concentrations: During routine activities, conduct manual sampling on a 6 hourly basis when online	F: Yes CS: Monitoring and implementation costs. Standard practice.	Monitoring of OIW concentrations when online analyser unavailable when safe and practicable to do so. Horiba sampling provides additional verification of OIW concentrations. Increased confidence that OIW analyser is able to measure accurately above its normal calibration range.	It is not feasible for Operations to continually monitor OIW concentrations when the OIW online analyser is not available through continuous manually sampling. Six hourly sampling allows sufficient time to complete sampling when online analyser is offline and is proportional to the potential impact, during routine activities. Additional cost to resource manual sampling during non-routine activities is considered	Yes **C 5.5**

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[14]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
analyser is unavailable, where safe and practicable to do so. During non-routine activities, when OIW > 30 mg/L, conduct: • manual sampling (1-hourly to 6-hourly, dependant on OIW concentrations, as described in the relevant Operating Procedure); and • calibration of the online OIW analyser (frequency of calibration is dependent upon delta between manual sample and OIW analyser).			proportionate to additional verification of OIW concentrations.	
The online analyser is calibrated with a manual sample in accordance with Offshore Laboratory Determination of Oil in Water Standard Operating Procedure.	F: Yes CS: Monitoring and implementation costs. Standard practice.	Calibration of equipment to maintain quality control.	Calibrations undertaken at appropriate frequency to maintain quality control and in line with procedures.	Yes **C 5.6**
Non-routine PW discharge activities will not occur concurrently.	F: Yes CS: Minimal cost due to reducing flexibility to blend reservoir liquids	Management to avoid concurrent non-routine PW discharge activities limits elevations in OIW concentrations within PW and when combined with the 30 mg/L monthly rolling average limit, effectively minimises impacts to the environment.	The adoption of a limit ensures that PW OIW is controlled; the benefits outweigh cost/sacrifice.	Yes **C 5.7**
Professional Judgement – Eliminate				
Reinjection of PW into reservoirs	F: Possible – some technical risk associated with reservoir uncertainty.	The environmental impacts in the approved mixing zone around the facility would be eliminated.	As part of the 2015 PW study into treatment improvement for GWA, Woodside examined the potential for reinjection of PW.	No

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[14]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	CS: Significant. The reinjection of PW would require significant modification to the GWA facility, including drilling of injection wells. This would require considerable design and construction costs. Previous studies indicate a cost in excess of AUD$20M CAPEX for PW reinjection, with an estimated OPEX cost of AUD$1M.	Long term biological impacts from Produced Water which are outside of the acceptable limits of change, i.e. impacts to ecosystem integrity from contaminant accumulation in sediment and bioaccumulation effects over time, are prevented by the PW Monitoring and Management Framework. Currently, PW does not represent a sediment accumulation or resulting bioaccumulation risk (refer to Potential impacts to Sediment Quality for more detail). Given that a moderate level of environmental protection will be sustained at 500m, which is the Operational Exclusion Zone of the facility, there is currently no opportunity for other socio-economic marine users to benefit from a smaller mixing zone. Therefore, there is negligible socio-economic benefit to reinjection.	Woodside has not identified a suitable reservoir, and such an option would likely require additional drilling activities to be undertaken. GWA is no longer capable of supporting platform-based drilling. Reinjection is not feasible unless a suitable reservoir is identified. It is not feasible to reinject into a shut-in GWA platform well because the wells continue to have very high reservoir pressure, which would require significant facility modifications to overcome. Drilling and Subsea work activities to establish a reliable PW reinjection well and subsea infrastructure also introduce significant complexity, risk and cost. Retrofitting PW topsides reinjection equipment to GWA introduces significant modifications which pose safety risks on an operational gas facility. Together the significant retrofit risks, associated environmental impact (drilling and subsea construction, greenhouse gas emissions associated with 7-15MW based on known requirements for Enfield - Laverda) is considered significantly disproportionate to the potential slight environmental impact improvement. As such, no further engineering design or screening studies reporting is considered reasonably practicable. It is not necessary to conduct a reservoir-by-reservoir analysis to understand these costs. For type B impacts, it is appropriate to consider case specific drivers to ALARP management. The lack of a suitable reservoir contrasts with Woodside's facilities that currently reinject Produced Water. At	

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[14]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
			Nganhurra (NGA), for example, water was re-injected as it was required to maintain reservoir pressure for production and was a key part of the Field Development Plan to optimise overall field recovery. As PW alone was not sufficient to maintain reservoir pressure, seawater was used to make up the balance. Therefore, given the significant economic benefits associated with reinjection at NGA, the ALARP outcome is different from NGA to GWA. The reinjection of PW would also introduce additional sources of environmental risks and impacts, such as those associated with drilling injection wells (e.g. drill cuttings) and maintaining injection capability (e.g. increased greenhouse gas emissions from power generation for pumps, increased chemical usage etc.). Given the localised, slight non-significant impact of PW discharges, and the considerable costs involved in developing a PW reinjection capability for the GWA facility, implementation risks and environmental impacts (greenhouse gas, chemical use), the costs are grossly disproportionate to the potential environmental benefit gained.	
Professional Judgement – Substitute				
None identified.				
Professional Judgement – Engineered Solution				
Utilise adsorbent hydrocarbon filters to manage OIW upsets.	F: Yes	Potential minor reduction in OIW concentration. Assist in removal of dispersed oil, depending on cause of high OIW readings.	Benefits outweigh cost/sacrifice, where implemented to manage OIW upsets only. Adsorbent filters are not used constantly during routine operations as they become	Yes **C 5.8**

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[14]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	CS: Minimal cost (filter replacement). Standard practice.		saturated quickly and require frequent changeout.	
Upgrade of existing (i.e. permanent) treatment system to increase capacity, whilst maintaining OIW limits: upgrade vessel internals in the T200 PWCS	F: Yes CS: Moderate. Cost of modifying current produced water system vessel internals	Potential minor reduction in OIW concentration. Overall consequence ranking will not be reduced further. Control was assessed to facilitate access to reserves (i.e. by increasing water handling capacity) constrained due to OIW performance.	Following the 2015 PW study into treatment improvement for GWA, the PW treatment system was improved in 2019 by upgrading the existing vessel internals in the T200 PWCS to increase flow whilst maintaining existing OIW limits.	Yes Engineered solution permanently implemented
Upgrade of existing (i.e. permanent) treatment system to increase capacity, whilst maintaining OIW limits: upgrade the OWDS and PW Degasser, install a hydrocyclone.	F: Potentially feasible. CS: Moderate. Cost of upgrading OWDS and PW degasser and installation of a hydrocyclone. Other equipment and software modifications would also be required to accommodate changes to control and safeguarding strategies for the vessels and a new hydrocyclone. Previous studies indicate a cost between of AUD$15-20M CAPEX for upgrades and hydrocyclone installation, with an estimated OPEX cost of AUD$500k p.a.	Potential minor reduction in OIW concentration. Overall consequence ranking will not be reduced further. Control was assessed to facilitate access to reserves (i.e. by increasing water handling capacity) constrained due to OIW performance.	As part of the 2015 PW study into treatment improvement for GWA, Woodside examined the potential for further developing GWA water handling capacity (beyond PWCS internals upgrade above) by upgrading the OWDS, the PW Degasser as well as the installation of a hydrocyclone. Cost associated with upgrading the OWDS, PW degasser and installation and operation of a hydrocyclone is not currently considered ALARP because the additional costs and risks associated with this option are considered disproportionate to the environmental benefit that is expected to be yielded.	No
Chemical injection of water clarifier to reduce OIW concentration	F: Potentially. Woodside trialled water clarifier injection to reduce OIW concentrations. This test resulted in a reduction in OIW concentration, however	Minor reduction in OIW concentration, however, does not reduce the overall consequence rating. Further, this results in additional chemical load, and	Woodside's assessment of chemical injection trials did not recommend proceeding with control due to the risk of equipment blockages and potential upsets to process chemistry. Mitigating these potential	No

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[14]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
	resulted in the formation of viscous material within the process equipment. CS: Moderate. Initial cost of modifying production system to include chemical dosing point. Ongoing cost of chemical procurement.	lifecycle environmental footprint associated with packaging, logistics, waste management and potential process upsets.	impacts may require modification of the production system, incurring a capital expenditure. The discharge of the clarifying agent with the PW stream may result in additional toxic effects. Ongoing chemical consumption would also incur operational expenditure. Given the nature and scale of impacts forming the current PW discharge, the cost of developing a chemical injection is disproportional to the environmental benefit.	
Adoption of a permanent secondary treatment stage to reduce OIW concentration	F: Potentially feasible. Woodside trialled a produced water compact flotation unit (CFU) to provide secondary treatment of PW. The initial trial was unsuccessful due to low flow experienced to the CFU skid. CS: Moderate. Initial cost of modifying production system to include tie-in point. Ongoing cost of CFU skid rental and maintenance.	Potential minor reduction in OIW concentration. Overall consequence ranking will not be reduced further. Control was assessed to facilitate access to reserves (i.e. by increasing water handling capacity) constrained due to OIW performance.	A continuous improvement PW treatment technology retrial occurred over the period 4th -11th December 2017. The scope was to test a Compact Flotation Unit on GWA. A sidestream of PW going to the closed drains caisson was treated to reduce OIW. CFU effectiveness was measured through a rental oil droplet online analyser during the retrial. The retrial (at a different tie-in point to the initial trial) was completed successfully as sufficient flow was experienced to the skid to gather meaningful data. The CFU did not perform well downstream of the degasser under real process conditions with increased flow through the PW system via one of the high water cut wells, i.e. trial was insufficient to enable bean up of a high water cut well with a 30 mg/L 24 hr rolling average OIW limit.	No
Adoption of a permanent tertiary treatment stage to reduce OIW concentration.	F: Potentially feasible. Large deck space would be needed which is not currently available. CS: Significant cost. Deck reinforcement or cantilevers	Installation of a tertiary treatment stage to support well optimisation and process debottlenecking (to optimise overall reservoir recovery) could be feasible to ensure OIW	As part of the 2015 PW study into treatment improvement for GWA, Woodside examined the potential for installation of an MPPE. Centrifuges and MPPE are large and heavy, requiring deck reinforcement or cantilevers,	No

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Demonstration of ALARP				
Control Considered	**Control Feasibility (F) and Cost/Sacrifice (CS)[14]**	**Benefit in Impact/Risk Reduction**	**Proportionality**	**Control Adopted**
	required, as well as high cost associated with these maintenance intensive technologies. Previous studies indicate a cost between of AUD$5-15M CAPEX for tertiary treatment stage technology, with an estimated OPEX cost of AUD$250k-750k.	remains below 30mg/L. As OIW performance is currently a production constraint, implementation of this option would support being able to lift that constraint, increasing water production and maintaining OIW levels. Negligible OIW reduction is expected. Installation of an MPPE may potentially provide a minor reduction in some toxicants (eg BTEX, PAHs) over the life of the facility. As the 99% species protection level is currently anticipated to be achieved within 200m of the facility during routine operations, the incremental improvement in environmental performance would be so small it would not currently be safely measurable.	significantly increasing CAPEX cost. They are also maintenance intensive. This introduces significant OPEX costs, and additional risk from exposure of personnel. Additionally, these options tend to have high power consumption, introducing an environmental impact from greenhouse gases. The adoption of tertiary treatment is not currently considered ALARP because the additional costs and risks associated with this option are considered disproportionate to the environmental benefit that is expected to be yielded. Installation that would not increase PW treatment capacity and is there purely to reduce hydrocarbon content in current discharges is considered disproportionate from a cost/sacrifice perspective for small localised environmental improvement gains.	
Mobile treatment technology during high water cut well unloading/cycling or production restart.	F: Yes CS: Equipment hire costs, mobilisation costs, labour, management of change, operational requirements.	Potential improved OIW treatment performance to avoid peaks in short duration OIW discharges. Peaks in OIW discharge are known to be of short duration, with monthly 30 mg/l rolling average maintained, therefore the overall risk reduction is negligible.	The equipment hire, ongoing deck space requirements, mobilisation, labour and management of change costs are disproportionate compared to temporary and localised impacts associated with short duration increase in OIW during high water cut well unloading, cycling and restart activities. Data obtained during high water cut well unloading indicate no impact to ecosystem integrity from PW outside of the approved mixing zone boundary. Mobilising temporary treatment technology reduces operational flexibility (e.g. after an ESD restart), which can be provided through other means (e.g. **C 5.2**).	No

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[14]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Temporary OIW polishing skid during GWF3 commissioning (initial start-up)	F: Yes CS: Equipment hire costs, mobilisation costs, labour, management of change, operational requirements.	Increased ability to treat higher OIW concentrations, flowline preservation fluids containing MEG, and minor fines from the well start-up activities. Greater operational flexibility and higher likelihood of being able to meet OIW discharge requirements whilst maintaining production during GWF-3 commissioning (initial start-up) activities.	Additional labour and temporary operating procedures associated with initial start up of GWF-3 are proportional to manage the risk of high OIW. GWA facility has deck space and suitable tie-in points for an OIW polishing skid, i.e. minimal modifications required to connect temporary skid. There is also proven application of this technology during previous tie-back start-ups; therefore the benefits of adopting this control outweigh the costs.	Yes **C 5.9**
Professional Judgment – Procedures and Administration				
Routine *in-situ* monitoring beyond the requirements of Woodside's OMDAMP for an existing asset	F: Yes CS: Increasing *in-situ* monitoring would result in additional offshore demand on resources, safety hazards and costs associated with monitoring and sampling, such as vessel activities, logistics, manual labour, analytical laboratory and service provider costs.	*In-situ* monitoring following release is not an effective control to manage the nature of PW discharges and results in limited to no impact reduction. *In-situ* monitoring beyond the adaptive management approach outlined in the OMDAMP does not follow good application of the hierarchy of controls and results in disproportionate sacrifice with regard to execution risks and costs for limited gain.	Long term monitoring of water and sediment characteristics at the GWA platform indicate that the PW discharge is not detectable beyond the approved mixing zone. Sediment contamination over time has been stable, is the result of historical drilling activities (i.e. not the result of PW discharge) and limited to within 400 m of the GWA platform. PW separation process design, optimisation, monitoring and surveillance offer the primary controls, with discharge OIW analysis in place to detect performance variations. Woodside maintains a routine OIW monitoring program for the PW stream (including adaptive management via the OMDAMP, which assesses the need for *in-situ* monitoring). The work undertaken to date provides Woodside with a sound understanding of the nature and scale of the environmental impacts from PW discharge, which would not be further improved by	No

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[14]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
			increasing the frequency of routine *in-situ* monitoring. Per the OMDAMP, should routine PW monitoring indicate potential impact beyond the approved mixing zone, further investigations are undertaken, including consideration of non-routine *in-situ* monitoring. The execution risks and cost of implementing this control is grossly disproportionate to the environmental benefit.	

Risk Based Analysis

Application of Woodside's Risk Management Procedures and implementation of the OMDAMP provides for assessment of potential PW impacts, identification of changes to discharges, systematic assessment of risks and ongoing assessment/monitoring of discharge streams to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing PW discharge monitoring.

Company Values

Corporate values require all personnel at Woodside to comply with appropriate policies, standards, procedures and processes while being accountable for their actions and holding others to account in line with the Woodside Compass. As detailed above, the Petroleum Activities Program will be undertaken in line with these policies, standards and procedures, which include suitable controls to manage PW discharge.

Societal Values

Due to the Petroleum Activities Program's proximity to sensitive receptors and potential uncertainty around PW discharges, the PW discharge consequence rating presents a Decision Type B in accordance with the decision support framework described in **Section 2.6.1**. Consultation was undertaken for this program to identify the views and concerns of relevant stakeholders, as described in **Section 5**.

Woodside has sent an Activity Factsheet to all identified relevant stakeholders regarding the Petroleum Activities Program (**Section 5** and **Appendix F**), no specific concerns around PW discharge were identified through this process.

ALARP Statement

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of PW discharge. Woodside has completed additional PW treatment studies, treatment trials, upgrades to PW system vessel internals, use of a temporary OIW skid for tie-back commissioning, OIW and discharge volume monitoring, and risk-based analysis (PW discharge modelling) to inform the evaluation and assessment of environmental impacts and risks. Woodside also implements a risk-based adaptive OMDAMP, which includes annual and triennial end of pipe

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[14]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
monitoring. The outcomes of both the modelling studies and long-term monitoring have been considered in determining the ALARP position. *In-situ* water quality and sediment sampling has demonstrated no impact outside of the approved mixing zone. As no reasonable additional/alternative controls are currently identified that would further reduce the impacts and risks without grossly disproportionate sacrifice, the impacts are considered ALARP.				

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Demonstration of Acceptability
To assess and determine the acceptable limits of impacts from PW discharges, Woodside has considered appropriate guidelines, principles of Ecologically Sustainable Development, Company Values and Societal Values. **Other Requirements (includes laws, polices, standards and conventions)** The adopted controls and acceptability assessment has considered regulatory guidance, in particular WA EPA (2016) Technical Guidance: Protecting the Quality of Western Australia's Marine Environment and the ANZG (2018) guidelines. Both sources of regulatory guidance state that environmental values should be identified, and levels of ecological protection should then be set. To ensure ecosystem health is maintained overall, the cumulative size of the areas where lower levels of ecological protection apply should be proportionally small compared to the areas designated high and maximum. The ANZG (2018) guidelines similarly provide guidance that levels of protection should be identified, based on the environmental values to be protected. The Monitoring and Management Framework aligns to the levels of protection described by both WA EPA (2016) Technical Guidance and the ANZG (2018) guidelines through the acceptable limit of change. A maximum level of protection is required for most categories of Marine Park however a high level of protection may be appropriate for non-conservation areas as stated in the EPA guideline (2016). By monitoring and managing to the 99% species protection safe dilutions (high level of ecological protection) at 1200 m there can be high confidence that any potential for impacts can be detected and managed via the OMDAMP. **Principles of Ecologically Sustainable Development** Woodside has a strong history of exploration and development of oil and gas reserves in the north-west of Western Australia with an excellent environmental record, while providing revenue to State and Commonwealth Governments, returns to shareholders, jobs and support to local communities. Titles for oil and gas exploration are released based on commitments to explore with the aim of uncovering and developing resources. It is under the petroleum title lease agreement that Woodside continues to produce the hydrocarbon fields for which acceptance of this EP is sought under the Environment Regulations. Woodside has established a number of research projects in order to understand the marine environments in which it operates, notably in the Exmouth Region and the Kimberley Region, and also Rankin Bank, Glomar Shoals, Enfield Canyon and Scott Reef. Where scientific data does not exist, Woodside works from a base that a pristine natural environment exists and therefore, implements all practicable steps to prevent damage. Woodside's corporate values (**Appendix A**) require that we consider the environment and communities in which we operate when making decisions. Risks are inherent in petroleum activities; however, through sound management, systematic application of policies, standards, procedures and processes, Woodside considers potential PW impact is slight, short term and localised, and discharge of PW is acceptable. **Internal Context** The Petroleum Activities Program is consistent with Woodside corporate policies, standards, procedures and processes as outlined in the Demonstration of ALARP (above) and Environmental Performance Outcomes (below), including: • Woodside Health, Safety and Environment Policy (**Appendix A**); • Woodside Risk Management Policy (**Appendix A**); and • Woodside Environmental Performance Procedure (which specifies maximum mixing zones and minimum sampling requirements). Given that an approved mixing zone has been established at 1200 m, the proposed limits of acceptable change meet the requirements of the Environmental Performance Procedure. Woodside corporate values include working sustainably, with respect to the environment and communities in which it operates, listening to internal and external stakeholders, and considering Health, Safety and Environment (HSE) when making decisions. Stakeholder consultation, outlined below, has been undertaken prior to the Petroleum Activities Program. **External Context** Woodside recognises that its licence to operate from a regulator and societal perspective is to some extent, based on historical performance, complying with appropriate policies, standards and procedures, and perception of the expectations of external stakeholders. External stakeholder consultation (**Section 5)** was undertaken prior to the Petroleum Activities Program and stakeholder feedback (**Appendix G**) was incorporated into this EP where appropriate. By providing PW monitoring and control measures that are commensurate with the risk rating, location, and sensitivity of the receiving environment (including social and aesthetic values), Woodside considers that societal concerns are addressed to an acceptable level. **Acceptability Statement**

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Demonstration of Acceptability
Routine and non-routine discharges of PW have been evaluated as representing potential slight, localised, short-term impacts to water quality, marine sediment, marine fauna and ecosystem/habitat. As per Section 2.6.1, Woodside considers 'high order impacts' (Decision Type B impacts such as PW discharge) as acceptable if ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for, and the alternative control measures are grossly disproportionate to the benefit gained. In addition, acceptability is assessed against the above criteria. Further opportunities to reduce the impacts have been investigated (refer ALARP demonstration discussion). The adopted controls are considered good oil-field practice/industry best practice, are consistent with ANZG (2018) and Woodside's internal requirements. The potential impacts are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of PW discharge to a level that is broadly acceptable.

EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 5 No impact to ecosystem integrity from Produced Water outside of the Approved Mixing Zone boundary.	**C 5.1** Monitor and manage OIW concentrations in accordance with PARCOM 1997/16 Annex 3 methodology. **C 5.2** Continuous reservoir management during routine operations, i.e. changing the relative contribution to facility production of each well, including choking back high OIW wells, to maintain OIW concentrations below Performance Standard.	**PS 5.1** For routine operations, OIW is limited to a 30mg/L 24 hr rolling average. For non-routine high water cut well unloading, OIW is limited to 100 mg/L 24 hr rolling average, for up to 7 days. For non-routine high water cut well cycling, OIW is limited to 100 mg/L 24 hr rolling average, for up to 3 days. For non-routine GWF3 commissioning (initial start-up) activities, OIW is limited to 100 mg/L 24 hr rolling average, for 48 hrs from each well start-up. For non-routine production restart activities, OIW is limited to 100 mg/L 24 hr rolling average, for up to 3 days for the restart of each processing train (T100 and T200). PW OIW is limited to a 30 mg/L monthly rolling average for all activities.	**MC 5.1.1** Records demonstrate during routine activities and non-routine activities OIW rolling average limits are not exceeded.
	C 5.3 Implementation of the Adaptive Monitoring and Management Framework for Produced Water.	**PS 5.3** No potential to impact ecosystem integrity from PW outside of acceptable limit of change. The acceptable limit of change is no impacts from PW beyond the approved mixing zone (1200 m)	**MC 5.3.1** Records show that routine monitoring has been conducted as per **Table 6-1**. Further Investigations have identified no potential to impact ecosystem integrity from PW outside of acceptable limit.
	C 5.4 Online monitoring and/or procedural controls in place to monitor and control	**PS 5.4** Instrumentation integrity will be managed in accordance with SCE Management Procedure (Section 6.1.5.2) and SCE technical	**MC 5.4.1** Records demonstrate implementation of SCE technical Performance Standard(s) and Safety

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
	PW discharge volume and OIW concentrations; and prevent discharge of PW with high OIW concentrations: Process performance monitored by OIW concentration analyser or manual sampling, and volume meter(s) available.	Performance Standard(s) to prevent environment risk related Damage to SCEs for: P31 - Environmental Emissions Monitoring and Controls to; • provide means of detection of environmental releases, emissions and discharges to prevent MEEs from manifesting over time, and/or as required to assure compliance monitoring and reporting equipment. to ensure monitoring data is available to control PW discharge volume and OIW concentrations; and prevent discharge of PW with high OIW concentrations.	Critical Element Management Procedure.
	C 5.5 Online monitoring and/or procedural controls in place to monitor and control PW discharge volume and OIW concentrations; and prevent discharge of PW with high OIW concentrations: During routine activities, conduct manual sampling on a 6 hourly basis when online analyser is unavailable, where safe and practicable to do so. During non-routine activities when oil in water exceeds 30 mg/L, the facility will conduct: • manual sampling (1-hourly to 6-hourly, dependant on OIW concentrations as described in the relevant Operating Procedure); and • calibration of the online OIW analyser (frequency of calibration is dependent upon delta between manual sample	**PS 5.5** During routine operations, in the event the OIW analyser is offline, manual sampling is undertaken when safe and practicable to do so (subject to MOC if samples are unable to be taken). Six hourly samples are taken in accordance with the GWA's sampling requirements. During non-routine operations a competent technician/operator will be available on the facility to conduct: • manual sampling (1-hourly to 6-hourly), dependant on OIW concentrations, as described in the relevant Operating Procedure; and • calibration of the online OIW analyser (frequency of calibration is dependent upon delta between manual sample and OIW analyser). to ensure that OIW analyser is able to measure accurately above its normal calibration range.	**MC 5.5.1** Records demonstrate manual sampling and calibration is undertaken as appropriate.

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
	and OIW analyser).		
	C 5.6 The online analyser is calibrated with a manual sample in accordance with Offshore Laboratory Determination of Oil in Water Standard Operating Procedure.	**PS 5.6** Complete calibrations of online analyser and manual OIW sampling equipment in accordance with Offshore Laboratory Determination of Oil in Water Standard Operating Procedure.	Refer to **MC 5.5.1**
	C 5.7 Non-routine (potentially high OIW) well activities do not occur concurrently.	**PS 5.7** Non-routine (potentially high OIW) well activities not to be undertaken concurrently.	**MC 5.7.1** Records demonstrate that non-routine (potentially high OIW) well activities did not occur concurrently.
	C 5.8 Adsorbent hydrocarbon filters are utilised to manage OIW upsets**.**	**PS 5.8** Utilise adsorbent hydrocarbon filters to manage OIW upsets.	**MC 5.8.1** Records demonstrate that adsorbent hydrocarbon filters have been utilised to manage OIW upsets.
	C 5.9 Temporary OIW skid used during GWF-3 commissioning (initial start -up).	**PS 5.9** Temporary OIW skid available and utilised during GWF-3 commissioning (initial start-up).	**MC 5.9.1** Records demonstrate a temporary OIW skid used during GWF-3 commissioning (initial start-up).

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6.6.6 Routine and Non-routine Discharges: Discharge of Sewage, Putrescible Waste, Greywater, Bilge Water, Drain Water, Cooling Water and Brine

Context	
Drainage Systems – **Section 3.6.4** Utilities Systems – **Section 3.6.5** Vessels – **Section 3.7**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**

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	Socio-economic	Decision Type	Consequence / Impact		Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Discharge of sewage, greywater and putrescible waste from vessels and GWA facility to the marine environment.			✓					A	F	Cumulative E	-	-	LCS GP PJ	Broadly Acceptable	**EPO 6**
Discharge of deck, bilge and drain water from vessels and GWA facility to the marine environment.			✓					A	F		-	-			
Discharge of RO brine from vessels and GWA facility to the marine environment.			✓					A	F		-	-			
Discharge of cooling water from vessels and GWA facility to the marine environment.			✓					A	F		-	-			

Description of Source of Impact

Sewage, Putrescible Waste and Greywater

Sewage and greywater is treated onboard the GWA facility by maceration and then disposed to ocean via the sewage caisson. Putrescible wastes, such as food scraps, are also discharged via the sewage caisson from the GWA facility after being ground to < 25 mm diameter.

Vessels may also discharge sewage, greywater and putrescible wastes. Sewage onboard vessels is routinely treated (either via sewage treatment plant (STP) or macerator) prior to discharge. Treatment systems may require routine maintenance or repair during operations, which may require infrequent, short periods in which sewage is directly discharged overboard as treatment systems are not always operational.

The volume of sewage and greywater generated is estimated to be in the order of 8 to 9 m^3 per day (based on an average volume of 75 L/person/day). The actual volume of discharge varies depending on personnel levels on the GWA facility and vessels.

Note that wastes may also be stored and transported to shore for disposal.

Drain and Bilge Water

Operational non-process discharges, process maintenance drainage and flushing discharges, washdown water and potential spills are contained in the non-hazardous and hazardous open drain systems on the Platform.

The drainage system on the GWA facility consists of:

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- Non-hazardous open drains - which collect drainage water from non-hazardous areas and drains which are discharged directly to ocean.
- Hazardous open drains - which collect wastewater, hydrocarbons and chemicals from the hazardous area via deck drains, tundishes and drip trays. Collected fluids are treated as described in **Section 3.6.4.2**.
- Hazardous closed drains system – which collect liquids from normally pressurised and hazardous equipment prior to maintenance, and intermittent flow from other process equipment. Hydrocarbon liquids collected are treated as described in **Section 3.6.4.1.**

Chemicals used onboard the GWA platform may be introduced to the environment via the drains system, including;

- Deck washdown, maintenance drainage of treated water systems (e.g. tempered water), and other cleaning/flushing activities
- Mandatory annual testing of the active fire deluge and foam system for safety requirements
- Marine growth treatment of drain caissons.

Vessels routinely generate and discharge relatively small volumes of bilge water. Bilge tanks receive fluids from many parts of the vessel, including machinery spaces. Bilge water can contain water, oil, detergents, solvents, chemicals, particles and other liquids, solids or chemicals. Vessels may also discharge drainage water from decks directly overboard or via deck drainage systems; deck drainage may also contain traces of chemicals. Water sources could include rainfall events and/or from deck activities such as cleaning/wash-down of equipment/decks.

Cooling Water

The seawater system is routinely used onboard the GWA facility for process and machinery cooling (**Section 3.6.5.3**), which is returned to the sea via the seawater dump caisson. Seawater used for cooling is dosed with sodium hypochlorite to inhibit marine growth to a target chlorine concentration of 0.5 ppm. Seawater system discharge temperature and volumes are typically 32 °C and 4,275 m^3/hr respectively.

Brine

The RO plant onboard the GWA facility is used to produce potable water, with the brine from the RO plant discharged to the marine environment at the GWA facility. Brine from the RO plant is generally 55-60 parts per thousand salt, with approximately 75 m^3 of brine produced per day. Small quantities of anti-scaling and cleaning chemicals may also be discharged with the brine.

Impact Assessment

Sewage, Putrescible Waste and Greywater

The environmental impact associated with ocean disposal of sewage, greywater and 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.

No significant impacts from the planned (routine and non-routine) discharges to the marine environment are anticipated due to the minor quantities involved, the expected localised mixing zone (as indicated by modelling at the GWA platform location (Woodside, 2008)) and the high level of dilution into the open water marine environment of the Operational Area.

Water quality monitoring around the GWA platform (the location of the most significant routine discharges) indicates that there is no detectable decrease in oxygen saturation, nutrients or increase in oxygen demand at the GWA platform (BMT Oceanica 2015). This is supported by monitoring of sewage discharges, which has demonstrated that a 10 m^3 sewage discharge reduced to approximately 1% of its original concentration within 50 m of the discharge location (Woodside, 2008). In addition to this, monitoring at distances 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. TN, total phosphorous and selected metals) were recorded above background levels at any station (BMT Oceanica 2015).

Although the NWS Province is characterised as a low nutrient environment (DEWHA, 2008), studies of adjacent shelf water have found the area to be “a highly productive ecosystem in which nutrients and organic matter are rapidly recycled” (Furnas and Mitchell 1999). The estimated daily loading from sewage and putrescible waste (2.4 to 3.0 kg/day of TN and 0.38 to 0.43 kg of TP/day) is not significant in comparison to the daily turnover of nutrients in the area. Vessels are typically moving when in the Operational Area, which facilitates the mixing of sewage, putrescible wastes and greywater from vessels.

The impact of nutrients associated with discharge of sewage, greywater and putrescible waste is considered to have a localised impact with no lasting effect due to the small mass relative to daily turnover, and the assimilative capacity of the receiving environment.

Drain and Bilge Water

The impacts of drainage can include a decline in water quality and may be directly toxic to marine organisms, with impacts varying depending on volumes and type of contaminants.

Drain water from the GWA facility may contain small quantities of hydrocarbons, and other chemicals such as detergents. Drain discharge from areas with greater risk of hydrocarbon contamination is via caissons with

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hydrocarbon recovery systems. This means floating hydrocarbons are not routinely discharged to the environment via drains; any hydrocarbons discharged are primarily soluble fractions, with very low concentrations expected.

Water foaming agents used in aqueous fire fighting foam (AFFF), by nature of the surfactant properties by which it effectively extinguishes liquid fires, may be harmful to aquatic organisms within freshwater environments like ponds and streams. This surfactant effect is greatly diminished in the offshore environment due to wave and wind action and does not present the same risks to pelagic fish and other marine life. Nevertheless, the planned release of these materials is restricted to testing activities to ensure safe and effective operation of the system in an emergency.

Impacts from drainage water from the GWA facility are assessed as being highly localised and short-lasting. Bilge and deck drainage water from vessels is expected to mix rapidly in the marine environment upon discharge. Given the rapid mixing, relatively small typical bilge and deck drainage water, and expected low levels of potential contaminants, impacts from bilge and deck drainage water from vessels are assessed as short-lasting and highly localised.

Cooling Water

The impacts of cooling water can include a decline in water quality and may directly affect marine organisms due to temperature changes, with impacts varying depending on volumes, temperature and type of contaminants. Temperature change from cooling water may affect open-water receptors (fish and plankton populations). Elevated seawater temperatures may cause a variety of effects on both fish and plankton, ranging from behavioural response (including attraction and avoidance behaviour) and minor stress from prolonged exposure. Fish are unlikely to be impacted by the elevated temperatures other than through behavioural changes (avoidance and attraction). While impacts to plankton may include mortality, with the rapid turnover of plankton communities and mixing of adjacent populations, populations are expected to recover rapidly once discharge ceases.

Discharged cooling water is typically warmer than the surrounding seawater, which typically ranges from 24.3 to 28.5 °C (average of 26.4 °C). Given this difference in temperature, discharged cooling water is relatively buoyant compared to the receiving seawater, and forms a plume in near-surface waters down current from the discharge location. As a surface plume, discharged cooling water is mixed by sea surface waves and wind. Monitoring of water in the mixing zone around the GWA facility (refer to **Section 6.6.5**) indicates that water temperatures are consistent with background levels at the GWA platform location (BMT Oceanica 2015); no impacts from increased water temperature are expected to occur.

Sodium hypochlorite is expected to readily dissociate and break down once discharged. Monitoring of water in the mixing zone around the GWA facility (refer to **Section 6.6.5**) has not indicated the pH of water within the mixing zone to differ from the surrounding environment (BMT Oceanica 2015); given sodium hypochlorite is basic the monitoring suggests the concentrations diminish rapidly following discharge.

Brine

Brine plumes may result in osmotic stress to marine biota that rely on gills or diffusion across cell membranes to maintain osmotic pressure within cells. Mobile fauna such as fish may move away from the brine plume; hence impacts will be restricted to planktonic and sessile organisms.

Once discharged into the marine environment, the brine plume sinks due to its relatively high density. Sinking of the plume facilitates turbulent mixing, as does surface currents and waves. Monitoring of water in the mixing zone around the GWA facility (refer to **Section 6.6.5**) confirm salinity within the mixing zone is consistent with the surrounding environment (BMT Oceanica 2015); these results provide evidence that the RO brine plume is mixed rapidly. Impacts from RO brine discharge will have no lasting effects on the environment and are highly localised to the discharge location.

Cumulative Impacts

Given the activities that may be conducted during the Petroleum Activities Program, there is the potential for cumulative impacts from routine discharges of sewage, putrescible waste, greywater, bilge water, drain water, cooling water and brine due to:

- repeated / ongoing discharges at the same location (GWA facility) over the course of the Petroleum Activities Program
- cumulative discharges from differing point sources (GWA facility and vessels).

Given the nature of these routine discharges, the localised spatial extent of impacts, the fact that vessels cannot discharge within the 500 m PSZ and the well mixed receiving environment, the cumulative impacts from these discharges are not considered to result in impacts more than slight short-term impact. Given the highly localised nature of the impacts of routine discharges, no cumulative impacts from similar discharges from other production facilities (e.g. NRC) are expected.

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Contract vessels compliant with Marine Orders for safe vessel operations: • Marine Orders 91 (Oil) • Marine Orders 95 (Pollution prevention – Garbage) • Marine Orders 96 – (Pollution prevention – sewage)	F: Yes CS: Minimal cost. Standard practice.	Marine Orders required under Australian regulations; implementation is standard practice for commercial vessels as applicable to vessel size, type and class. Marine Orders 91, 95 and 96 (pollution prevention) reduces the potential impact of marine wastewater discharges on water quality.	Controls based on legislative requirements – must be adopted.	Yes **C 6.1**
Good Practice				
Chemical Selection and Assessment Environment Guideline • Where Gold/Silver/E/D OCNS rating (and no OCNS substitution or product warning), chemicals are selected – no further control required; and • If chemicals with a different OCNS rating, sub warning or non-OCNS rated chemicals are required chemicals will be assessed in accordance with the guideline prior to use.	F: Yes. Woodside routinely implements a chemical selection process based on the OCNS at the GWA facility. CS: Minimal. The OCNS is widely used throughout the industry and chemical suppliers are aware of the requirements of the scheme.	Selection and assessment of chemicals in accordance with the Woodside process, reduces environmental impacts associated with planned chemical discharge.	The Woodside's chemical selection process is used to ensure chemicals are selected with the lowest practicable environmental risks while still providing the required technical capability.	Yes **C 4.1**
Putrescible waste from GWA facility is macerated prior to overboard discharge to increase dispersion thus reducing impact of discharge on water quality.	F: Yes CS: Minimal cost. Standard practice.	Treating and macerating putrescible waste is standard industry practice, ensuring the substance disperses in the receiving environment with minimal effects to water quality.	Benefits outweigh cost sacrifice.	Yes **C 6.2**

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Sewage from GWA facility is macerated prior to overboard discharge to increase dispersion thus reducing impact of discharge on water quality.	F: Yes CS: Minimal cost. Standard practice.	Treating and macerating sewage is standard industry practice, ensuring the substance disperses in the receiving environment with minimal effects to water quality.	Benefits outweigh cost sacrifice.	Yes **C 6.3**
Electrochlorination system used for seawater systems to control marine growth.	F: Yes CS: Minimal cost. Standard practice. Eliminates chemical handling	Electrochlorination as a means of controlling biofouling is a widely used technique. It is used by marine vessels, drilling platforms and production facilities around the world as it provides a cost effective treatment system that does not require the use of large volumes of chemicals	Benefits outweigh cost sacrifice.	Yes **C 6.4**
Professional Judgement – Eliminate				
GWA and vessel decks re-designed to capture and treat all drainage.	F: No. Discharge from deck drainage is produced from rainfall events and is unavoidable. CS: Eliminating the discharge by collecting all contaminated run-off and storing it is not practicable due to the size/weight and complexity of the facilities required on the platform and vessels. Transporting waste to shore is not a practicable option due to increased financial, logistical, and HES risks and impacts.	Not considered – control not feasible.	Not considered – control not feasible.	No

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Storage, transport and treatment / disposal onshore of sewage, greywater, putrescible and bilge wastes.	F: No. Long term transport of waste onshore would present additional safety and hygiene hazards resulting from the storage, loading and transport of the waste material CS: Not considered – control not feasible	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Substitute				
Long term transport of potable water from shore for GWA facility and vessels.	F: Yes. Potable water can be sources form onshore water supplies. CS: Significant. The long term costs and operational complexity associated with potable water bunkering outweigh cost and negligible environmental footprint associated with offshore RO supply.	The potential environmental impact is ranked as having negligible effect; Eliminating RO brine the discharge would provide negligible environmental gain.	When considering the negligible impact from the discharge of RO brine reliance on bunkering of potable water and incremental support vessel activities is disproportionate to the environmental impact.	No
Professional Judgement – Engineered Solution				
Replace existing sewage treatment with an integrated STP of type certified by MARPOL Annex IV Sewage [MEPC.159(55)].	F: Yes. CS: Significant. Replacement of the existing sewage treatment system onboard the GWA facility would require design, procurement and installation costs, for little to no decrease in nutrient concentrations released to the environment.	No reduction in impacts due to eutrophication, as nutrient content would be unchanged. Potential for reduced pathogen loading, but given no sensitive receptors (i.e. humans) affected by the discharge, this has no environmental benefit.	Given the considerable costs involved in replacing the existing STP, along with the negligible reduction in environmental impact, the cost is considered to be grossly disproportionate to the environmental benefit.	No

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Upgrade existing sewage treatment system by retrofitting a disinfection system.	F: Yes. However, disinfection of sewage is intended to reduce pathogenic bacterial loads and hence will have no impact on nutrient concentrations. CS: Significant. Installation of a disinfection system would incur design, procurement, installation and ongoing operational costs. Additional chemicals may also be required, introducing an additional source of environmental risk.	Minor reduction in impacts due to treatment of sewage, given offshore environment and high natural mixing which would occur.	Given the installation of a disinfection system does not reduce the environmental impact of sewage discharge, along with the potential for additional chemical use, the cost is considered to be grossly disproportionate to the environmental benefit.	No
Facility open hazardous drain system integrity maintained, and open hazardous and closed drain caisson sump pumps available to support hydrocarbon recovery.	F: Yes CS: Minimal cost. Standard practice.	The open hazardous drain system will be maintained to support appropriate disposal of environmentally hazardous liquids.	Benefits outweigh cost sacrifice.	Yes **C 6.5**
Maintain level instrumentation to monitor and support hydrocarbon level management in Open Hazardous and Closed Drain Caissons to reduce likelihood of hydrocarbon entrainment/ underflow from caisson to the environment.	F: Yes CS: Minimal cost. Standard practice.	Caisson level instrumentation ensures functional operational monitoring, to ensure hydrocarbon level is within expected ranges, and excursion alarms annunciate to alert operations as required.	Benefits outweigh cost sacrifice.	Yes **C 6.6**

ALARP Statement:

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of discharge of sewage, putrescible waste, greywater, bilge water, drain water, cooling water and brine. 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.

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Demonstration of Acceptability
Acceptability Statement: The impact assessment has determined that, given the adopted controls, impacts from the discharge of sewage, putrescible waste, greywater, bilge water, drain water, cooling water and brine represent localised short-term impacts, that together are unlikely to result in a potential impact greater than slight, short-term contamination above background levels outside a localised mixing zone. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice and meet legislative requirements under Marine Orders 91, 95 and 96. 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.

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 6 Limit adverse water quality impacts to Slight (E) from routine and non-routine wastewater discharges during the Petroleum Activities Program.	**C 6.1** Contract vessels compliant with Marine Orders for safe vessel operations: • Marine Orders 91 (Oil) • Marine Orders 95 (Pollution prevention – Garbage) • Marine Orders 96 – (Pollution prevention – sewage).	**PS 6.1** Vessels contracted whose practices comply with Marine Orders as applicable to vessel size, type and class.	**MC 6.1.1** Marine verification records demonstrate compliance with standard maritime safety procedures (Marine Orders 91, 95 and 96).
	Refer to **C 4.1**	Refer to **PS 4.1**	Refer to **MC 4.1.1**
	C 6.2 Putrescible waste from GWA facility macerated prior to overboard discharge.	**PS 6.2** All putrescible wastes discharged to sea when macerated (specified to < 25 mm size).	**MC 6.2.1** Putrescible and sewage system maintenance records.
	C 6.3 Sewage system macerator maintained.	**PS 6.3** Sewage system macerator maintained as far as practicable.	
	C 6.4 Electrochlorination system used for seawater systems to control marine growth.	**PS 6.4** Seawater electrochlorination system electrical currents set in accordance with required operating modes upon system start-ups.	**MC 6.4.1** Documented procedures to establish electrochlorination system electrical output currents.
	C 6.5 Facility open hazardous drain system integrity maintained, and open hazardous and closed drain caisson sump pumps available to support hydrocarbon recovery.	**PS 6.5** Integrity will be managed in accordance with SCE Management Procedure (Section 6.1.5.2) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F22 – Open Hazardous Drains to: – prevent escalation of an incident following loss of containment, fire and/or explosion by removing or containing flammable liquid from hazardous areas; – support appropriate containment and disposal of environmentally hazardous liquids to avoid damage to the environment; and	Refer to **MC 17.1**

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EPOs, EPSs and MC			
		– closed drain and open hazardous drain caisson pumps available to support hydrocarbon recovery.	
	C 6.6 Maintain level instrumentation to monitor and support hydrocarbon level management in Open Hazardous and Closed Drain Caissons.	**PS 6.6** Instrumentation integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P31 - Environmental Emissions Monitoring and Controls to: – provide means of detection of environmental releases, emissions and discharges to prevent MEEs from manifesting over time, and/or as required to assure compliance monitoring and reporting equipment.	Refer to **MC 1.6.1**

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6.6.7 Routine and Non-Routine Atmospheric Emissions: Fuel Combustion, Flaring and Fugitives

Context		
Utility Systems – **Section 3.6.5** Operational Flaring **– Section 3.6.2.2** Routine and non-routine atmospheric emissions – **Section 3.6.9** Vessels – **Section 3.7**	Physical Environment – **Section 4.4**	Stakeholder Consultation – **Section 5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Emissions generated from the GWA facility gas turbines, operational flaring and fugitive sources. Emissions generated by support vessels				✓				A	F	-	-	LCS GP, PJ	Broadly Acceptable	**EPO 7**
GWA emissions associated with onshore processing, third party transportation, regassification and combustion by end users				✓				B	F	-	-	LCS GP, PJ RBA CV SV	Acceptable if ALARP	**EPO 8**

Description of Source of Impact

Atmospheric emissions attributed to GWA operations, as assessed in this EP, can be classified into two categories:

- Atmospheric pollutants (non-greenhouse gas emissions) are gases or particles produced from the facility and support vessel, within the Operational Area, which are discharged to the atmosphere and pose a recognised level of adverse effect on flora, fauna and/or human health.
- GHG emissions refer to gases that trap heat within the atmosphere through the adsorption of longwave radiation reflected from the earth's surface. This includes both direct and indirect GHG emissions (**Table 3-4**).

In this section greenhouse gases are estimated using the National Greenhouse and Energy Reporting (NGER) Measurement Determination 2008 (as amended including 100-year Global Warming Potential).

<u>Direct Atmospheric and GHG emissions</u>

Direct atmospheric emissions generated from the GWA facility during the Petroleum Activities Program include gas turbines (that can also run on diesel), flares, fugitives and process vents. Direct emissions and combustion products include CO_2, water vapour, NO_x, SO_2, methane, particulates, Volatile Organic Compounds (VOCs).

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Fuel Emissions: Gas / Diesel Turbines

On the GWA facility both fuel gas and diesel are used for operations. Fuel gas consumption for export compression and power generation are the largest sources of combustion emissions from the GWA facility. Diesel is used for firewater pumps, emergency generators, cranes, back-up fuel for the turbine generators and for restart after planned or unplanned shutdowns. In 2019/20, 50,457 tonnes of fuel gas was used on the GWA facility, the combustion of which equated to the emission of 116,380 tonnes of CO_2 equivalents. Diesel usage on the facility (excluding support vessels) in 2019/20 was 473 tonnes, the combustion of which equated to the emission of 1,506 tonnes of CO_2 equivalents (**Table 6-5**). Fuel gas and diesel use is not expected to significantly increase over the period in which this EP is in force; however production may gradually decline, following GWF-3 initial production, resulting in an increase in emissions intensity.

National Pollutant Inventory Emission Estimation Techniques were applied to determine annual atmospheric (NO_x. SO_x and CO) from fuel combustion on the GWA facility (**Table 6-5**). The greenhouse gases, CO_2, CH_4, N_2O and CO_2e, were estimated using the National Greenhouse and Energy Reporting (NGER) Measurement Determination 2008 (as amended). These are derived from the National Greenhouse Accounts Factors (NGAF).

Table 6-5: Estimated annual atmospheric and greenhouse gas emissions from fuel combustion at the GWA facility (based on FY2019/20)

Emission Type	Estimated annual emissions from fuel gas combustion (tonnes) [1]	Estimated annual emissions from diesel combustion (tonnes) [2]	Estimated total annual emissions from fuel combustion
CO_2	116,087	1,499	117,586
CH_4	8.52	0.08	8.60
N_2O	0.24	0.02	0.26
Total CO_2e	*116,380*	*1,506*	*117,886*
NO_x	465	29	494
SO_x	1	Trace	1
CO	119	8	127

[1]Based on combustion of 50,457 tonnes of fuel gas during 2019/20
[2]Based on combustion of 473 tonnes of diesel during 2019/20

Flaring

The release of hydrocarbon gas to atmosphere by flaring is an essential practice, primarily for safety requirements. Emissions and combustion products from flaring, includes CO_2, NO_x, SO_2, methane, particulates, and Volatile Organic Compounds (VOCs). Incomplete combustion under certain scenarios may also generate dark smoke.

Operational flaring is comprised of two elements:

- normal operational flaring associated with flare system purge and pilot, process flows and glycol regeneration
- non-routine flaring that may result from activities such as planned shutdowns and ESD testing, and un-planned shutdowns and ESDs, production restarts, equipment outage/failures, subsea flowline depressurisation and well remediation activities.

During flaring, the burnt gas generates mainly water vapour and CO_2. It is estimated that approximately 21,450 total tonnes of gas is flared per year (including water vapour, inert gas and hydrocarbon gas), varying with production rates, non-routine activities, outages and shutdowns. Annual atmospheric emissions from estimated flaring are provided in Table 6-6.

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Table 6-6: Estimated annual atmospheric and greenhouse gas emissions from flaring at GWA

Component	Estimated flaring emissions (tonnes)
Qty	21,450
CO_2	57,915
CH_4	80.9
N_2O	2.3
Total CO_2e	*60,704*
NO_x	20.5
SO_x	Trace
CO	119

Non-routine venting of process hydrocarbons via Flare System

During normal operations, hydrocarbon gas is flared via the HP and LP flare systems. These systems are maintained to effectively combust hydrocarbons as a critical component for the safe operation of the GWA facility. In the unlikely event that the flares are extinguished or unavailable (such as following a major shutdown prior to system ramp-up), the hydrocarbon gas discharged via the flare system may initially not be combusted during the period required to purge the flare system and re-establish flare ignition. This may result in the short term (typically less than 24 hours), low-rate release of hydrocarbon gas to the atmosphere. Intermittent venting from the GWA facility represents a minor source of atmospheric emissions and is not considered to pose a risk beyond the routine air emissions described in this section.

Fugitive Emissions

Fugitive emissions can occur from pressurised equipment, and are inherent in design, required for infrequent operational activities, or can be caused by unintentional equipment leaks. Sources can include from valves, flanges, pump seals, compressor seals, relief valves, vents, sampling connections, process drains, open-ended lines, casing, tanks and other potential leakage sources from pressurised equipment. Fugitive emissions are, by their nature, difficult to quantify and the normal approach, as accepted by the NGER scheme, is to indirectly estimate amount of emissions based on product throughput.

As much of the safe operation of the GWA facility relies on the effective containment of hydrocarbons, the volumes of routine and non-routine fugitive emissions are considered to be small (Refer to **Section 6.7** and **6.8** for potential atmospheric unplanned hydrocarbon releases associated with accidents, incidents and emergency situations). National Greenhouse Accounts Factors[15] are used to estimate greenhouse gas emissions by facilities in Australia, including from fugitive emissions. Using these estimation techniques, GWA reported 61 tonnes of gas lost through fugitive emissions in FY2019/2020. This equates to approximately 1,708 tonnes of CO_2 equivalents as methane (CH_4).

Discrete relatively small volumes of packed gases and charged systems including refrigerant gases are used across the GWA facility and vessels which have potential for small volume leaks (typically less than 100 kg per isolatable inventory). Refrigerants used on the facility are ozone depleting substance free, synthetic greenhouse gases and managed by licenced refrigeration technicians. The GWA facility is fitted with a gaseous fire extinguishing system utilising CO_2 and FM200. FM200 has zero ozone depleting potential and a low global warming potential. The gaseous fire extinguishing agents are only released as demanded by the applicable safety system or as per certification testing requirements.

Emissions Intensity from GWA facility

Emissions intensity is a measure of GHG emissions per unit of production. Emissions intensity is usually inversely proportional to production, as the process (e.g. export gas compression, electrical generation, seawater lift pumps for cooling, dehydration, heating energy) required to produce hydrocarbons, and the associated energy demand, is relatively constant. On the GWA facility, the largest single energy consumer is the export gas compressor on Train 200, with no compressor on Train 100. As reservoir production declines energy intensity will increase, as systems are operated at partial capacity.

To provide a benchmark of the GWA facility emissions intensity data from a five-year period (2016 to 2021) was reviewed. It’s inappropriate to compare emissions intensity of the GWA facility (two production trains, 50% compression) with that of NRC (three production trains, 100% compression and supplies power to the Angel facility) or Pluto Alpha (no compression or water handling). Emissions intensity of the GWA facility has followed a downward trend (**Figure 6-3**). Most notably emissions intensity improved (decreased) following start up of GWF-2 tieback in November 2018 with a further reduction following the start-up of BESS and implementation of several other emissions reduction scopes (**Table 6-7**) in August 2019 (**Figure 6-3**). Shutdown activities commonly represents an increase in intensity (e.g. September 2020), along with peak

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emissions intensity associated with prolonged restart activities with limited production. Steady, reliable production represents periods of lowest intensity. Further opportunities to improve emissions intensity are being assessed as part of the Production Optimisation and Opportunity Management Procedure (**Section 7.1.3.6**), aiming to offset inefficiencies associated with reservoir decline.

Table 6-7 Emissions reduction activities implemented at GWA since 2016 and currently under assessment

Activity	Estimated emissions benefit (kT CO2e/pa)	Delivered
T200 condensate stripper cessation	5	Q2 2016
BESS	9.2	Q3 2019
RB211 air inlet filters	1.2	Q3 2019
Export Compressor Rewheel	No net reduction, reduced intensity	Q3 2019
Flare purge reduction	3	Q3 2020
Turn off T100 stripping gas compressor	est. 10	Assess
T100 reduced operating pressure	No net reduction, reduces intensity	Assess
Load shedding upgrade	tbc	Assess

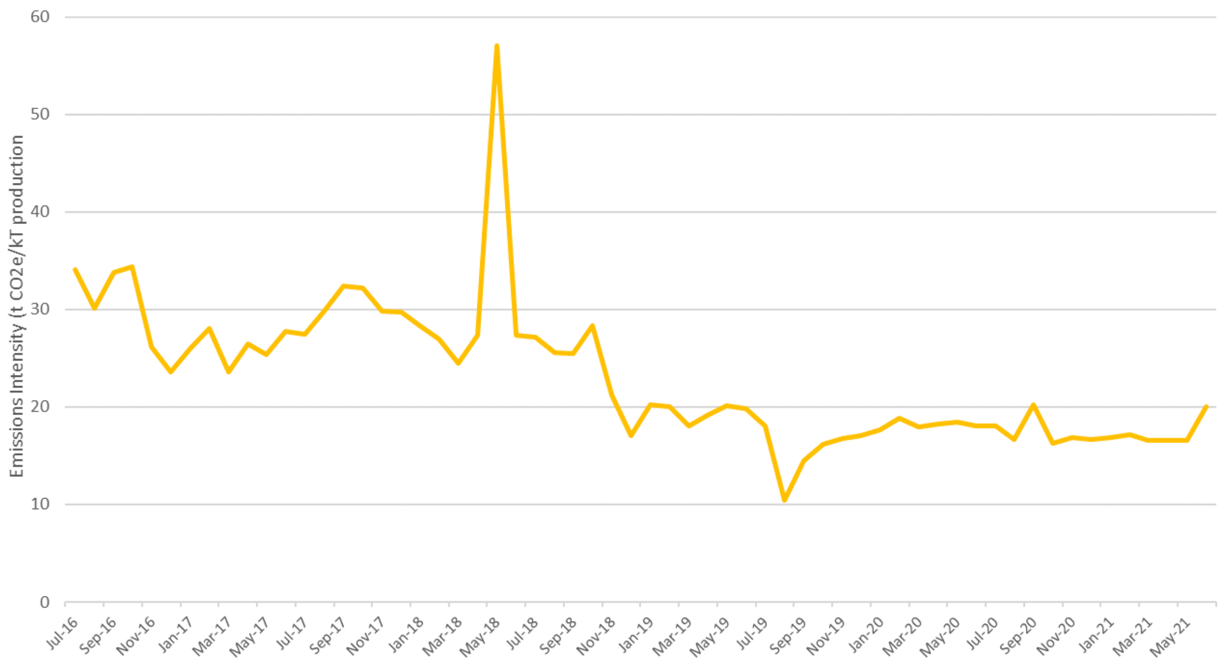

Figure 6-3: Emissions intensity from the GWA facility July 2016 – June 2021

Indirect Emissions

GHG and Atmospheric Emissions from Support Vessels

Support vessels currently use either low sulphur marine diesel or LNG, or a combination of both. Atmospheric and GHG emissions from support vessels vary depending on the nature of activities being undertaken; for example, travelling or "steaming" to a destination at low speed uses less fuel and generates lower atmospheric and GHG emissions than high speed steaming. Emissions generated during safety related vessel standby activities, holding station using DP during loading and unloading of materials to the facility or undertaking subsea IMR work also vary. Vessel Masters control day to day operations that determine support vessel emissions. Woodside has the potential to influence fleet level approach to support vessel emissions through contracting activities.

Greenhouse Gas Emission from other Sources

Indirect emissions attributed to GWA result from hydrocarbon processing (onshore), third party transport of products, regassification, distribution and combustion by end users. Indirect GHG emissions attributed to GWA operations were

[15] https://www.industry.gov.au/data-and-publications/national-greenhouse-accounts-factors

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estimated using relevant emissions intensity methods (**Table 6-8**). Key influences impacting indirect greenhouse gas emissions from GWA include:

- Total production – indirect emissions are proportional to total production, which varies with shutdown activity, new field tiebacks or gradual reservoir decline.
- Split of saleable products from KGP – the proportion of hydrocarbons from GWA sold as LNG, condensate, domestic gas and LPG varies. Each product requires differing amounts of energy to process to the point of sale and varies based on reservoir composition and commercial reasons.

Based on the production rates in 2019/20, the indirect emissions from GWA, including those apportioned at KGP, from transport and customer combustion, are estimated to be approximately 27.6 $MtCO_2e$ per annum.

Table 6-8: Indirect Greenhouse Gas Emissions attributable to the GWA production

Source of Impact	Annual estimated emissions ($MtCO_2e$)
Onshore hydrocarbon processing	2.5[1]
Third party transport of products, regassification, distribution and end use	25.1[2]

[1] source: NWS NGER report FY2019/20 and KGP emissions intensity apportionment calculation
[2] source: EcoInvent 3.5 database and *National Greenhouse and Energy Reporting (Measurement) Determination 2008.* EcoInvent v3.5 represents a large collection of inventory data. It has been recognised as emission factor source for the European Union Renewable Energy Direction greenhouse gas methodology and is aligned to the principles of the NGERs methodology.

Climate change is caused by the concentration of GHG emissions in the global atmosphere. It is important to acknowledge that climate change impacts cannot be directly attributed to any one project, as they are instead the result of GHG emissions, minus GHG sinks, that have accumulated in the atmosphere since the industrial revolution started. This means there is no direct link between GHG emissions from GWA and climate change impacts. The more relevant consideration is the contribution that a project makes to net emissions, as it is the overall global atmospheric concentration of emissions that causes climate change.

Consumption of GWA gas is expected to displace higher carbon intensive energy sources. If the use of GWA gas displaces energy from more emissions-intensive fuels, then there will be a commensurate net reduction in global GHG emissions. The accumulation of GHG emissions in the atmosphere is, in turn, influenced by global energy demand and the composition of the global energy mix. It is, therefore, relevant to understand that the crucial role that natural gas can play in supporting the transition to lower-carbon energy is expected to underpin strong demand for natural gas in the decades ahead.

Impact Assessment

Air Quality

Facility and vessel routine and non-routine emissions, predominantly routine fuel combustion and flaring have the potential to generate dark smoke and particulates resulting in a localised and temporary reduction in air quality and generation of dark smoke and ozone. Potential impacts of emissions depend on the nature of the emissions, as well as the location and nature of the receiving environment.

Platform design, including the rapidly dispersive characteristics of the gas turbine exhausts, flare and other emissions; the estimated level of pollutants in the emissions; and the absence of elevated background ambient levels, have been considered in estimating the potential for interaction with human and environmental sensitivities. The GWA facility and Operational Area is in a remote offshore location, with no expected adverse interaction with populated areas or sensitive environmental receptors associated with air emissions.

There is a breeding BIA for the wedge-tailed shearwater overlapping the Operational Area; as such, wedge-tailed shearwaters may occur nearby to the facility airshed (BIA does not directly overlap facility). The nearest potential seabird roosting habitat, the Montebello Islands, lies approximately 53 km south of the Operational Area at the closest point. Given, the low numbers of transient individuals expected to potentially occur within the Operational Area, combined with the highly dispersed nature of GWA air emissions; no adverse impacts to wedge-tailed shearwaters are anticipated due to changes in air quality.

Potential impacts are expected to be short-term, localised air quality changes, limited to the airshed local to the platform. Air emission impacts are not expected to have direct or cumulative impacts on sensitive environmental receptors, or above National Environmental Protection (Ambient Air Quality) measures. Additionally, air quality around the GWA platform is maintained to provide a safe working environment for operational staff.

The flare and potential dark smoke resulting from emissions may impact visual amenity. The offshore location of the Petroleum Activities Program is not directly visible from the nearest landfall (Montebello Islands, 53 km south of the Operational Area at the closest point). Hence, no impacts to visual amenity for residential communities are expected. Visual amenity impairment to tourism activities are similarly not expected.

Greenhouse Gas Emissions

GHG emissions attributed to the offshore facility, vessel operations, onshore processing of GWA gas, third-party transport, regassification, distribution and combustion by the end user contribute to global concentrations of GHG emissions. This impact assessment considers the contribution of emissions attributed to GWA to global emissions and the potential impacts

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of climate change on sensitive receptors, including matters of national environmental significance within Australian jurisdictions. It is important to acknowledge that climate change impacts cannot be directly attributed to any one activity, as they are instead the result of global GHG emissions, minus global GHG sinks, that have accumulated in the atmosphere since the industrial revolution started.

It is not possible to link GHG emissions from GWA with climate change or any particular climate related impact given:

- It is the net global GHG concentrations that cause climate change and climate related impacts
- Estimated scope 1 and scope 3 emissions associated with GWA are negligible in the context of existing and future predicted global concentrations
- The inability to precisely predict the amount of total future global GHG emissions:
- The inability to predict future national and international initiatives on climate change and the impact they will have on total future global GHG emissions, including GWA emissions

GWA gas production, processing, transporting and consumption results in generation of GHG emissions, however these emissions currently displace emissions from other sources. The IEA's Sustainable Development Scenario, which is aligned with a "well below 2°C" goal, includes continuation of existing gas supplies (IEA, 2021) such as GWA.

Ecosystems that are particularly susceptible to adverse effects of climate change include alpine habitats, coral reefs, wetlands and coastal ecosystems, polar communities, tropical forests, temperate forests and arid and semi-arid environments (DoEE, 2019). In Australia, this includes coral reefs, alpine regions, rainforests, arid and semi-arid environments, mangroves, grasslands, temperate forests and sclerophyll forests. Future climate change (increased temperature and decreased, but more variable, rainfall) has the potential to have a range of impacts on ecological factors and threaten biodiversity in the Australian Mediterranean ecosystem (CSIRO, 2017).

Ecological Impacts

Redistribution and reorganisation of natural of natural systems, driven by climate-change, is a major threat to biodiversity (Chapman et al., 2020). A report by Australia's Biodiversity and Climate Change Advisory Group summarises the potential impacts of climate change to marine and terrestrial species, habitats and ecosystems across Australia (Steffen et al., 2009). The impacts to taxa are outlined in **Table 6-9** and the impacts to ecosystems in Table 6-10.

Extensive modelling and monitoring studies over the last twenty years provide considerable evidence that global climate change is already affecting and will continue to affect species (Hoegh-Guldberg et al., 2018) however these impacts are likely to be highly species-dependent and spatially variable. The most frequently observed and cited ecological responses to climate-change include species distributions shifting towards the poles, upwards in elevation and shifts in phenology (earlier and later autumn life history events) (Dunlop et al., 2012). Climate change may not only change species distribution patterns but also life-history traits such as migration patterns, reproductive seasonality and sex-ratios (**Table 6-9**).

Table 6-9: Overview of impacts of climate change to the future vulnerability of particular taxa (modified after Steffen et al 2009)

Taxa	Potential vulnerability
Mammals	Narrow-ranged endemics susceptible to rapid climate change *in-situ* (Williams et al., 2003); changes in competition between grazing macropods in tropical savannas mediated by changes in fire regimes and water availability (Ritchie and Bolitho, 2008); herbivores affected by decreasing nutritional quality of foliage as a result of CO_2 fertilisation.
Birds	Changes in phenology of migration and egg-laying; increased competition of resident species; breeding of waterbirds susceptible to reduction; top predators vulnerable to changes in food supply; rising sea levels affecting birds that nest on sandy and muddy shores, saltmarshes, intertidal zones, coastal wetlands and low-lying islands; saltwater intrusion into freshwater wetlands affecting breeding habitat.
Reptiles	Warming temperatures may alter sex ratios of species with environmental sex determination to cope with warming *in-situ*.
Amphibians	Frogs may be the most at-risk terrestrial taxa. Amphibians may experience altered interactions between; pathogens, predators and fires.
Fish	Freshwater species vulnerable to reduction in water flows and water quality; limited capacity for freshwater species to migrate to new waterways; all species susceptible to flow-on effects of warming on the phytoplankton base of food webs.
Invertebrates	Expected to be more responsive than vertebrates due to short generation times, high reproduction rates and sensitivity to climatic variables.
Plants	Climate change may impact various functional dynamics of plants due to changes in; increasing CO_2, fires, plant phenology and specific environmental characteristics.

Impacts of climate change such as altering temperature, rainfall patterns and fire regimes, are likely to lead to changes in vegetation structure across all terrestrial ecosystems within Australia (**Table 6-10**; Dunlop et al., 2012). Increases in fire regimes will impact Australian ecosystems altering composition structure, habitat heterogeneity and ecosystem processes.

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Changes in climate variability, as well as averages, could also be important drivers of altered species interactions, both native and invasive species (Dunlop et al., 2012). Climate change could result in significant ecosystem shifts, as well as alterations to species ranges and abundances within those ecosystems (Hoegh-Guldberg et al., 2018).

Table 6-10: Projected impacts of CO_2 rise and climate change on Australian ecosystems (modified after Steffen et al 2009)

Key component of environmental change	Projected impacts on ecosystems
Coral reefs	
CO_2 increases leading to increased ocean acidity	Reduction in ability of calcifying organisms, such as corals, to build and maintain skeletons.
Sea surface temperature increases, leading to coral bleaching	If frequency of bleaching events exceeds recovery time, reefs will be maintained in an early successional state or be replaced by communities dominated by macroalgae.
Oceanic systems (including planktonic systems, fisheries, sea mounts and offshore islands)	
Ocean warming	Many marine organisms are highly sensitive to small changes in average temperature (1 2 degrees), leading to effects on growth rates, survival, dispersal, reproduction and susceptibility to disease.
Changed circulation patterns, including increase in temperature stratification and decrease in mixing depth, and strengthening of East Australian Current	Distribution and productivity of marine ecosystems is heavily influenced by the timing an location of ocean currents; currents transfer the reproductive phase of many organisms. Climate change may suppress upwelling in some areas and increase it in others, leadin to shifts in location and extent of productivity zones.
Changes in ocean chemistry	Increasing CO_2 in the atmosphere is leading to increased ocean acidity and a concomitant decrease in the availability of carbonate ions.
Estuaries and coastal fringe (including benthic, mangrove, saltmarsh, rocky shore, and seagrass communities)	
Sea level rise	Landward movement of some species as inundation provides suitable habitat, changes upstream freshwater habitats will have flow-on effects to species.
Increase in water temperature	Impacts on phytoplankton production will affect secondary production in benthic communities.
Savannas and grasslands	
Elevated CO_2	Shifts in competitive relationships between woody and grass species due to differential responses.
Increased rainfall in north and northwest region	Increased plant growth will lead to higher fuel loads, in turn leading to fires that are more intense, frequent and occur over large areas.
Tropical rainforests	
Warming and changes in rainfall patterns	Increased probability of fires penetrating into rainforest vegetation resulting in shift from fire-sensitive vegetation to communities dominated by fire-tolerant species.
Change in length of dry season	Altered patterns of flowering, fruiting and leaf flush will affect resources for animals.
Rising atmospheric CO_2	Differential response of different growth forms to enhanced CO_2 may alter structure of vegetation.
Temperate forests	
Potential increases in frequency and intensity of fires	Changes in structure and species composition of communities with obligate seeders may be disadvantaged compared with vegetative resprouters.
Warming and changes in rainfall patterns	Potential increases in productivity in areas where rainfall is not limiting; reduced forest cover associated with soil drying projected for some Australian forests.
Inland waterways and wetlands	
Reductions in precipitation, increased frequency and intensity of drought	Reduced river flows and changes in seasonality of flows.

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Changes in water quality, including changes in nutrient flows, sediment, oxygen and CO_2 concentration	May affect eutrophication levels, incidence of blue-green algal outbreaks.
Sea level rise	Saltwater intrusion into low-lying floodplains, freshwater swamps and groundwater; replacement of existing riparian vegetation by mangroves.
Arid and semi-arid regions	
Increasing CO_2 coupled with drying in some regions	Interaction between CO_2 and water supply critical, as 90% of the variance in primary production can be accounted for by annual precipitation.
Shifts in seasonality or intensity of rainfall events	Any enhanced runoff redistribution will intensify vegetation patterning and erosion cell mosaic structure in degraded areas. Changes in rainfall variability and amount will also impacts on fire frequency. Dryland salinity could be affected by changes in the timing and intensity of rainfall.
Warming and drying, leading to increased frequency and intensity of fires	Reduction in patches of fire-sensitive mulga in spinifex grasslands potentially leading to landscape-wide dominance of spinifex.
Alpine/montane areas	
Reduction in snow cover depth and duration	Potential loss of species dependent on adequate snow cover for hibernation and protection from predators; increased establishment of plant species at higher elevations as snowpack is reduced.

The IPCC Special Report describes impacts of warming above pre-industrial levels to key receptor groups including terrestrial ecosystems, mangroves, warm-water corals, unique and threatened systems, and arctic regions (Hoegh-Guldberg et. al. 2018). These receptor groups show varying sensitivity to warming conditions, with a range of responses shown at 1 ºC warming; from corals suffering moderate impacts, to mangroves not showing any impacts that are detectable and attributable to climate change (Hoegh-Guldberg et al., 2018). Once warming reaches 1.5 ºC, all receptor groups show impacts attributable to climate change with severity ranging from moderate impacts that are detectable and attributable to climate change (mangroves), to impacts that are severe and widespread (warm-water corals) (Hoegh-Guldberg et al., 2018). At the point where global temperature rise, due to climate change, reaches 2°C, increasing numbers of receptor groups suffer impacts which are high to very high, and likely to be irreversible (terrestrial ecosystems, warm-water corals, unique and threatened systems, and arctic regions) (Hoegh-Guldberg et al., 2018). Some key impacts are discussed further in sections to follow.

<u>Terrestrial Ecosystems</u>

All terrestrial ecosystems are likely to be impacted by a changing climate (**Table 6-10**; Steffen et al 2009; Hughes 2010; Dunlop et al. 2012; Hoegh-Guldberg et. al., 2018). The predicted impact of climate change on these ecosystems is highly variable, both between ecosystems and within individual ecosystems (Dunlop et al., 2012). Below is a summary of impacts to key terrestrial ecosystems.

Tropical Rainforests

Projections of future climate changes in the wet tropics of Australia under different scenarios are outlined by McInnes (2015). It is likely that temperatures in the wet tropics will become hotter and potentially fires and cyclones will be more intense. Consequently, there is an increased probability of fires penetrating into rainforest vegetation resulting in a shift from fire-sensitive vegetation to communities dominated by fire-tolerant species; and changing rainforest disturbance regime as cyclones become more intense) (Hughes, 2011; Steffen et al., 2009). Changes in the timing of seasons (e.g. extended summer) could cause change in the seasonal response of plants, and alterations to species ranges and abundances (Hoegh-Guldberg et al., 2018).

Alpine/ Montane Areas

Alpine systems are generally considered to be among the most vulnerable to future climate change (Hughes 2003). The extent of true alpine habitat in Australia is very small (0.15% of the Australian land surface) with limited high-altitude refuge (Hughes, 2003).

Australian alpine regions are home to a variety of alpine vertebrates who rely on snow cover for their survival. There is evidence of a reduction in populations of dusky antechinus, broad-toothed rats and the mountain pygmy possum. The first two species are active under the snow throughout winter and are therefore subject to increased predation by foxes when snow is reduced (Hughes, 2003). The pygmy possum depends upon snow cover for stable, low temperatures during hibernation (Hughes, 2003).

<u>Marine Ecosystems</u>

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Sea surface temperatures have increased across the globe over recent decades which poses a significant threat to marine ecosystems including changes to species abundance, community structure and increased frequency and intensity of thermally induced coral bleaching events (CSIRO, 2017).

Between 1920 and 2000, sea level is estimated to have risen on average by 1.2 mm per year due to climate change (Church et al., 2006). In addition to changes in sea level, oceanic warming has also served to alter ocean currents around Australia. In response to both ocean warming and stratospheric ozone depletion the East Australian Current has increased in strength by about twenty percent since 1978 (Cai and Cowan, 2006).

Sea-surface temperatures are projected to continue to increase, with estimates of warming in the Southern Tasman Sea of between 0.6 to 0.9°C and between 0.3 to 0.6°C elsewhere along the Australian coast by 2030 (Church et al., 2006). Sea levels will increase by 18 to 59 cm by 2100 in response to both thermal expansion and melting of ice-sheets (Solomon et al., 2007). This will lead to some coastal inundation affecting mangroves, salt marshes and coastal freshwater wetlands. Furthermore, as CO_2 is gradually absorbed by oceans and fresh water, the water becomes more acidic, which increases the solubility of calcium carbonate, the principal component of the skeletal material in aquatic organisms (Steffen et al., 2009). Below is a summary of potential climate change impacts to two key ecosystems - mangroves and coral reefs.

Mangroves

Mangrove ecosystems in Australia will face higher temperatures, increased evaporation rates and warmer oceans (McInnes, 2015) as well as an associated sea-level rise (Hoegh-Guldberg et al., 2018). Modelling indicates an increased likelihood of future severe and extended droughts across parts of Northern Australia (Dai, 2013). Consequently, mangrove ecosystems may increase their southern range as a result of warmer temperatures. However, higher temperatures and evaporation rates, and extended droughts could lead to die-offs in northern Australia and a change in mangrove distribution and abundance (Duke et al., 2017). Mangrove systems should cope with rising sea-level by accumulating more peat or mud which will give them the opportunity to adjust to a rising sea level (Field, 1995).

Coral Reefs

Climate change has emerged as a threat to coral reefs, with temperatures of just 1°C above the long-term summer maximum for an area over 4–6 weeks being enough to cause mass coral bleaching and mortality (Baker et al., 2008; Hoegh-Guldberg, 1999; Hughes et al., 2017; Spalding and Brown, 2015). Coral mortality or die off following coral bleaching events can stretch across thousands of square kilometres of ocean (Gilmour et al., 2016; Hoegh-Guldberg, 1999; Hughes et al., 2017). The impacts associated with a warming ocean, coupled with increasing acidification, are expected to undermine the ability of tropical coral reefs to provide habitat for fish and invertebrates, which together provide a range of ecosystem services (e.g., food, livelihoods, coastal protection) (Hoegh-Guldberg et al., 2018).

Social impacts:

Changes to climate can result in impact to social receptors that have values which include the ecological receptors (discussed above). This includes KEFs and AMPs. Climate change also impacts on the functions, interests or activities of other users which rely on ecological value, including commercial and recreational fisheries and tourism.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[16]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
Vessels operations compliant with Marine Order 97 (Marine Pollution Prevention – Air Pollution). To reduce atmospheric emissions associated with vessel operations.	F: Yes CS: Minimal cost. Standard Practice.	Marine Order 97 is required under Australian regulations; implementation is standard practice for commercial vessels as applicable to vessel size, type and class.	Control based on legislative requirements – must be adopted.	Yes **C 7.1**
National Greenhouse and Energy Reporting Scheme	F: Yes CS: Minimal cost. Standard Practice.	Control based on legislative requirements to provide the national	Control based on legislative	Yes **C 7.2**

[16] *Qualitative measure*

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[16]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
and National Pollutant Inventory (NPI) reporting – estimation of greenhouse gas, energy and criteria pollutants.		reporting framework for the reporting and dissemination of information related to emissions, hazardous wastes, greenhouse gas emissions, greenhouse gas projects, energy consumption and energy production to meet the objectives and desired outcomes of the legislation(s) such as: • the maintenance and improvement of air and water quality, minimisation of environmental impacts associated with hazardous wastes; and an improvement in the sustainable use of resources; and • act as the single framework to inform policy, meet reporting requirements, avoid duplication, and to ensure that facility net greenhouse gas emissions are managed within applicable baselines.	requirements – must be adopted.	
Apply for and manage net direct and indirect NWS GHG emissions to within the relevant baseline under the *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*	F: Yes CS: Minimal Cost. Standard Practice.	Control based on legislative requirement utilising the national reporting framework for the reporting of information related to GHG emissions. The Safeguard Mechanism requires Operators to offset carbon emissions in excess of the relevant baseline using Australian Carbon Credit Units (ACCUs).	Control based on legislative requirements – must be adopted.	Yes **C 7.3**
Good Practice				
Forecast, measure, monitor and or estimate facility fuel and flare emissions (in accordance with NGERS/NPI) to inform optimisation management practices and minimise	F: Yes CS: Minimal cost. Standard practice.	Minimises environmental impact of emissions through planning, ongoing review, governance and optimisation. It combines with good operating practice to maximise production, reduce fuel gas use and emissions to manage cost, which	Control is WMS requirement – must be adopted.	Yes **C 7.4**

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[16]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
environmental impact of direct GWA and indirect KGP emissions.		improves energy intensity (e.g. cleaner production), optimising emissions from the NWS. Fuel and flared gas are potential product streams, as such, Woodside applies routine short and long term optimisation and opportunity management framework to identify and prioritise enhancement opportunities which includes improvements through energy efficiency (e.g. BESS), reduced fuel and flare gas usage (e.g. reduced flare purge rates). Annual fuel and flare target setting followed by monthly reporting enables review of performance, investigation of trends and insights to improve overall energy intensity at GWA and for indirect emissions at KGP. Daily production meetings allow for optimisation of NWS as an integrated production system, considering impacts of variables such as maintenance activities and temperature influence on production rates. To support this, fuel intensity, flared gas and energy efficiency is monitored to determine potential for improvement.		
Implement the *Methane Guiding Principles Management Guideline* at GWA	F: Yes CS: Some cost associated with implementation of a new WMS guideline on an offshore facility. Can be managed by proving technology application and process at onshore facilities and sharing learnings.	Methane reduction activities are aligned with environment, social and governance expectations. Reduction of methane fugitives reduces facility GHG emissions with high short term global warming potential and aligns with commitments under Methane Guiding Principles.	Control is a WMS requirement – must be adopted.	**Yes** **C 7.5**

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[16]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Contracting strategy and evaluation for hire of support vessels includes consideration of vessel emissions parameters and low carbon / alternative fuels	F: Yes CS: Fuel cost over the five year contract is considered in evaluation of responses, allowing for competitive consideration of low carbon alternatives (e.g. batteries).	Minimises cost and emissions through eco-efficiency approach recognising cost of fuel and carbon emissions over the contract term	Control effectively allocates a cost to emissions to recognise that higher emitting fuel sources with other lower operating costs do not represent overall best value.	Yes **C 8.1**
Professional Judgement – Eliminate				
Eliminate flaring by venting un-combusted hydrocarbons.	F: No. Routine hydrocarbon venting is not considered good industry practice; as unburnt hydrocarbons pose potential for greater environment impact compared to combustion emissions. The ability to flare hydrocarbons is a key safety feature on the facility. Removing the ability to flare hydrocarbons may result in unacceptable safety risks on the GWA facility. CS: Not assessed, control not feasible.	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Eliminate flaring by reinjecting un-combusted hydrocarbons.	F: No. Hydrocarbon reinjection, as opposed to transport to onshore facilities, would not be consistent with the approved Goodwyn Field Development Plan (FDP) which seeks to optimized hydrocarbon recovery whilst fulfilling North West Shelf gas supply commitments. As such, gas reinjection would not meet concept screening criteria to warrant option evaluation. CS: Not assessed, control not feasible.	Not assessed, control not feasible.	Not assessed, control not feasible.	No

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[16]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Substitute				
Fuel for energy generation on facility is selected for lowest emissions generation where practicable: • Fuel gas used in preference to diesel for power generation. • Battery energy storage system (BESS) operational	F: Yes, fuel gas is the primary fuel source on GWA. BESS provides back up spinning reserve enabling turning off a gas turbine, with associated fuel gas savings. CS: Cost effective.	Diesel substitution reduces CO_2 emissions for a given unit of power, and reduces spill risk associated with fuel bunkering activities. BESS has successfully delivered substitution of one gas turbine reserve supply and associated fuel, air and GHG emissions. BESS provides additional benefit of back up power in case of loss power supply.	Cost effective. Opportunities minimise fuel bunkering transfer risks.	Yes. Solution permanently implemented
Professional Judgement – Engineered Solution				
Maintain flare to maximise efficiency of combustion and minimise venting, incomplete combustion waste products and smoke emissions.	F: Yes. CS: Minimal cost, subject to review: e.g. Production Optimisation and Opportunity Management Procedure delivered reduction in GWA flare purge rate in 2020. Standard practice.	Flare tip integrity and ignition system functionality minimises potential for venting, incomplete combustion waste products and smoke emissions.	Control is WMS requirement – must be adopted.	Yes **C 7.6**
Installation of flare gas recovery systems to reduce emissions entering the atmosphere from flaring.	F: Yes. CS: Significant additional cost associated with the design and installation of flare gas recovery systems, including significant retrofitting of multiple stages of compression systems, coupled with associated ancillaries, valving and piping, platform modification and weight considerations. The safe addition of the required rotating equipment also poses significant production sacrifice, and potential domestic gas supply impacts due to the initial design layout and space safety constraints.	Small to negligible environmental benefit from reducing atmospheric emissions from flaring. The environmental benefit gained from the recovery of flaring emissions would be limited to only a portion of flare system flows due to process safety constraints and flare system operation over a wide design envelope (associated with flow variations). Furthermore, required retrofitting of multiple stages of compression (e.g. for LP/HP streams) would offset any environmental benefits through increased power generation emissions. The retrofitting interaction with the safety critical flare system and continued operation of gas compression would also increase platform safety risks.	Given the increased safety risk and the very low, if any, environmental benefit provided when increased power generation emissions are taken into consideration, the installation of flare gas recovery systems is considered grossly disproportionate to the environmental benefit it would provide.	No
Discussion of ALARP				

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[16]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***

Atmospheric Emissions

On the basis of the environmental risk assessment outcomes and the use of the relevant tools appropriate to decision type A, Woodside considers the adopted controls appropriate to manage the impacts of GWA facility and vessel atmospheric emissions. 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.

GHG Emissions

Risk Based Analysis

Application of Woodside's Risk Management Procedures, implementation of the Emissions and Energy Management Procedure and Production Optimisation, Opportunity Management Procedure and the Methane Guiding Principles Management Guideline reduces GHG emissions risk to ALARP (**Section 7.1.3.6**). This includes a system of continual review and improvement of key emissions sources and fugitive methane from NWS assets as an integrated system, including GWA. GWA emissions reduction activities from implementation of existing procedures have resulted in ongoing energy efficiency benefits and net reductions of over 18 kt CO2e per year (**Table 6-7**).

Societal Values

Consultation was undertaken for this program to identify the views and concerns of relevant stakeholders, as described in Section 5. No specific concerns around air emissions, resulting in changes to air quality and greenhouse gas emissions, were identified through this process.

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 B), Woodside considers the adopted controls appropriate to manage the impacts from GHG emissions from the GWA facility, support vessels and indirect emissions sources that Woodside can practicably influence during the five year term of this EP. The adopted controls meet legislative requirements including:

- Marine order 97 for support vessels
- NGERS and NPI reporting for direct emissions attributed to GWA
- *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*.

Indirect GHG emissions from onshore processing are managed under Ministerial Statement 536. As part of the North West Shelf Project Extension approvals process (currently under assessment) a draft Greenhouse Gas Management Plan has been submitted to the EPA that includes an emissions limit.

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: Atmospheric Emissions

The impact assessment has determined that, given the adopted controls, atmospheric emissions represent a negligible impact that is unlikely to result in greater than isolated impacts with close proximity of the GWA facility, in an unpopulated area approximately 138 km north-west of Dampier, from the nearest community receptor. The adopted controls are considered good oil-field practice/industry best practice and meet requirements of Australian Marine Orders and National Pollutant Inventory reporting.

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 atmospheric emissions from the GWA facilities and support vessels to a level that is broadly acceptable.

Acceptability Greenhouse Gas Emissions

To assess and determine that impacts from GHG emissions will be of an acceptable level, Woodside considered corporate commitments, principles of Ecologically Sustainable Development, Company Values and Societal Values.

Principles of ESD

Giving considerations to economic development that safeguards the welfare of future generations, GWA is considered to align with the following core objectives of ESD by:

- Responding to the global energy transition, providing a clean and reliable energy source as gas is expected to play a key role in the future energy mix (e.g. partner with renewables). In addition, gas has the potential to

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contribute to an incremental reduction in global GHG emissions by displacing more carbon intensive power generation (e.g. coal), firming up renewables, or in hard-to-abate sectors.

- Committing to management and mitigation measures for GHG emissions within operational control of the facility, given the uncertainty about future climate change trajectories.
- Committing to mitigation measures for indirect GHG emissions that are controlled or influenced by Operator and connected to the operations of the GWA facility
- Contributing to the UN Sustainable Development Goals of achieving universal access to energy
- Providing gas to customers within countries that have ratified the Paris agreement, where each country is responsible for accounting for, reporting and reducing emissions that physically occur in its jurisdiction.

Internal Context

The Petroleum Activities Program is consistent with Woodside corporate polices, culture, processes, standards, structure and systems as outlined in the Demonstration of ALARP and Environmental Performance Outcomes, including:

- Woodside Health, Safety, Environment Policy
- Woodside Risk Management Policy
- Woodside Climate Change Policy which includes, but is not limited to, the following principles that are implemented company-wide:
  - Advocating for stable policy frameworks that reduce carbon emissions through engaging and advising legislators and regulators to support frameworks that can progress an orderly transition to a lower-carbon future.
  - Promoting and marking the role of LNG in the global energy mix (e.g. displacing higher carbon intensity fuels)
  - Monitoring and reporting on the global energy outlook to understand implication of potential changes in global climate policy
- Setting clear targets, to reduce net equity emissions below the gross 2016-2020 annual average by 15% in 2025 and 30% in 2030 on a pathway to our aspiration of net zero by 2050[17].
- WMS requirements such as the GHG emissions and Energy Management Procedure, Production Optimisation and Opportunity Management Procedure and Methane Guiding Principles Management Guideline (**Section 7.1.3.6**) which require continuous improvement by implementing optimisation processes to identify, evaluate, implement and review emissions reductions projects and develop, govern and report on plans to reduce methane fugitive emissions. These requirements have resulted in implementation of projects such as reducing flare purge and the BESS (**Table 6-7**).

External Context

Woodside recognises that our license to operate from a regulator and societal perspective is based on historical performance, complying with appropriate policies, standards and procedures, and understanding the expectations of external stakeholders. GHG emissions are a global concern as such Woodside has undertaken an impact assessment of GHG from the GWA facility and implemented the mitigation and management controls to address this issue.

According to Wood Mackenzie Energy Research Consultancy, Woodside operated facilities are amongst the cleanest in the world delivering LNG into North Asia. More broadly than GWA, the global consensus on climate change led to the implementation of the Paris Agreement which establishes a target to limit climate change to well below 2°C. The Paris Agreement establishes a framework where countries make Nationally Determine Contributions (NDCs) to manage and reduce their own emissions.

Australia has ratified the Paris Agreement and has set a target to reduce emissions by 26-28 per cent below 2005 levels by 2030. Australia's emissions projections 2020 (DISER, 2020) provides a summary of how Australia is tracking to achieve its NDC. Projected emission to 2030 from the LNG Sector (direct combustion and fugitive), including the NWS, are included in the methodology used to underpin these projections.

Woodside acknowledges the publication of the 2021 IPCC report, noting that it will be released in stages, which will be assessed under our management of change process as appropriate or relevant. The IPCC report presented a number of scenarios to understand climate response to a range of GHG emissions levels. The best-case scenario, based on very low and low GHG emissions and CO_2 emissions, decreases to net zero around or after 2050 aligning with Woodsides aspiration to reach net zero by 2050 (IPCC, 2021).

Other requirements (includes laws, polices, standards and conventions):

The Petroleum Activities Program is consistent with laws, policies, standards and conventions including:

[17] For Woodside's equity share of emissions from the facility (e.g. fuel use, flaring, production of natural occurring CO_2 from our petroleum reservoirs) and emissions associated with the generation of any power that we purchase.

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- The adopted controls and acceptability assessment has considered regulatory guidance, in particular requirements of *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*.
- Principle customers for GWA gas are located in countries that have ratified the Paris Agreement which are using LNG as part of their plans to meet those goals replacing coal, or firming up renewables, or in hard-to-abate sectors. Under the Paris Agreement and global GHG accounting conventions, each country is responsible for accounting for, reporting and reducing emissions that physically occurs in its jurisdiction. This means the Paris agreement is the framework which manages indirect emissions associated with customer consumption of GWA gas.
- Adoption of Methane Guiding Principles: minimising upstream and downstream methane emissions, committing to an integrated program of methane reductions across the five principles, with public reporting on progress towards commitments. This includes continually reducing methane emissions, improving accuracy of methane emissions data, advancing strong performance across the gas supply chain, i.e. in third party systems (such as regasification and distribution).

Indirect emissions from onshore processing are regulated by relevant legislation and approval requirements, for example the *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015.* A Greenhouse Gas Management Plan is currently being considered by the Western Australian EPA as part of the North West Shelf Environmental Review Document.

Acceptability Statement: Greenhouse Gas Emissions

As per **Section 2.8.2** decision type B are acceptable if “ALARP”, demonstrated using good industry practice and risk-based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained. In addition, acceptability is assessed against the above criteria. Further opportunities to reduce the impacts have been investigated (refer ALARP demonstration discussion). The adopted controls are considered good oil-field practice/industry best practice and are consistent with Woodside’s internal requirements. The potential impacts are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the impacts of GHG emissions to a level that is broadly acceptable

EPOs, EPSs and MC

Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 7 Optimise efficiencies in air emissions and reduce direct GHG emissions to ALARP and Acceptable Levels.	**C 7.1** Contract vessels compliant with Marine Order 97 (Marine Pollution Prevention – Air Pollution).	**PS 7.1** Vessels contracted whose practices comply with Marine Orders as applicable to vessel size, type and Class.	**MC 7.1.1** Marine verification records.
	C 7.2 National Greenhouse and Energy Reporting Scheme and National Pollutant Inventory (NPI) reporting – estimation of greenhouse gas, energy and criteria pollutants	**PS 7.2** GWA activity emissions reported annually in accordance with NGERS and NPI.	**MC 7.2.1** NGERs and NPI reporting records.
	C 7.3 Apply for and manage net direct and indirect NWS GHG emissions to within the relevant baseline under the *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*	**PS 7.3** Manage net direct and indirect NWS GHG emissions to within the accepted baseline, under the *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*	**Mc 7.3** Records demonstrate implementation

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EPOs, EPSs and MC			
	C 7.4 Forecast, measure, monitor and or estimate facility fuel and flare emissions (in accordance with NGERS/NPI) to inform optimisation management practices and minimise environmental impact of emissions.	**PS 7.4.1** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P31 - Environmental Emissions Monitoring and Controls to; – provide means of detection of environmental releases, emissions and discharges to prevent MEEs from manifesting over time, and/or as required to assure compliance monitoring and reporting equipment.	**MC 7.4.1** Records demonstrate implementation of SCE technical Performance Standard(s) and Safety Critical Element Management Procedure.
		PS 7.4.2 Fuel and flare intensity profiles tracked against optimisation targets.	**MC 7.4.2** Records demonstrate performance against annual fuel and flare intensity profiles.
		PS 7.4.3 Implement Production Optimisation and Opportunity Management Procedure for the GWA facility as a component of NWS operations	**MC 7.4.3** Records demonstrate annual process is applied.
	C7.5 Implement the *Methane Guiding Principles Management Guideline* at GWA	**PS 7.5.1** Develop and implement a Methane Reduction Plan for GWA, including identification of accountability for implementation	**MC 7.5.1** Methane Reduction Plan for GWA developed and implemented
	C 7.6 Maintain flare to maximise efficiency of combustion and minimise venting, incomplete combustion waste products and smoke emissions.	Refer to **PS 7.4.1**	Refer to **MC 7.4.1**
EPO 8 Optimise efficiencies in indirect GHG emissions, associated with GWA, within Operator control or influence, to ALARP and Acceptable Levels.	**C 8.1** Contracting strategy and evaluation for hire of support vessels includes consideration of vessel emissions parameters and low carbon / alternative fuels	**PS 8.2** Evaluation of tenders for support vessels considers emissions parameters	**MC 8.3** Records demonstrate that emissions were considered in tender evaluations
	Refer to C 7.2	**Refer to PS 7.2**	**Refer to MC 7.2.1**
	Refer to C 7.3	**Refer to PS 7.3**	**Refer to MC 7.3.1**

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EPOs, EPSs and MC			
	Refer to C 7.4	**Refer to PS 7.4.3**	**Refer to MC 7.4.3**

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6.6.8 Routine Light Emissions: Light Emissions from Platform Lighting, Vessel Operations and Operational Flaring

Context	
Platform Lighting – **Section 3.6.5.1** Operational Flaring – **Section 3.6.2.2** Vessels – **Section 3.7**	Biological Environment – **Section 4.5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Light emissions from GWA facility and vessels.						✓		A	F	-	-	GP, PJ	Broadly Acceptable	**EPO 8**
Light emissions from GWA facility during flaring.						✓		A	F	-	-			

Description of Source of Impact

Lighting is used to ensure a safe working environment to support 24-hour operations and to communicate the presence of the GWA facility and associated vessels to other marine users (i.e. navigation lights), as per **Section 3.6.5.1**. As lighting is required for the safe operation of the facility and vessels it cannot reasonably be eliminated.

External lighting is located over the entire GWA facility and on vessels, with most external lighting directed towards working areas, such as the production deck of the GWA facility or the back deck of vessels. The production deck of GWA is approximately 25 m above sea level, with the highest point of the facility (the top of the flare tower) reaching approximately 175 m above sea level. External lighting on vessels is typically lower than the GWA facility lights, with vessel lighting usually reduced to improve night vision of bridge crew.

During IMR activities, underwater lighting is generated over short periods of time while ROVs are in use, as well as from deck lighting. Given the typical intensity of ROV lights and the attenuation of light in seawater, light from ROVs will be localised to the vicinity of the ROV and vessels.

Lighting from the facility and vessels may appear from direct unshielded light sources or through skyglow. Where direct light falls upon the ocean, this area of light is referred to as light spill. Skyglow is the diffuse glow caused by light that is screened from view, but through reflection and refraction creates a glow in the atmosphere. The distance at which direct light and skyglow may be visible from the source is dependent on the lighting on the vessel and environmental conditions.

Impact Assessment

Receptors that have important habitat present within a 20 km buffer of the Operational Area were considered as having potential for interaction, based on recommendations of the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (Commonwealth of Australia, 2020) (NLPG). The 20 km threshold provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings (15 to 18 km) and fledgling seabirds grounded in response to artificial light 15 km away.

Light emissions have the potential to disrupt ecological processes that rely on natural light for visual cues. Light emissions can affect fauna in two main ways:

- **Behaviour** - many organisms are adapted to natural levels of lighting and the natural changes associated with the day and night cycle as well as the phase of the moon. Artificial lighting has the potential to create a constant level of light at night that can override these natural levels and cycles.

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- **Orientation** - species such as marine turtles and birds may 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 override natural cues, leading to disorientation.

The fauna within the Operational Area are predominantly pelagic fish and zooplankton, with a low abundance of transient species such as seabirds, marine turtles, whale sharks and large whales transiting through the Area. Additionally, there is no known critical habitat within the Operational Area for EPBC listed species, although there are BIAs listed in **Section 4.6** that overlap the Operational Area. Given the lack of significant fauna populations expected to occur within the Operational Area, impacts from light emissions are considered to be highly unlikely.

Seabirds

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). There is no emergent land that could be used for roosting or nesting habitat in the Operational Area with the nearest suitable habitat 53 km to the south, the Montebello Islands. One BIA, for wedge-tailed shearwater breeding is 9 km from the GWA facility and overlaps with the south-west portion of the Operational Area with the breeding period occurring, at the Montebello Islands, from August to April (Section 4.6.2.6).

The most vulnerable life stages for seabirds and migratory shorebirds are nesting adults or fledglings. Nesting or fledgling seabirds and migratory shorebirds are vulnerable to artificial lighting within 20 km of the nesting location (Commonwealth of Australia, 2020). For shearwater species, fledglings are predominantly impacted by onshore lighting sources, which can override sea finding cues and attract fledglings further inland, preventing them from reaching the sea (Mitkus et al., 2018; Telfer et al., 1987). Artificial light can also impact important behaviour of nesting adults (e.g. adult nest attendance, maintaining nest sites) or confuse shearwater species, resulting in injury or mortality as a result of birds colliding with structures (Cianchetti-Benedetti et al., 2018; Rodriguez et al., 2017). As the Operational Area is 53 km from the nearest emergent land, impacts to adult nesting or fledgling seabirds and migratory shorebirds are not expected. Artificial light from the Petroleum Activities Program is not predicted to disrupt critical breeding behaviours within important nesting habitat or displace seabirds from nesting habitat.

Marine Turtles

Although the Flatback turtle internesting BIA is within the Operational Area, given the distance of the nearest turtle nesting and internesting areas (habitat critical to survival to marine turtles) is the Montebello Islands, about 53 km from the Operational Area at the nearest point and approximately 89 km from the GWA facility, there is no potential for lighting impacts to turtle hatchling emergence. Although individuals may migrate and forage in the Operational Area marine turtles do not use light cues to guide these behaviours (PENV 2020). Further, PENV (2000) found no evidence, published or anecdotal, to suggest that foraging or migrating turtles are impacted by light from offshore facilities and vessels. As such, light emissions from the facility and vessels are unlikely to result in displacement of, or behavioural changes to individuals in these life stages (PENV 2020).

Fish

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 vessels. Similarly, any localised impacts to marine fish is not expected to impact on any commercial fishers in the area. No significant cumulative impacts over the life of the Petroleum Activities Program or in relation to other operations and activities in the region (e.g. NRC, Okha) are expected

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[18]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
None identified.				
Good Practice				

[18] *Qualitative measure*

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[18]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
No use of external lighting during Petroleum Activities Program.	F: No. Light management will be consistent with that required to provide a safe working environment onboard GWA and vessels. CS: Not considered – control not feasible.	Not considered – control not feasible.	Not considered – control not feasible.	No
Professional Judgement – Eliminate				
Do not flare.	F: No. While flaring is not a routine activity, the ability to flare is a safety critical requirement onboard the GWA facility. 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				
None identified.				
ALARP Statement: On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the potential impacts and risks from routine light emissions from the GWA facility and vessels to be ALARP in its risk state. 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, in its current state, operational light emissions from the GWA facility and vessels represent a negligible disturbance to fauna within the Operational Area. Further opportunities to reduce the impacts have been investigated above. The potential impacts are consistent with good oil-field practice/industry best practice and are considered to be broadly acceptable in its current state. Therefore, Woodside considers standard operations appropriate to manage the impacts of light emissions to a level that is broadly acceptable.

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6.7 Unplanned Activities (Accidents, Incidents, Emergency Situations)

6.7.1 Unplanned Hydrocarbon or Chemical Release: Hydrocarbon Release during Bunkering/refuelling and Chemical Release during Transfer, Storage and Use

Context		
Operational Details – **Section 3.6** Chemical Usage – **Section 3.9.2**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**	Stakeholder Consultation – **Section 5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Accidental spill of hydrocarbons to the environment during bunkering / refuelling.			✓			✓		A	D	2	M	LCS GP	Broadly Acceptable	**EPO 9**
Accidental discharge of chemicals to the marine environment from storage, use or transfer.			✓			✓		A	E	2	M			

Description of Source of Risk

Bunkering of marine diesel between the platform support vessels and the GWA platform routinely occurs during the Petroleum Activities Program, along with bulk transfers of chemicals such as glycol (MEG and TEG). Risks associated with these activities are described below.

Marine Diesel Bunkering/Refuelling

Two key scenarios for the loss of containment of marine diesel during bunkering operations were identified:

- 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 would be in the order of less than 200 L, based on the likely volume of a bulk transfer hose (assuming a failure of the dry break and complete loss of hose volume); and
- partial or total failure of a bulk transfer hose or fittings during bunkering or refuelling, combined with a failure in procedure to shutoff fuel pumps, for a period of up to five minutes, resulting in approximately 8 m^3 marine diesel loss to the deck and/or into the marine environment.

Mechanisms are available to capture diesel from process/piping associated with bunkering and fuel transfers, which can be used to drain to a caisson with an oil recovery system. The diesel unloading stations have isolation and vent valves to allow draining of bunkering hoses between uses.

Bulk Chemical Transfer

Bulk transfer of MEG and TEG between platform support vessels and the GWA facility occurs typically in smaller quantities than marine diesel. Similar to a spill event during refuelling, the most likely spill volume of MEG / TEG 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 MEG / TEG being discharged. This unlikely scenario represents a complete failure of the bulk transfer hose combined with a failure to follow procedures (which require transfer activities to be monitored), coupled with a failure to immediately shut off pumps.

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Chemicals Use and Storage

Chemicals are used during the Petroleum Activities Program for a variety of purposes (refer to **Section 3.9.2**). Spills of chemicals (including non-process hydrocarbons) can originate from stored hydrocarbons/chemicals or equipment on the platform, vessel decks or subsea (refer to **Section 6.6.4** for an assessment of the impacts of planned chemical discharges).

Operational process chemicals are typically stored in dedicated vessels which have similar controls of those related to mitigating hydrocarbon releases (e.g. dedicated tanks, permanent piping to the process, isolatable by valves etc.). The chemicals stored in the largest volumes on the GWA facility are MEG and TEG, both operational process chemicals stored in bulk (30 m^3 and 23 m^3 respectively). The MEG and TEG tanks are classified as a pressure vessels, as such are covered under relevant performance standards.

The GWA facility and Platform Support Vessels also store other non-process chemicals and hydrocarbons in bulk, in various volumes (up to approximately 6,000 L). Operational non-process chemicals and maintenance chemicals present on the GWA facility and support vessels are generally held in low quantities (usually less than 50 L).

Subsea Support Vessels undertaking IMR activities may also store quantities of chemicals for subsea use. Accidental releases of small quantities of subsea chemicals may occur (e.g. deck spills). Operational experience indicates potential volumes of such spills is small (< 20 L). Subsea chemical use is described in **Section 3.10.5**; subsea operational chemicals are subject to the chemical selection process outlined in **Section 3.9.3**.

Small inventories of chemicals (<25 L) are typically stored in dedicated chemical storage cabinets. Larger bulk chemicals are usually kept in their transportable containers (e.g. bulk containers, barrels, drums, pails etc.), and these are usually stored in drain collection areas or bunds. Releases from equipment are predominantly from the failure of hydraulic hoses or minor leaks from process components, or spills during refuelling of equipment, which can either be located within bunded/drained areas or outside of bunded/drained areas (e.g. over grating on cranes).

ROV hydraulic fluid is supplied through hoses containing approximately 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.

Quantitative Spill Risk Assessment

Woodside has commissioned RPS to model several small marine diesel spills, including surface spill volumes of 8 m^3 in the offshore waters of northwest WA.

The results of these models have indicated that exposure to surface hydrocarbons above the 10 g/m^2 threshold is limited to the immediate vicinity of the release site, with little potential to extend beyond 1 km. Therefore, it is considered that exposure to thresholds concentrations from an 8 m^3 surface spill from bunkering activities would be well within the EMBA for the hydrocarbon release scenario detailed in **Section 6.8.7**. Given this, the offshore location of the Operational Area, and the fact that the same hydrocarbon type is involved for both scenarios, specific modelling for an 8 m^3 marine diesel release was not undertaken for this Petroleum Activities Program.

Hydrocarbon Characteristics

Refer to **Section 6.8.1.1** for a description of the characteristics of marine diesel, including detail on the predicted fate and weathering of a spill to the marine environment.

As mentioned, note the marine diesel scenario considered in **Section 6.8.7** is significantly larger than the volumes considered here.

Consequence Assessment

Marine Diesel

The biological consequences of a small volume marine diesel spill (as described above) to relevant open water sensitive receptors may be minor consequences to megafauna, plankton, water quality and pelagic fish populations (both at the surface and in the water column) that are within the spill affected area. No consequences to commercial fisheries are expected.

A spill of marine diesel may also have an acute impact on the water column biota within the immediate vicinity of the spill. However, considering the hydrocarbon type, weathering and spreading is expected to be rapid and the consequences on water column biota limited to minor and short term.

Refer to the Summary of Potential Impacts to environmental values(s) within **Section 6.8.7** for a description of the impacts of hydrocarbons on the above biota, noting that the extent of the EMBA associated with a marine diesel spill from loss during bunkering is much reduced by comparison (in terms of spatial and temporal scales) and hence the potential for consequences from a loss during bunkering are considered to be minor and short-term.

Chemicals and Non-Process Hydrocarbons

MEG and TEG are miscible in water and are considered to pose little or no risk to the environment. A maximum credible spill of MEG or TEG is expected to mix with the receiving environment with no lasting environmental impact.

Accidental releases of chemicals or non-process hydrocarbons may decrease the water quality in the immediate area of the release, however; the consequences are expected to be slight given the temporary and localised nature due to

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water depths, the open ocean mixing environment, Operational Area distance from sensitive receptors and relatively low credible release volumes. 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). If 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. Impacts to fish are expected to be of no lasting effect, as fish species are mobile and expected to avoid the area affected by an accidental spill.

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				
Contract vessels compliant with Marine Order 91 (Marine pollution prevention – oil) for safe vessel operations. Compliance with Marine Order 91 reduces the risk of accidental hydrocarbon release during transfer.	F: Yes CS: Minimal cost. Standard practice	Marine Order 91 is required under Australian regulations; implementation is standard practice for commercial vessels as applicable to vessel size, type and class.	Control based on legislative requirement – must be adopted.	Yes **C 9.1**
Good Practice				
Chemical Selection and Assessment Environment Guideline • Where Gold/Silver/E/D OCNS rating (and no OCNS substitution or product warning), chemicals are selected – no further control required; and • If chemicals with a different OCNS rating, sub warning or non-OCNS rated chemicals are required chemicals are assessed in accordance with the guideline prior to use.	F: Yes. Woodside routinely implements a chemical selection process based on OCNS at the GWA facility. CS: Minimal. The OCNS is widely used throughout the industry and chemical suppliers are aware of the requirements of the scheme.	Selection and assessment of chemicals in accordance with the Woodside process, reduces environmental impacts associated with planned chemical discharge.	Benefits outweigh cost sacrifice	Yes **C 4.1**
Diesel bunkering hoses; • have dry break couplings; and • be pressure rated at purchase; to reduce the risk of accidental hydrocarbon release during bunkering.	F: Yes CS: Minimal cost. Standard practice.	Reduces the likelihood of a hose failure.	Benefits outweigh cost sacrifice	Yes **C 9.2**

[19] *Qualitative measure*

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[19]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Implementation of bunkering procedures to reduce the risk of a hydrocarbon release as a result of a bunkering incident.	F: Yes CS: Minimal cost. Standard practice.	Implements a procedure to outline the methods and requirements for undertaking safe bunkering. This reduces the likelihood of a bunkering incident.	Benefits outweigh cost sacrifice	Yes **C 9.3**
Chemicals are be stored safely to prevent release to the marine environment.	F: Yes CS: Minimal cost. Standard practice	Reduces risk of unplanned chemical release	Benefits outweigh cost sacrifice	Yes **C 9.4**
Incident reports are raised for unplanned releases within event reporting system.	F: Yes CS: Minimal cost. Standard practice.	Good practice that operators identify, report and learn from unplanned release events. Supports compliance with regulatory reporting requirements.	Control based on Woodside standard and regulatory requirements	Yes **C 9.5**
Professional Judgement - Elimination				
None identified.				
Professional Judgement – Substitute				
None identified.				
Professional Judgement – Engineered Solution				
None identified.				
ALARP Statement: On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts of accidental spills of hydrocarbons or chemicals from bunkering/refuelling and from storage, use and transfer. As no reasonable additional/alternative controls were identified that would further reduce the consequences and risks without grossly disproportionate sacrifice, the risks are considered ALARP.				

Demonstration of Acceptability
Acceptability Statement: The consequence assessment has determined that, given the adopted controls, accidental spills during bunkering/refuelling, or spills from storage, transfer and use represent a moderate risk rating that is unlikely to result in a consequence greater than Minor, short-term impacts. Further opportunities to reduce the risks have been investigated above. The adopted controls are considered good oil-field practice/industry best practice and meet requirements of Australian Marine Orders. The potential risks are considered broadly acceptable if the adopted controls are implemented. Therefore, Woodside considers the adopted controls appropriate to manage the risks of bunkering/refuelling, and storage, transfer and use to a level that is broadly acceptable.

EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 9 Environment risk posed by hydrocarbon and chemical spills limited to Moderate during bunkering, refuelling and chemical transfer, storage and use during the	**C 9.1** Contract vessels compliant with Marine Order 91 (Marine pollution prevention – oil) for safe vessel operations.	**PS 9.1** Vessels contracted whose practices comply with Marine Orders as applicable to vessel size, type and class.	**MC 9.1.1** Marine verification records demonstrate compliance with standard maritime safety procedures (Marine Order 91).

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
Petroleum Activities Program.	Refer to **C 4.1**.	Refer to **PS 4.1**.	Refer to **MC 4.3.1**.
	C 9.2 Diesel bunkering hoses to: • have dry break couplings; • be pressure rated at purchase.	**PS 9.2** All diesel transfer hoses to have dry break couplings and pressure rating suitable for intended use.	**MC 9.2.1** Records demonstrate diesel transfer hoses are fitted with dry break couplings and are pressure rated.
	C 9.3 Implementation of bunkering procedures.	**PS 9.3a** Implement GWA Diesel Fuel System Equipment Operating Procedure. Key requirements include: • Bunkering will commence during daylight hours only and proceed only in acceptable sea state conditions. • Communications between the supply vessel and facility bunker station will be maintained during bunkering. • Hoses, couplings and sea surface will be visually monitored during refuelling. • Tank levels will be monitored continuously on the facility. • Spill cleanup equipment will be available in proximity to the bunker station. • Bunkering hose inventory will be drained to the supply vessel before disconnection.	**MC 9.3.1** Records demonstrate bunkering undertaken in accordance with facility and contractor bunkering procedures.
		PS 9.3b Vessels will have their own bunkering plans, checklists and Ship Oil Pollution Emergency Plan (SOPEP) depending on the specifications of both the supplying and receiving vessel.	
	C 9.4 Chemicals and hydrocarbons will be stored safely to prevent the release to the marine environment.	**PS 9.4** Chemical storage areas for transportable containers on the GWA facility will have adequate containment in place to contain an accidental chemical spill.	**MC 9.4.1** GWA facility chemical storage locations provided with adequate bunding/containment.

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
	C 9.5 Incident reports are raised for unplanned releases within event reporting system.	**PS 9.5** Incident reports raised for unplanned releases; and Recordable Incidents notified for unplanned liquid releases to sea, of; • 80L or more of hydrocarbons; or • 1000L or more of environmentally hazardous chemical[20]; in any 48 hour period.	**MC 9.5.1** Records demonstrate incident reports raised for unplanned releases, and applicable Recordable Incident notifications completed.

[20] *Chemicals that are not on the CEFAS OCNS Ranked List of Notified Chemicals or CEFAS OCNS listed chemicals which have a CEFAS OCNS substitution warning, a OCNS product warning or are OCNS Hazard Quotient white, blue, orange, purple, A, B or C.*

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6.7.2 Unplanned Discharges: Hazardous and Non-hazardous Waste Management

Context		
Operational Details – **Section 3.6**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5**	Stakeholder Consultation – **Section 5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Incorrect disposal or accidental discharge of non-hazardous and hazardous waste to the marine environment.		✓	✓			✓		A	E	2	M	LCS GP	Broadly Acceptable	**EPO 10**

Description of Source of Impact

Non-hazardous and Hazardous Waste

Normal operations on the GWA facility and support vessels results in a variety of hazardous and non-hazardous wastes. These materials could potentially impact the marine environment if incorrectly disposed of, lost overboard, or discharged in significant quantities.

Non-hazardous wastes include domestic and industrial wastes, such as aluminium cans, bottles, paper and cardboard, scrap steel. Hazardous wastes include recovered solvents, excess or spent chemicals, oil contaminated materials (e.g. sorbents, filters and rags), batteries, used lubricating oils and potentially material containing Naturally Occurring Radioactive Material (NORMs)[21].

Sand and sludges may also be periodically generated during well clean-up operations, de-sanding and vessel maintenance. All waste materials not suitable for discharge to the environment that are generated on GWA, including hazardous wastes (i.e. liquid and solid wastes), are transported to shore for disposal or recycling by Woodside's licensed waste contractor.

Impact Assessment

Non-hazardous and Hazardous Waste

The potential impacts of solid wastes accidentally discharged to the marine environment include direct pollution and contamination of the marine 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. Solid material accidently lost to the marine environment could potentially lead to slight localised contamination of benthic sediments.

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 the species present.

[21] *Laboratory analyses results of material produced from the desander (refer to Section 3.6.5.6) are consistent with the Exempt Waste category as per the Australian six-tier radioactive waste classification scheme (i.e. very low levels of radioactivity; thus waste is managed and disposed of similar to the process applied for non-radioactive waste). The results also support the understanding that sand generated from the GWA facility contains little to no NORMs.*

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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				
Contract vessels compliant with Marine Orders for safe vessel operations: • Marine Order 94 (Marine pollution prevention – packaged harmful substances) 2014; • Marine Order 95 (Pollution prevention – Garbage).	F: Yes CS: Minimal cost. Standard practice.	Implementation of Marine Order 94 and 95 reduces the likelihood of a harmful substance being released to the environment. Implementation is standard practice for commercial vessels as applicable to vessel size, type and class.	Controls based on legislative requirements – must be adopted.	**Yes** **C 10.1**
Management and handling of NORMs in accordance with Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) guidelines reduced the likelihood of accidental release or incorrect disposal.	F: Yes CS: Minimal cost. Standard practice.	Australian Regulations require NORMS to be managed for appropriate classification, handling and disposal.	Controls based on legislative requirements – must be adopted.	Yes **C 10.2**
Good Practice				
Storage, handling and transport of wastes in accordance with the Waste Management Plan for Offshore Facilities.	F: Yes CS: Minimal cost. Standard practice.	Reduces the likelihood of a release of waste to the environment by providing guidance on storage, handling and transport of wastes.	Benefit outweighs cost sacrifice.	Yes **C 10.3**
If safe and practicable to do so; vessel ROV or crane used to attempt recovery material[23] environmentally hazardous or non-hazardous solid object/waste container lost overboard.	F: Yes CS: Minimal cost. Standard practice.	Potentially reduces consequence by recovering object/waste container from the environment.	Benefit outweighs cost sacrifice.	Yes **C 10.4**
Incident reports are raised for unplanned releases within event reporting system.	F: Yes CS: Minimal cost. Standard practice.	Good practice that operators identify, report and learn from unplanned release events. Supports compliance with regulatory reporting requirements.	Control based on Woodside standard and regulatory requirements.	Yes **C 9.5**
Professional Judgement –Elimination				
None identified.				
Professional Judgement – Substitute				

[22] *Qualitative measure*

[23] *For the purposes of this control/performance standard "material" is defined as unplanned releases of environmentally hazardous or non-hazardous solid object/waste events with an environmental consequence of >F.*

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)[22]***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
None identified.				
Professional Judgement – Engineered Solution				
None identified.				
ALARP Statement: On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of accidental discharge of non-hazardous and hazardous wastes. 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 consequence assessment has determined that, given the adopted controls, the accidental discharge of non-hazardous waste and hazardous waste represent a moderate risk rating and is unlikely to result in a consequence greater than slight, short-term impacts to water quality, marine sediments and marine species. Woodside, across its operations (including the GWA facility) has a well-established waste management culture which underpins a strong performance and limits the potential for accidental releases to the marine environment. Opportunities to reduce waste management impact and risks are employed through standard practice such as job planning, implementation of the Waste Management Plan, and job hazard analysis practices. The adopted controls are considered good oil-field practice/industry best practice, and meet relevant Commonwealth and WA State regulatory requirements. 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 accidental discharge of non-hazardous and hazardous waste to a level that is broadly acceptable.

EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 10 Environmental risk from hazardous and non-hazardous waste management limited to Moderate during the Petroleum Activities Program.	**C 10.1** Contract vessels compliant with Marine Orders for safe vessel operations: • Marine Order 94 (Marine pollution prevention – packaged harmful substances) 2014; • Marine Order 95 (Pollution prevention – Garbage).	**PS 10.1** Vessels contracted whose practices comply with Marine Orders as applicable to vessel size, type and class.	**MC 10.1.1** Marine verification records demonstrate compliance with standard maritime safety procedures (Marine Orders 21 and 30).

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EPOs, EPSs and MC			
	C 10.2 Management of NORMs in accordance with Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) guidelines.	**PS 10.2** In the event that waste materials are routinely identified as NORM (above exempted levels) disposal will be coordinated in line Management of NORM guidelines (Radiation Health and Safety Advisory Council 2005), and State waste management requirements for appropriate waste disposal.	**MC 10.2.1** Waste management records demonstrate appropriate handling and disposal of NORM classified material.
	C 10.3 Implementation of Waste Management Plan for Offshore Facilities	**PS 10.3** Implementation of Waste Management Plan for Offshore Facilities, including: • waste segregation and storage • records of all waste to be disposed, treated or recycled shall be maintained. They shall include (though not limited to) quantity of waste, waste type and disposal/recycle location. • waste streams shall be appropriately handled and managed according to their hazard and recyclability class. • all non-putrescible waste (excludes all food, greywater or sewage waste) shall be transported and disposed of onshore.	**MC 10.3.1** Records demonstrate implementation of Waste Management Plan for Offshore Facilities.

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EPOs, EPSs and MC			
	C 10.4 If safe and practicable to do so; vessel ROV or crane used to attempt recovery of material environmentally hazardous or non-hazardous solid object/waste container lost overboard.	**PS 10.4** Material[24] environmentally hazardous or non-hazardous solid waste object/container dropped to the marine environment will be recovered where safe and practicable to do so. 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).	**MC 10.4.1** Records detail the recovery attempt consideration and status of material environmentally hazardous or non-hazardous solid waste object/container lost to the marine environment.
	Refer to **C 9.5**	Refer to **PS 9.5**	Refer to **MC 9.5.1**

[24] *For the purposes of this control/performance standard "material" is defined as unplanned releases of environmentally hazardous or non-hazardous solid object/waste events with an environmental consequence of >F.*

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6.7.3 Physical Presence: Vessel Collision with Marine Fauna

Context														
Vessels – **Section 3.7**								Species – **Section 4.6**						
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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Physical presence of vessels resulting in collision with marine fauna.						✓		A	E	1	L	LCS	Broadly Acceptable	**EPO 11**
Description of Source of Impact														
The vessels operating in the Operational Area may present a potential hazard to cetaceans and other protected marine fauna, such as whale sharks and marine reptiles. 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 include vessel type, vessel operation (specific activity, speed), physical environment (e.g. water depth) and the type of animal potentially present and their behaviours.														
Consequence Assessment														
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. According to the data of Vanderlaan and Taggart (2007), it is estimated that the risk is less than 10% at a speed of 4 knots. Vessel-whale collisions at this speed are uncommon and, based on reported data contained in the US National Ocean and Atmospheric Administration database (Jensen and Silber 2004) there only two known instances of collisions when the vessel was travelling at less than 6 knots, both of these were from whale watching vessels that were deliberately placed amongst whales. Vessels undertaking the Petroleum Activities Program within the Operational Area are likely to be travelling less than 8 knots; much of the time vessels are holding station. Therefore, the risk of a vessel collision with protected species resulting in death is inherently low. The nearest recognised BIAs for cetaceans (considered to be at risk due to relatively slow movement and proportion of time spent at or near the sea surface) is the humpback whale migration BIA, which lies approximately 22 km south-east of the Operational Area (refer to **Section 4.6.3**). The pygmy blue whale migration BIA also lies beyond the Operational Area (approximately 26 km north-west). Adverse interactions between vessels and humpback or pygmy blue whales are considered to be unlikely due to the slow speeds of project vessels within the Operational Area, and the distance of the Operational Area from these known BIAs. Whale sharks are at risk from vessel strikes when feeding at the surface or in shallow waters (where there is limited option to dive). Whale sharks may traverse offshore NWS waters including the Operational Area during their migrations to and from Ningaloo Reef and a BIA for foraging whale sharks overlaps with the Operational Area. However, it is expected that whale shark presence within the Operational Area would not comprise of significant numbers given there is no main aggregation area within the vicinity of the Operational Area, and their presence would														

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be transitory and of a short duration. There are no constraints preventing whale sharks from moving away from vessels (e.g. shallow water or shorelines).

With consideration of the absence of potential nesting or foraging habitat (i.e. no emergent islands, reef habitat or shallow shoals) and the water depth (about 77-200 m), it is considered that the Operational Area is unlikely to represent important habitat for marine turtles. It is acknowledged, however, that there are significant nesting sites along the WA mainland coast and islands of the region and that turtles may occur within the Operational Area in low numbers. There is an internesting BIA for the flatback turtle which overlaps the Operational Area, which is associated with the Montebello Islands (see **Section 4.6.2**). The Montebello Islands themselves are located about 54 km south of the Operational Area and this internesting area is a spatially assigned buffer for marine turtles nesting at the Montebello Islands. Therefore, it is unlikely that flatback turtles nesting at the Montebello Islands will be found to aggregate in significant numbers more than 50 km away and within the Operational Area. Notably, the typical response from turtles on the surface to the presence of vessels is to dive (a potential “startle” response), which decreases the risk of collisions (Hazel et al. 2007). As with cetaceans, the risk of collisions between turtles and vessels increases with vessel speed (Hazel et al. 2007). Given the low speeds of vessels undertaking the Petroleum Activities Program, along with the expected low numbers of turtles within the Operational Area, interactions between vessels and turtles are considered to be highly unlikely.

It is not deemed credible, that vessel movement associated with the Petroleum Activities Program could have a significant impact on marine fauna populations given (1) the low presence of transiting individuals, (2) avoidance behaviour commonly displayed by whales, whale sharks and marine turtles and (3) low operating speed of the activity support vessels (generally less than 8 knots or stationary, unless operating in an emergency). Activities are considered unlikely to result in a consequence greater than slight short-term disruption to individuals or a small proportion of the population and no impact on critical habitat or fauna activity.

Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[25]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans will be implemented to reduce the likelihood of collision with marine fauna.	F: Yes CS: Minimal cost. Standard practice.	Reductions in speed around protected fauna reduce the likelihood of collision.	Controls based on legislative requirements – must be adopted.	**Yes** **C 3.1**
Good Practice				
None identified.				
Professional Judgement – Eliminate				
Do not use vessels.	F: No. No alternative to the use of vessels during the Petroleum Activities Program was identified. Given that vessels must be used to undertake the Petroleum Activities Program. There is no feasible means to eliminate the source of risk. CS: Not assessed, control not feasible	Not assessed, control not feasible.	Not assessed, control not feasible.	No

[25] *Qualitative measure*

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***[25]	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Substitute				
None identified.				
Professional Judgement – Engineered Solution				
None identified.				
ALARP Statement: On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the risk of vessel collision with 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 consequence assessment has determined that, given the adopted controls, vessel collision with marine fauna represents a low risk rating that is unlikely to result in a consequence greater than slight short-term disruption to individuals or a small proportion of the 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-field practice/industry best 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.

EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 11 No vessel strikes on protected marine fauna (EPBC Fauna).	Refer to **C 3.1**	Refer to **PS 3.1**	Refer to **MC 3.1.1**
			Refer to **MC 3.1.2**

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6.7.4 Physical Presence: Introduction of Invasive Marine Species

Context		
Vessels – **Section 3.7**	Biological Environment – **Section 4.5**	Stakeholder Consultation – **Section 5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Invasive species in vessel ballast tanks or on vessels / submersible equipment.					✓	✓		A	E	1	L	LCS GP	Broadly Acceptable	**EPO 12**

Description of Source of Impact

The GWA facility relies on a number of vessels to service routine needs (i.e. platform support vessels) and less frequently to provide specialist services (i.e. subsea support vessels for IMR activities) (refer to **Section 3.7**). Vessels may be sourced from the local area (Dampier, Port Hedland, etc.) or from further afield, depending on the type of vessel required and availability. In addition, infrequent import of materials (e.g. spares) from international suppliers may be required. Vessels arriving from international waters typically call into Dampier, where quarantine clearance including ballast log reviews is conducted in accordance with *Biosecurity Act 2015.*

All vessels are inherently subject to some level of marine fouling. Organisms attach to the vessel hull, particularly in areas where organisms can find a good surface (e.g. seams, strainers and unpainted surfaces) or where turbulence is lowest (e.g. niches, sea chests etc.). Organisms can also be drawn into ballast tanks during on-boarding of ballast water as cargo is unloaded or to balance vessels under load.

Non-indigenous Marine Species (NIMS) have been introduced into a region beyond their natural biogeographic range and have the ability to survive, reproduce and establish founder populations. Not all NIMS introduced into an area will thrive or cause demonstrable impacts. Indeed, the majority of NIMS around the world are relatively benign and few have spread widely beyond sheltered ports and harbours. Only a subset of NIMS that become abundant and impact on social/cultural, human health, economic and/or environmental values can be considered IMS.

During the Petroleum Activities Program, the following vessel activities have the potential to lead to the introduction of IMS:

- discharge of ballast water from vessels
- vessel interactions with nearby fixed infrastructure/GWA platform.

The majority of vessels used during the Petroleum Activities Program are platform support vessels; these are typically sources from Australia and are not considered high risk for IMS introduction.

Consequence Assessment

IMS have historically been introduced and translocated around Australia by a variety of human means including biofouling and ballast water. Species of concern are those that:

- are not native to the region
- are likely to survive and establish in the region
- are able to spread by human mediated or natural means.

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Species of concern vary from one region to another depending on various environmental factors such as water temperature, salinity, nutrient levels and habitat type. These factors dictate their survival and invasive capabilities.

Introducing IMS into the local marine environment may alter the ecosystem, as IMS have characteristics that make them superior (in a survival and/or reproductive sense) to indigenous species. They may prey upon 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.

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 introduction is captured 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.

Despite the potential high consequence of the establishment of a marine pest within a high value environment as a result of introduction like coastal or sheltered nearshore waters, the deep offshore open waters of the Operational Area are not conducive to the settlement and establishment of IMS (Geiling 2016), due to the lack of light or suitable habitat to sustain growth or survival. The Petroleum Activities Program will be undertaken in an open ocean, offshore location more than 12 nm from shorelines and/or critical habitat and in waters approximately 77 to 200 m deep.

Most vessels used during the Petroleum Activities Program are typically sourced from Australia and are not considered high risk for IMS introduction. Given this, the likelihood of introducing/acquiring IMS during the Petroleum Activities Program is considered highly unlikely and considered manageable given the ballast water and biofouling controls that will be implemented.

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 activity program, risk and impact evaluations of the different aspects of marine pest translocation associated with the activity are undertaken. The results of this assessment are presented in the table below.

As a result of this assessment Woodside has presented the highest potential consequence as a E (Environment) and likelihood as Highly Unlikely (1), resulting in an overall Low risk following the implementation of identified controls.

IMS Introduction Aspect	***Credibility of Introduction***	***Consequence of Introduction***	***Likelihood***
Transfer of IMS from infected vessel to Operational Area and establishment on the seafloor or subsea infrastructure.	**Not Credible** The deep offshore open waters of the Operational Area, away from shorelines and/or critical habitat, more than 12 nm from a shore and in waters 77 – 200 m deep are not conducive to the settlement and establishment of IMS.		
Transfer of IMS from infected vessel to and subsequent establishment on the GWA Platform.	**Credible** There is potential for the transfer of marine pests to occur.	If IMS were to establish this would potentially result in fouling of intakes (depending on the pest introduced), and would likely result in the quarantine of the GWA facility until eradication could occur (through cleaning and treatment of infected areas), which would be costly to undertake. **Minor (D) – Reputation and Brand** Such introduction would be expected to have Minor (D) impact to Woodside's reputation and brand, and close scrutiny of asset	**Highly Unlikely (1)** Interactions between the GWA facility and support vessels will be limited during the petroleum activity program, with a 500m safety exclusion zones being adhered too. Spread of marine pests via ballast water or spawning in these open ocean environments is considered Highly Unlikely (1).

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		level operations or future proposals. **Slight (E) – Environment** Environmental consequence of introduction of IMS to the GWA platform is considered Slight (E), localised and would relate to habitat directly on the GWA facility.	
Transfer of IMS from infected vessel to and subsequent establishment on GWA Platform, then transfer of IMS to a secondary vessel from the GWA facility.	**Not Credible** Risk is considered so remote that it is not credible for the purposes of the Petroleum Activity Program. The transfer of a marine pest from an injected activity vessel to the GWA facility was already considered highly unlikely given the offshore open ocean environment. For marine pests to then establish into a mature spawning population on GWA and then transfer to another support vessel is not considered credible (i.e. beyond the Woodside risk matrix). The GWA facility is located in an offshore, open ocean, deep environment. Support vessels only spend short periods of time alongside GWA (i.e. during backloading or bunkering activities). There is also no direct contact (i.e. they are not tied up alongside) during these activities. It is also noted that Woodside has been conducting marine vessel movements between the GWA facility and WA ports (such as Dampier), for a long period of time and no IMS has been detected in these ports (DoF 2017).		

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Legislation, Codes and Standards				
On arrival in Australia all 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.	Reduction in the likelihood that ballast water will host IMS.	Controls based on legislative requirements under the *Biosecurity Act 2015* – must be adopted.	**Yes** **C 12.1**
Good Practice				
Woodside's IMS risk assessment process will be applied to the 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 • duration of time out of water since last deployment • transport conditions during mobilisation	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 platform and project vessels within the Operational Area is reduced. No change in consequence would occur.	Benefits outweigh cost/sacrifice.	**Yes** **C 12.2**

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
• 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.				
Undertake diver-based monitoring of the GWA platform for IMS.	F: Potentially, diver-based surveys are technically feasible for the GWA facility but are not approved under the in-force Safety Case. CS: Significant. IMS inspections of in-water assets typically requires vessel logistics and diver-based inspection teams to reliably detect IMS. This is a costly, time-consuming process that would likely require facility simultaneous operational constraints, and invariably introduces a series of significant safety risks in a hazardous offshore environment. Monetary cost of IMS survey for GWA facility sized infrastructure would be comparable to safe diver campaign arrangements in the order of AUD$200k/day plus mob/demob costs. Costs of ROV to support survey are in the order of AUD$150k/day plus mob/demob costs (based on subsea ROV hire costs). Health and safety exposure includes those of personnel while conducting diver-based surveys- 4 days of 2-3 people (based on subsea ROV surveys of similar size), as well as offshore vessel and facility simultaneous operations hazards.	Platform monitoring does not prevent the potential for translocation (i.e. only as a mitigation measure). Detection may facilitate for subsequent development of options to manage IMS. Subsequent success may be limited due to structure complexity and hazardous environment.	Grossly disproportionate. Interactions between GWA facility and support/subsea vessels posing IMS translocation risk will be limited, and the vessels involved will have been managed through the implementation of Woodside's IMS Management Plan (IMSMP) (C19.2) a verified process which provides Woodside confidence in the verification of EPO 18. Consequently, any additional benefit gained through the implementation of this control is considered disproportionate given material execution safety risks, and controls already adopted (and noting already incurred cost through implementation of IMSMP (i.e. inspections and cleaning where risk warrants)) and the unlikely likelihood of a translocation event.	No

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Demonstration of ALARP				
Control Considered	***Control Feasibility (F) and Cost/Sacrifice (CS)***	***Benefit in Impact/Risk Reduction***	***Proportionality***	***Control Adopted***
Professional Judgement – Eliminate				
Do not use vessels.	F: No. No alternative to the use of vessels during the Petroleum Activities Program was identified. Given that vessels must be used to undertake the Petroleum Activities Program. There is no feasible means to eliminate the source of risk. CS: Not assessed, control not feasible	Not assessed, control not feasible.	Not assessed, control not feasible.	No
Professional Judgement – Substitute				
Source vessels based in Australia only.	F: Yes. Support vessels are routinely sourced from Australia. However, depending on the nature of subsea IMR activities, there may not be a suitable subsea support vessel within Australian waters. CS: Potential for significant cost and schedule impacts.	Reduction in the likelihood that a vessel will host IMS.	Disproportionate. The cost/sacrifice is grossly disproportionate to the benefit gained.	No
IMS Inspection of all vessels.	F: Yes. Approach to inspect vessels is feasible. CS: Significant cost and schedule impacts. Thorough inspections require vessels to be removed from the sea (e.g. slipped or dry docked) and examined by an IMS expert. This process incurs significant financial and schedule sacrifices. Timely vessel based support is integral to the safe and efficient operation of the GWA facility and subsea infrastructure.	Reduction in the likelihood that a vessel will host IMS.	Disproportionate. The cost/sacrifice is grossly disproportionate to the benefit gained.	No
Professional Judgement – Engineered Solution				
None identified.				

ALARP Statement:

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of IMS introduction and establishment. 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.

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Demonstration of Acceptability
Acceptability Statement: The risk assessment has determined that, given the adopted controls, introduction of IMS represent a low risk rating that is highly unlikely to result in a consequence greater than slight short-term impact on marine communities within the Operational Area. Further opportunities to reduce the impacts and risks have been investigated above. The adopted controls are considered good oil-field practice/industry best 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 IMS to an acceptable level.

EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 12 No introduction of IMS into the Operational Area as a result of the Petroleum Activities Program.	**C 12.1** All 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 12.1** Compliance with Australian Ballast Water Management Requirements (as defined under the Biosecurity Act 2015) (aligned with the International Convention for the Control and Management of Ships' Ballast Water and Sediments) to prevent the introduction of IMS.	**MC 12.1.1** Ballast water exchange records maintained by vessels which verifies compliance against Ballast Water Management requirements.
	C 12.2 Woodside's IMS risk assessment process will be applied to activity vessels and immersible equipment. Assessment will consider the following risk factors: • For vessels • vessel type • recent IMS and cleaning history, including for internal niches	**PS 12.2** Prior to entering the Operational Area Project vessels and relevant immersible equipment are determined to be low risk[26] of introducing IMS of concern. **PS 12.3** IMS risk assessments undertaken by an authorised Environment Advisor who has	**MC 12.2.1** Records of IMS risk assessments maintained for all project vessels and relevant immersible equipment entering the Operational Area to undertake the Petroleum Activities Program.

[26] Low risk of introducing IMS of concerns is defined as either no additional management measures required or, management measures have been applied to reduce the risk.

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EPOs, EPSs and MC			
	• 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	completed relevant Woodside IMS training or by qualified and experienced IMS inspector.	**MC 12.2.2** Records of Environment Adviser training and IMS inspector qualifications (as relevant).

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6.8 Unplanned Activities (Accidents, Incidents, Emergency Situations) – Major Environmental Events

The risks considered in this section have been identified as MEEs due to the potential for significant consequence. These sources of risk are subject to additional consideration in accordance with the process described in **Section 2.7**.

All MEEs presented are as a result of hydrocarbon loss of containment to the marine environment and atmosphere. The risk assessments have been informed using quantitative hydrocarbon spill modelling. An overview of the MEEs is provided in **Section 6.8.2**.

6.8.1 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, Spill Impact Mapping and Analysis Program (SIMAP), 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 OIW 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.

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6.8.1.1 Hydrocarbon Characteristics

The characteristics of the hydrocarbons used to model the relevant spill scenarios for this EP are provided in this section. GWA Condensate and GWA-03 Condensate are the hydrocarbons used to model the worst-case credible spill scenario from which the EMBA has been created.

GWA Condensate

GWA Condensate is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi-volatile components. In favourable evaporation conditions, about 65.9% of the oil mass should evaporate within the first 12 hours, a further 22.5% should evaporate within the first 24 hours and a further 10.8% should evaporate over several days. About 0.8% of the oil is shown to be persistent (RPS Group, 2021).

The whole oil has a low asphaltene content (< 0.5%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble, aromatic, hydrocarbons contribute approximately 16.3% by mass of the whole oil. About 9.1% by mass is highly soluble and highly volatile. A further 7.2% by mass has semi-to-low volatility. These compounds dissolve more slowly but tend to persist in soluble form for longer. Discharge onto the water surface will favour the process of evaporation over dissolution under calm sea conditions, but increased entrainment of oil and dissolution of soluble compounds can be expected under breaking wave conditions (RPS Group, 2021).

The mass balance forecast for the constant-wind case (see **Figure 6-4**) for GWA Condensate shows that about 88.4% of the oil is predicted to evaporate within 24 hours. Under calm conditions, the majority of the remaining oil on the water surface will weather at a slower rate due to being comprised of the longer-chain compounds with higher boiling points. Evaporation of the residual compounds will slow significantly, and they will then be subject to more gradual decay through biological and photochemical processes (RPS Group, 2021).

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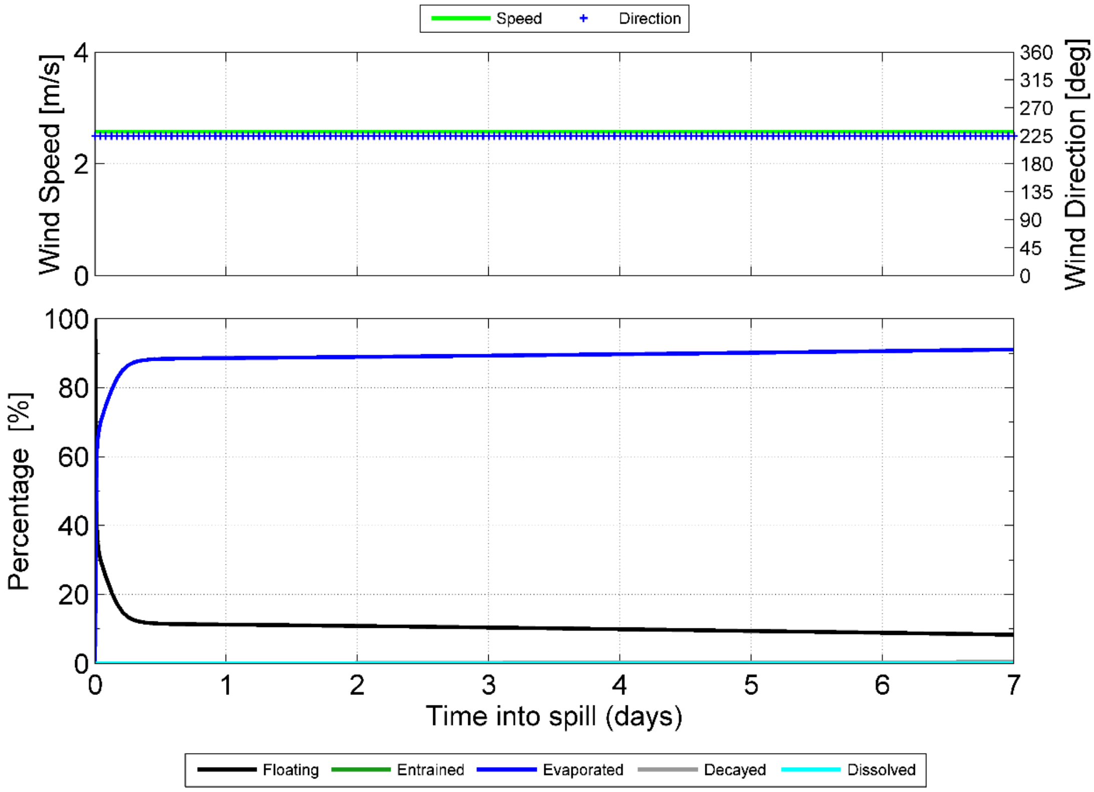

Figure 6-4: Proportional mass balance plot representing the weathering of GWA Condensate spilled onto the water surface as a one-off instantaneous release and subject to a constant 5 kn (2.6 m/s) wind at 27 °C water temperature and 25 °C air temperature.

Under the variable-wind case (see **Figure 6-5**), where the winds are of greater strength on average, entrainment of GWA Condensate into the water column is predicted to increase. About 24 hours after the spill, around 13.6% of the oil mass is forecast to have entrained and a further 81.1% 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).

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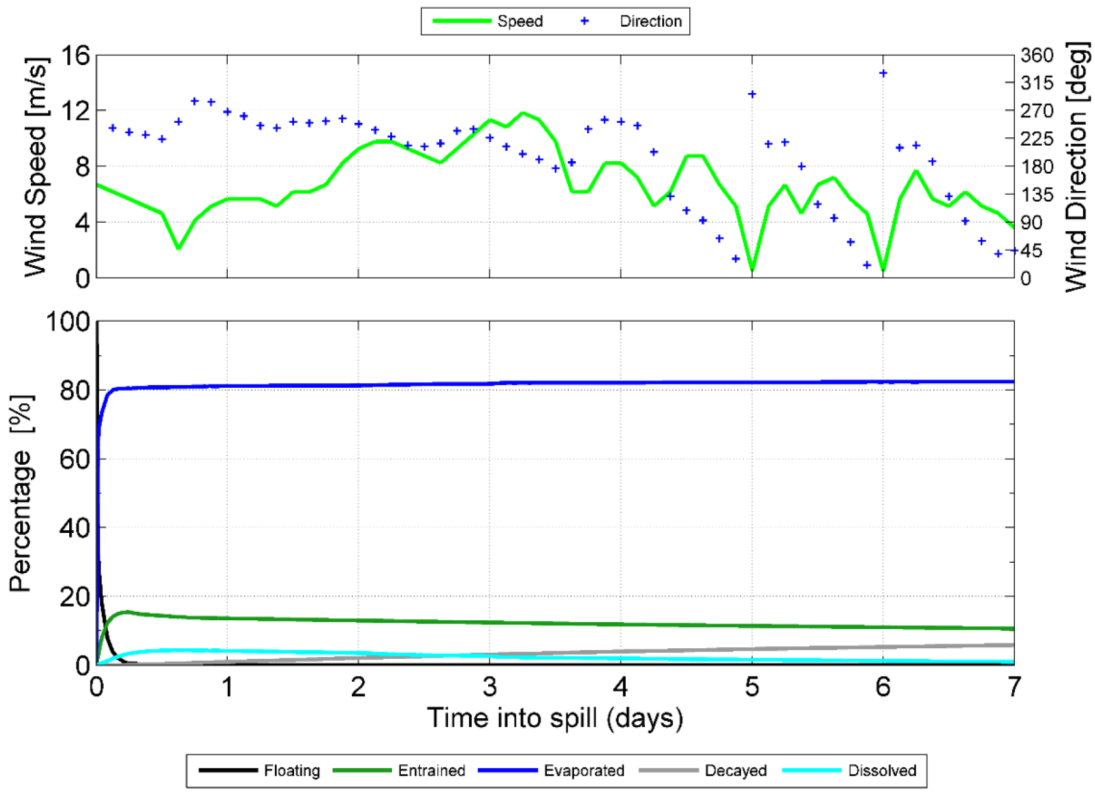

Figure 6-5: Proportional mass balance plot representing the weathering of GWA Condensate spilled onto the water surface as a one-off instantaneous release and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

GWA-03 Condensate

GWA-03 Condensate is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi-volatile components. In favourable evaporation conditions, about 71.6% of the oil mass should evaporate within the first 12 hours; a further 19.8% should evaporate within the first 24 hours; and a further 7.0% should evaporate over several days. Only about 1.6% of the oil is shown to be persistent (RPS Group, 2021).

The whole oil has a low asphaltene content (< 0.5%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble, aromatic, hydrocarbons contribute approximately 13.2% by mass of the whole oil. Around 9.6% by mass is highly soluble and highly volatile. A further 3.6% by mass has semi-to-low volatility. These compounds dissolve more slowly but tend to persist in soluble form for longer. Discharge onto the water surface will favour the process of evaporation over dissolution under calm sea conditions, but increased entrainment of oil and dissolution of soluble compounds can be expected under breaking wave conditions (RPS Group, 2021).

The mass balance forecast for the constant-wind case (see **Figure 6-6**) for GWA-03 Condensate shows that about 91.4% of the oil is predicted to evaporate within 24 hours. Under calm conditions, the majority of the remaining oil on the water surface will weather at a slower rate due to being comprised of the longer-chain compounds with higher boiling points. Evaporation of the residual compounds will slow significantly, and they will then be subject to more gradual decay through biological and photochemical processes.

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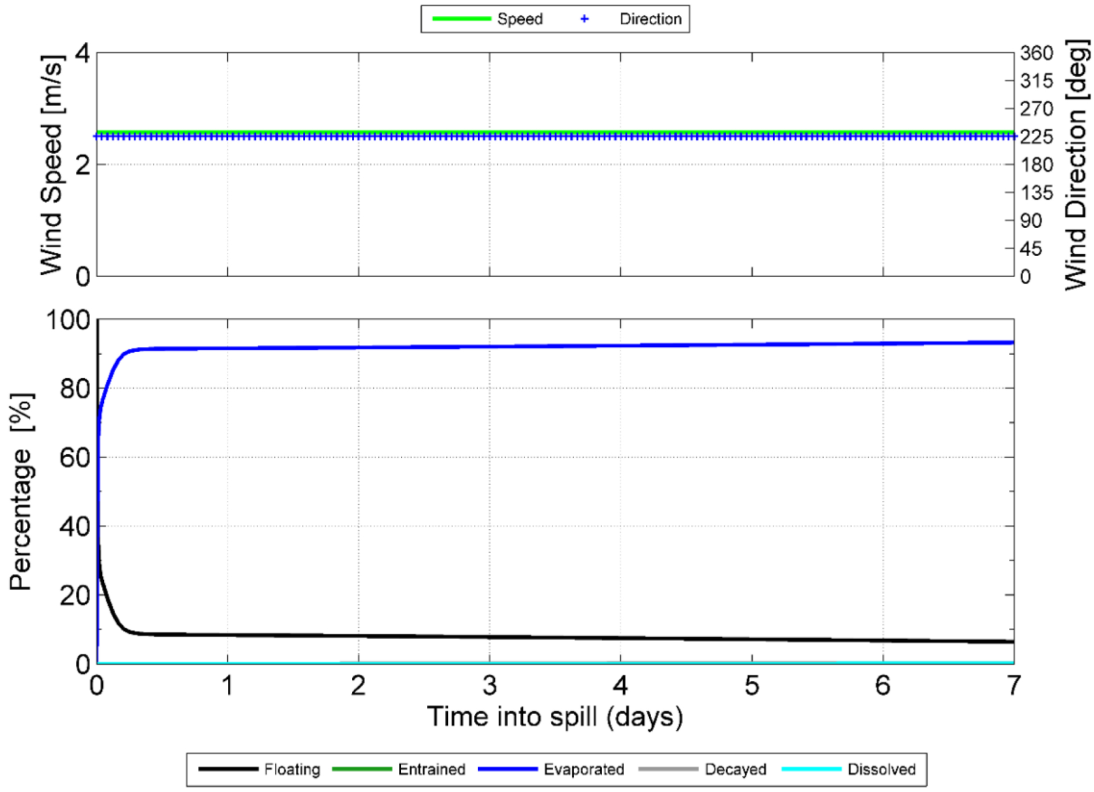

Figure 6-6: Proportional mass balance plot representing the weathering of GWA-03 Condensate spilled onto the water surface as a one-off instantaneous release and subject to a constant 5 kn (2.6 m/s) wind at 27 °C water temperature and 25 °C air temperature.

Under the variable-wind case (see **Figure 6-7**), where the winds are of greater strength on average, entrainment of GWA-03 Condensate into the water column is predicted to increase. About 24 hours after the spill, around 11.9% of the oil mass is forecast to have entrained and a further 85.4% 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).

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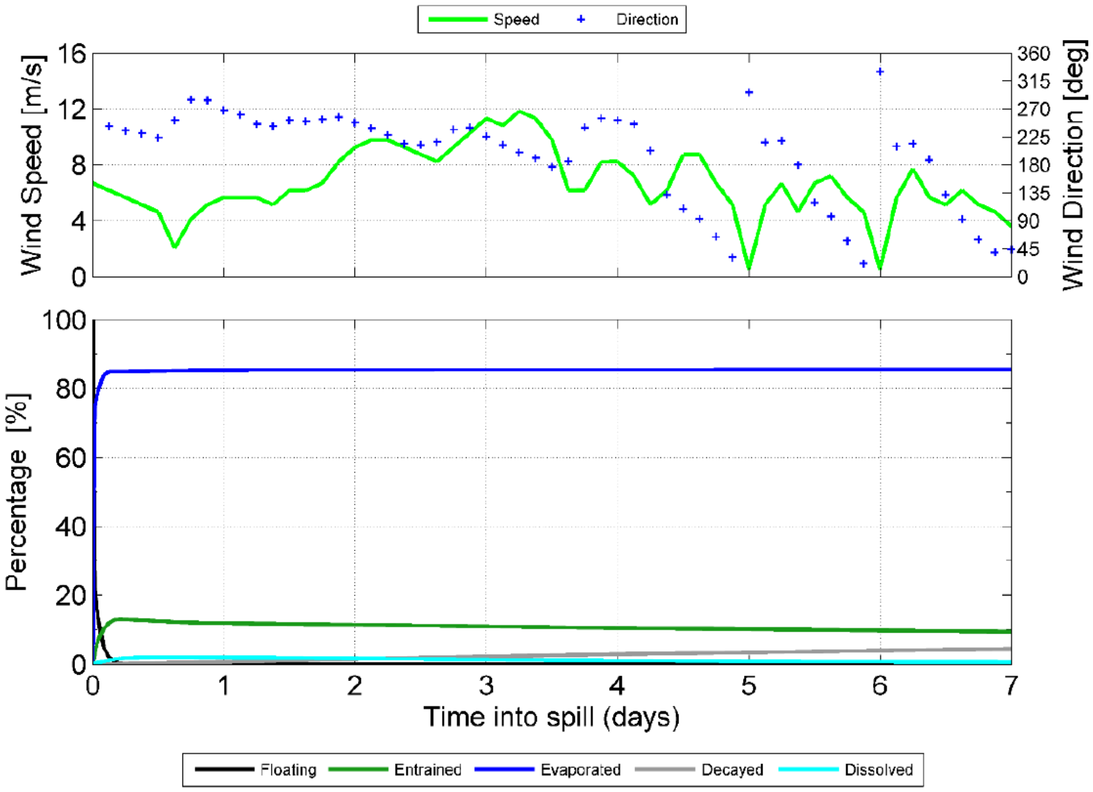

Figure 6-7: Proportional mass balance plot representing the weathering of GWA-03 Condensate spilled onto the water surface as a one-off instantaneous release and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

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 (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 6-8**, 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

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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.

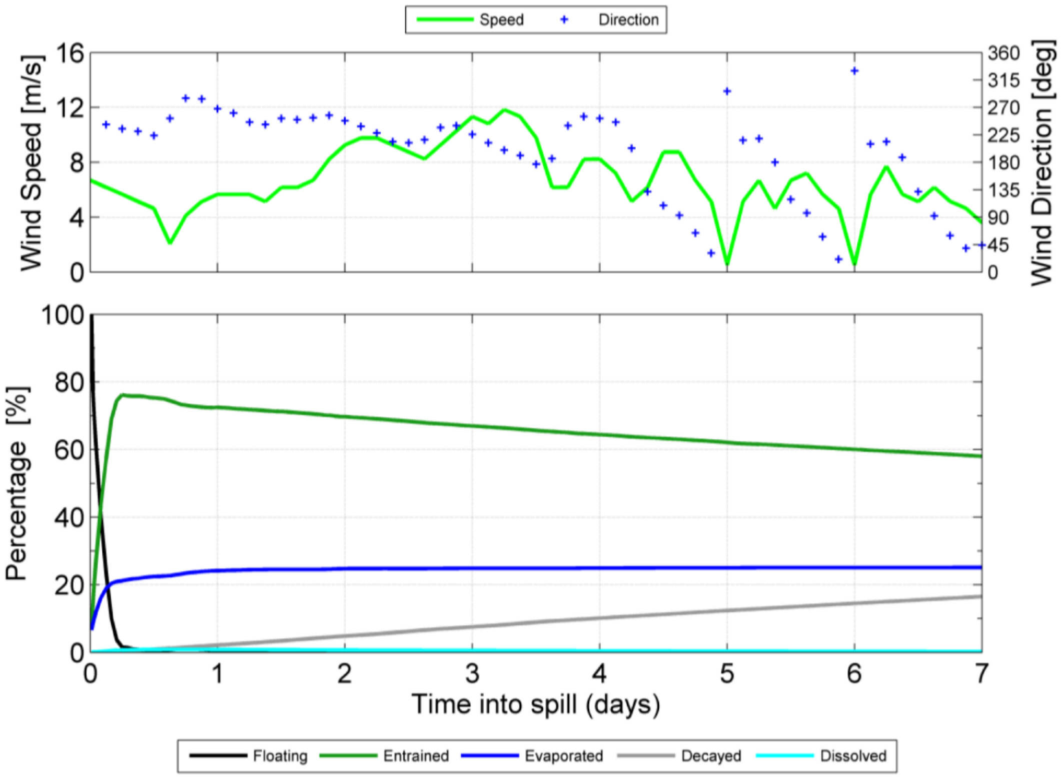

Figure 6-8: Proportional mass balance plot representing the weathering of marine diesel spilled onto the water surface as a one-off release (50 m^3 over one hour) and subject to variable wind at 27°C water temperature and 25°C air temperature.

6.8.1.2 Environment that May Be Affected and Hydrocarbon Contact Thresholds

The outputs of the quantitative hydrocarbon spill modelling are used to assess the environmental consequence by delineating which areas of the marine environment could be exposed to hydrocarbon levels exceeding selected hydrocarbon threshold concentrations if a credible hydrocarbon spill scenario occurred. The summary of the locations where hydrocarbon thresholds could be exceeded by any of the simulations modelled is defined as the EMBA. 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, and the EMBA represents the total extent of all the locations where hydrocarbon thresholds could be exceeded from all modelling runs.

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 hydrocarbon fate. Together, these EMBA have defined the spatial extent for the existing environment described in **Section 4**.

The spill modelling outputs are presented as areas that meet threshold concentrations for surface, entrained and dissolved hydrocarbons for the modelled scenarios. Surface spill concentrations are expressed as grams per square metre (g/m^2), with entrained and dissolved aromatic hydrocarbon concentrations expressed as parts per billion (ppb). A conservative approach to selecting thresholds was taken by adopting the guideline impact thresholds (NOPSEMA, 2019) for surface, entrained, dissolved and accumulated hydrocarbons to define the EMBA for condensate spills from a loss of well control and loss of marine diesel. An additional threshold has been included to define the boundary within which socio-cultural impacts may occur, based on visible surface oil (1 g/m2)

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impacting on the visual amenity of the marine environment and is described below. Each of these hydrocarbon thresholds are presented in **Table 6-11**.

Table 6-11: Summary of Thresholds Applied to the Quantitative Hydrocarbon spill Risk Modelling Results

Hydrocarbon Type	Surface Hydrocarbon (g/m^2)	Dissolved Hydrocarbon (ppb)	Entrained Hydrocarbon (ppb)	Accumulated Hydrocarbon (g/m^2)	Scientific Monitoring (g/m^2)
Condensate	10	50	100	100	1
Marine diesel	10	50	100	100	

Scientific Monitoring

A planning area for scientific monitoring is also described in **Section 5.8** 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 the NOPSEMA (2019) bulletin Oil Spill Modelling.

A scientific monitoring program may 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 socioimpa-economic) for the entire 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.

6.8.2 MEEs Overview

Section 2.7 outlines the process for additional analysis and evaluation of MEEs. **Sections 6.8.3** to **6.8.8** present the bowtie output for each MEE identified (**Table 6-12**).

Table 6-12: MEE events for the GWA Facility

No.	Hazard	Top Event
MEE-01	Hydrocarbons in reservoirs, wells, wellheads and xmas trees	Well loss of containment
MEE-02	Hydrocarbons in Subsea Equipment (pipelines, manifolds, flowlines and risers)	Subsea pipelines and riser loss of containment
MEE-03	Hydrocarbons in Topsides Equipment	Topsides loss of containment
MEE-04	Hydrocarbons in Subsea and Topsides Equipment and Marine Vessels	Loss of structural integrity
MEE-05	Hydrocarbons in Wells, Subsea and Topsides Equipment and Marine Vessels	Loss of marine vessel separation
MEE-06	Hydrocarbons in Wells, Subsea and Topsides Equipment	Loss of control of suspended load from facility lifting operations

Each section includes a summary of the hazard description, hazard management, emergency response, ALARP summary and a list of SCE barriers identified on the bowties. Each group of SCEs is listed under Technical Performance Standards, with consistent naming conventions used across Woodside's PSM processes (e.g. pipeline integrity SCEs are captured as P09 – Pipeline Systems).

Section 6.8.9 presents the generic SCE Failure and generic Human Error bowties that illustrate the causes, outcomes and controls/barriers in place to manage potential common cause event (CCE) failure mechanisms for MEE controls associated with generic SCE equipment failure (CCE-01), and also Human Error (CCE-02). Controls and specific measures are listed for both bowties. Human Error is managed via the WMS and the Generic Human Error bowtie is included in the MEE section for completeness.

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ALARP is demonstrated through controls and barriers being analysed for selection based on their independence, prioritised in accordance with the Hierarchy of Controls where controls further up the hierarchy take precedence over controls further down, and further analysed to consider the type of effect the control provides. ALARP controls presented for MEE bowties are labelled in accordance with Type of Effect classifications presented in **Table 6-13**.

Woodside has developed a tailored ALARP position for hydrocarbon spill response, including EPOs, EPSs and MC for preparedness and response. The response arrangements are a mitigative control that applies to all MEEs where a hydrocarbon release may credibly occur. The hydrocarbon spill response arrangements are described in **Appendix D**.

Table 6-13: Barrier Hierarchy and Type of Effect

Type of Effect	Legend	Description
Elimination (Technical)		Elimination controls form the 'first line of defence'. They eliminate the underlying hazard and therefore are the most effective category of control measure. If practicable, they should be selected in preference to any other type, as their existence removes the need for any other controls (e.g. a corrosion-resistant metal could replace the original material of construction).
Elimination (Administration)		
Prevention (Technical)		Prevention controls are intended to remove certain causes of incidents or reduce their likelihood. The corresponding hazard remains, but the frequency of incidents involving the hazard is lowered (e.g. introduction of regular maintenance programs can prevent the development of events involving the hazard). Where hazards and causes could not be 'eliminated', controls are required to prevent them from leading to unwanted events and consequences.
Prevention (Administration)		
Detection (Technical)		Detection controls are those that identify a potentially hazardous scenario (e.g. a change in operating parameters), allowing initiation of procedures or systems to prevent the cause occurring. Controls that detect the occurrence of events are often critical to being able to respond with other control measures that reduce the propagation of the events. Detection controls themselves often provide no actual control other than the awareness of the need to respond.
Detection (Administration)		
Reduction/Control (Technical)		Reduction controls are intended to limit the scale and consequence of incidents. They include systems that detect incidents and take some action (e.g. to reduce the rate of leakage of a toxic gas) and also aspects such as inter-unit separation that prevent escalation of fire and explosion incidents. As there is always potential for controls to fail, additional measures are required to limit the scale and severity of any unwanted event or outcome that may arise, by providing the ability to intervene and limit the propagation of the events.
Reduction/Control (Administration)		
Mitigation (Technical)		Mitigation controls take effect in response to an incident. They include controls that lessen the significance or damage caused by an unwanted event. Such controls only take effect after the hazardous event and outcomes occur. Mitigation controls are generally those designed to protect personnel against the consequences of a hazard or to aid in recovering from the effects of the hazard.
Mitigation (Administration)		

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6.8.3 Unplanned Hydrocarbon Release: Loss of Well Containment (MEE-01)

Context		
Facility Layout and Description – **Section 3.5** Platform Well Management and Maintenance – **Section 3.11**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5** Protected Places – **Section 4.8** Socio-economic Environment – **Section 4.9**	Stakeholder Consultation - **Section 5**

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	Socio-economic	Decision Type	Consequence	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Release of hydrocarbons resulting from loss of subsea well containment. (GDA-05)		✓	✓	✓	✓	✓	✓	B	B	1	M	LCS RBA CV SV	Acceptable if ALARP	**EPO 13**
Release of hydrocarbons resulting from loss of platform (surface) well containment. (GWA-08)		✓	✓	✓	✓	✓	✓	B	B	1	M			

Description of Source of Risk

Background

A loss of well containment can lead to an uncontrolled release of reservoir hydrocarbons or other well fluids to the environment, (well blowout). Woodside has identified a well blowout as the scenario with the worst case credible environmental outcome as a result of this event. Due to the potential consequences, a loss of well containment is considered to be a MEE (MEE-01). A loss of well containment could occur due to a variety of causes including:

- internal corrosion
- external corrosion
- erosion
- material, design and other defects
- overpressure of the annuli
- fatigue
- extreme weather (wave loading)
- loss of well integrity during well maintenance and interventions
- premature detonation of explosives during well intervention (perforation);
- loss of structural integrity
- loss of marine vessel separation
- loss of control of suspended load from vessel (operating near subsea wells)
- MODU anchor drag
- human/management error.

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A number of common failure causes due to human error and Safety Critical Equipment (SCE) failures are presented in the generic Human Error and SCE failure bowties in **Section 6.8.9**. There are three escalation scenarios (from other MEEs) that can also lead to loss of well containment on the GWA platform, including:

- loss of structural integrity (MEE-04 – **Section 6.8.6**)
- loss of marine vessel separation (MEE-05 – **Section 6.8.7**
- loss of control of suspended load from facility lifting operations (MEE-06 – **Section 6.8.8**).

Loss of Well Containment – Credible Scenarios

The Petroleum Activities Program includes production from a series of platform and subsea wells (**Section 3.5**). The two credible worst-case loss of well containment scenarios were identified for the Petroleum Activities Program:

- Scenario 1 - Well blow-out at seabed – highest flow rate subsea well (GDA-05)
- Scenario 2 - Well blow-out at surface – platform wellhead release (GWA-08).

The credible worst-case subsea release, Scenario 1, was based on the maximum credible release volume from the highest flow rate subsea well (GDA-05). As a number of wells are platform wells, the GWA facility (and GWA-08) was selected as the release location for Scenario 2.

Loss of containment duration has been calculated based on time to drill a relief well in both scenarios. For Scenario 1 this duration is 71 days and for Scenario 2 duration is 68 days. Relief well drilling times presented here are worst case in that pre-lay moorings are assumed to be used, however; using rig anchors reduces the timeframe for preparation and mooring spread installation (from about 37 days to about 23 days). This duration is based on the estimated time required to successfully drill an intervention well (refer to **Appendix D** for additional discussion of relief well timing).

Table 6-14: Timeframes for completion of relief wells

Phase	Description	Time for Completion (days)	
		Scenario 1 (Subsea, GDA-05)	**Scenario 2** (Platform, GWA-08
Mobilisation of relief MODU	Sourcing a MODU through Australian Petroleum Production and Exploration Association (APPEA) Memorandum of Understanding (MoU) and mobilisation. Preparation and mooring spread installation	36.6	36.6
Relief well drill time	Drill well	16.7	14.6
Intersect and kill	Relief well intersects uncontrolled well, kills well, ceasing release of hydrocarbons. Plus NPT allowance	17.3	16.9
	Total days	**71**	**68**

The modelling inputs for each of these release scenarios are summarised in **Table 6-15**. The characteristics of GWA Condensate were used as the basis in the modelling for Scenario 1, and the characteristics of the GWA-03 Condensate were used for Scenario 2 (see **Table 6-16**). Refer to **Section 6.8.1** for additional information on modelling methods and environmental impact, thresholds and hydrocarbon characteristics justifications.

Table 6-15: Summary of worst-case loss of well containment hydrocarbon release scenarios

Scenario	Hydrocarbon	Rate (m^3/day)	Duration (days)	Depth (m)	Latitude	Longitude	Total Condensate Release Volume (m^3)
Scenario 1 – Well blowout at seabed (GDA-05)	GWA Condensate	1,543.7	71	125	19°43' 15.968" S	115°51' 10.743" E	108,843
Scenario 2 – Well blowout at surface (GWA-08)	GWA-03 Condensate	2,515.2	68	Surface	19°39' 12.809'' S	115°55' 42.567" E	171,033

Decision Type, Risk Analysis and ALARP Tools

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Woodside has a good history of implementing industry standard practice in well design and construction. In the company's recent history, it has not experienced any well integrity events that have resulted in significant releases or significant environmental impacts. Woodside has never experienced a worst-case loss of well containment in its operational history.

Decision Type

A decision type 'B' has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications should the event be realised. To align with this decision type, a further level of analysis has been applied using risk based tools, including the Bowtie Methodology (described in **Section 2.7.3**) and hydrocarbon spill trajectory modelling. Company and societal values were also considered in the demonstration of ALARP and acceptability, through peer review, benchmarking and stakeholder consultation.

The release of hydrocarbons as a result of well loss of containment is considered a Major Environment Event (MEE-01). The hazard associated with this MEE is hydrocarbons in reservoirs, wells, wellheads and xmas trees for GWA platform wells or subsea wells tied-back to the GWA platform.

Quantitative Spill Risk Assessment

Spill modelling of each of the worst-case credible loss of well containment spill scenarios was undertaken by RPS, on behalf of Woodside, over a 71 and 68 day simulation length to determine the fate of hydrocarbons released in each scenario based on the assumptions in **Section 6.8.1**. Modelling was undertaken over all seasons to address year-round operations. This is considered to provide a conservative estimate of the EMBA and the potential impacts from the identified worst-case credible release volumes for all loss of well containment scenarios.

Hydrocarbon Characteristics

The hydrocarbon characteristics for GWA Condensate and GWA-03 Condensate are summarised in **Table 6-16** below and described in more detail in **Section 6.8.1.1**.

Table 6-16: Hydrocarbon characteristics of GWA Condensate and GWA-03 Condensate

Hydrocarbon Type	Density (g/cm^3) at 15°C	Viscosity	Component Boiling Point (°C) (% of total)			
			Volatiles (%) < 180	Semi volatiles (%) 180-265	Low volatility (%) 265-380	Residual >380
GWA Condensate	0.7449	1.61	65.9	22.5	10.8	0.8
GWA-03 Condensate	0.753	0.540	71.6	19.8	7.0	1.6

Likelihood

In accordance with the Woodside Risk Matrix, a worst-case loss of well containment has been defined as a 'highly unlikely' event as it 'has occurred once or twice in the industry' (experience based likelihood) and aligns with a frequency of a '1 in 10,000 to 1 in 100,000 year' event. Information to support this likelihood determination is outlined below.

Review of industry statistics indicates that the probability of a loss of well containment for production wells is low (10.6% of blowouts) relative to other activities in other hydrocarbon provinces (Gulf of Mexico and the North Sea), such as exploration drilling (31.5% of blowouts), development drilling (23.6% of blowouts) and well workovers (20.5% of blowouts) (SINTEF 2017).

When considering likelihood from an 'Experience' perspective, the review also concluded:

- When considering likelihood of the environmental consequence of the blowout event, historic blowouts that have had major, long-term impact to the environment ('B' consequence rating) have not occurred many times in the industry. This also further supports the likelihood ranking of 'Highly Unlikely.

Consequence

The spatial extent and fate (including weathering) of the spilled hydrocarbon were considered during the impact assessment for a worst-case loss of well containment (presented in the following section). These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (**Section 6.8.1**) and relevant literature and studies considering the effects of hydrocarbon exposure.

Consequence Assessment

Environment that May Be Affected

Quantitative hydrocarbon spill modelling results for surface, dissolved and entrained hydrocarbon fates for Scenarios 1 and 2 are described below. Individual receptors contacted by the model are listed in Table 6-17. The individual hydrocarbon fates are described herein.

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Surface Hydrocarbons

Refer to **Figure 4-1** for the socio-economic and ecological EMBA surface hydrocarbon spatial extents.

- Scenario 1: The spill modelling results 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 (north-east and west) and 30 km (east) from the release location, respectively.
- Scenario 2: The spill modelling results 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 301 km (south-west) and 20 km (west) from the release location, respectively.

Entrained Hydrocarbons

Refer to **Figure 4-1** for the ecological EMBA entrained hydrocarbon spatial extent.

- Scenario 1: Entrained hydrocarbon concentrations equal to or greater than the 100 ppb ecological threshold are predicted to be found up to 414 km from the release location. The maximum entrained oil concentration forecast for any receptor is predicted to be 1,004 ppb at the Montebello MP.
- Scenario 2: Entrained hydrocarbon concentrations equal to or greater than the 100 ppb ecological threshold are predicted to be found up to 481 km (south-west) from the release location. The maximum entrained oil concentration forecast for any receptor is predicted to be 1,506 ppb at the Muiron Islands MMA

Dissolved Hydrocarbons

Refer to **Figure 4-1** for the ecological EMBA dissolved hydrocarbon spatial extent.

- Scenario 1: Dissolved hydrocarbon concentrations equal to or greater than the 50ppb ecological threshold are predicted to be found up to around 488 km (south-west) from the release location. The maximum dissolved hydrocarbon concentration forecast for any receptor is predicted as 1,416 ppb at the Montebello MP.
- Scenario 2: Dissolved aromatic hydrocarbon concentrations equal to or greater than the 50 ppb ecological threshold are predicted to be found up to around 339 km (south-west) from the release location. The maximum dissolved aromatic hydrocarbon concentration forecast for any receptor is predicted as 1,664 ppb at Rankin Bank.

Accumulated Hydrocarbons

Refer to **Figure 4-1** for the socio-economic and ecological EMBA surface hydrocarbon spatial extents.

- Scenario 1: Peak Island and the Southern Pilbara – Islands receptors are predicted to be contacted by shoreline hydrocarbons at concentrations equal to or greater than 10 g/m^2 with probabilities of 5%. Additionally, Muiron Islands and the Muiron Islands Marine Management Area (MMA) are predicted to be contacted by shoreline hydrocarbon concentrations equal to or greater than 10 g/m^2 with probabilities of 3%. The worst-case shoreline hydrocarbon concentration is predicted as 28 g/m^2 at the Muiron Islands and Muiron Islands MMA receptors.
- Scenario 2: The Muiron Islands and the Muiron Islands MMA receptors are predicted to be contacted by shoreline hydrocarbons at concentrations equal to or greater than 10 g/m^2 with a probability of 31%, as well as several other receptors with probabilities of, or less than 8%. The worst-case shoreline hydrocarbon concentration is predicted as 199 g/m^2 at the Muiron Islands and the Muiron Islands MMA receptors.

Given the low persistent fraction of the hydrocarbons that may be released by a loss of well containment, accumulated hydrocarbons are not expected to persist once stranded.

Summary of Potential Impacts to Environmental Value(s)

Table 6-17 presents the full extent of the EMBA for Scenarios 1 and 2, i.e. the sensitive receptors and their locations that may be exposed to hydrocarbons (surface, entrained, dissolved and accumulated) at or above the set threshold concentrations in the unlikely event of a loss of well containment during the Petroleum Activities Program. Details of these receptors are outlined in **Section 4**. The potential biological and ecological impacts of an unplanned hydrocarbon release as a result of a loss of well containment during the Petroleum Activities Program are discussed in the following sections.

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Table 6-17: Environment that May Be Affected - key receptor locations and sensitivities with the summary hydrocarbon spill contact for a loss of well containment

Environmental Setting	Receptor	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure)																											Probability of hydrocarbon contact and fate (%)[27]					
		Physical		Biological																						Socio-economic and Cultural										
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species									Other Species							Socio-cultural EMBA		EMBA			
		Open Water (Pristine)	Marine Sediment (Pristine)	Coral Reef	Seagrass Beds / Macroalgae	Mangroves	Spawning / Nursery Areas	Open water – Productivity / Upwelling	Non-biogenic 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 / Fur Seals)	Marine Turtles (Foraging, Internesting Areas, Significant Nesting Beaches)	Sea Snakes	Whale Sharks	Sharks and Rays	Seabirds and Migratory Shorebirds	Pelagic Fish Populations	Demersal Fish Populations	Fisheries - Commercial	Fisheries - Traditional	Tourism and Recreation	Protected Areas / Heritage – European / Indigenous / Underwater Cultural Heritage	Offshore Oil and Gas Infrastructure (topside and subsea)	Surface hydrocarbon (1–10 g/m²)	Accumulated hydrocarbons (10–100 g/m²)	Surface Hydrocarbons (≥ 10 g/m²)[28]	Entrained Hydrocarbons (≥ 100 ppb)	Dissolved Hydrocarbons (≥50 ppb)	Accumulated Hydrocarbons (≥ 100 g/m²)
Offshore[29]	Argo-Rowley Terrace MP	✓						✓							✓	✓			✓			✓	✓	✓		✓			✓					8		
	Gascoyne MP	✓	✓												✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓				20	2	
	Montebello MP	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓					95	98	
	Ningaloo MP										✓	✓	✓	✓					✓					✓				✓	✓					34	4	
Mainland (nearshore)	Exmouth	✓	✓	✓	✓	✓	✓					✓			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			7		12	1	

[27] *Worst case probability*

[28] *No shoreline contact at ≥ 10 g/m² was predicted for Scenarios 1 or 2.*

[29] *Note: hydrocarbons cannot accumulate on open ocean, submerged receptors, or receptors not fully emergent*

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Environmental Setting	Receptor	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure)																													Probability of hydrocarbon contact and fate (%)[27]					
		Physical		Biological																						Socio-economic and Cultural										
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species									Other Species							Socio-cultural EMBA		EMBA			
		Open Water (Pristine)	Marine Sediment (Pristine)	Coral Reef	Seagrass Beds / Macroalgae	Mangroves	Spawning / Nursery Areas	Open water – Productivity / Upwelling	Non-biogenic 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 / Fur Seals)	Marine Turtles (Foraging, Internesting Areas, Significant Nesting Beaches)	Sea Snakes	Whale Sharks	Sharks and Rays	Seabirds and Migratory Shorebirds	Pelagic Fish Populations	Demersal Fish Populations	Fisheries - Commercial	Fisheries - Traditional	Tourism and Recreation	Protected Areas / Heritage – European / Indigenous / Underwater Cultural Heritage	Offshore Oil and Gas Infrastructure (topside and subsea)	Surface hydrocarbon (1–10 g/m²)	Accumulated hydrocarbons (10–100 g/m²)	Surface Hydrocarbons (≥ 10 g/m²)[28]	Entrained Hydrocarbons (≥ 100 ppb)	Dissolved Hydrocarbons (≥50 ppb)	Accumulated Hydrocarbons (≥ 100 g/m²)
Islands	Southern Pilbara Islands	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓			31		33	5	2
	Barrow-Montebello Islands	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		8		16	4	
State Marine Parks and Nature Reserves	Barrow Island MP	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓				8	3	
	Barrow Island MMA	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓				20	8	
	Montebello Island MP	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			8		10	10	
	Muiron Islands MMA	✓	✓	✓	✓		✓	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓			31		42	8	2
	Ningaloo Coast WH										✓	✓	✓	✓					✓				✓					✓	✓			8		34	4	
	Ningaloo MP (State)										✓	✓	✓	✓					✓				✓					✓	✓			8		19	2	
Submerged	Northern Pilbara Reefs and Shoals	✓	✓	✓	✓		✓	✓		✓						✓	✓		✓	✓	✓	✓		✓	✓	✓		✓						5		

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Environmental Setting	Receptor	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure)																													Probability of hydrocarbon contact and fate (%)[27]					
		Physical		Biological																						Socio-economic and Cultural										
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species									Other Species							Socio-cultural EMBA		EMBA			
		Open Water (Pristine)	Marine Sediment (Pristine)	Coral Reef	Seagrass Beds / Macroalgae	Mangroves	Spawning / Nursery Areas	Open water – Productivity / Upwelling	Non-biogenic 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 / Fur Seals)	Marine Turtles (Foraging, Internesting Areas, Significant Nesting Beaches)	Sea Snakes	Whale Sharks	Sharks and Rays	Seabirds and Migratory Shorebirds	Pelagic Fish Populations	Demersal Fish Populations	Fisheries - Commercial	Fisheries - Traditional	Tourism and Recreation	Protected Areas / Heritage – European / Indigenous / Underwater Cultural Heritage	Offshore Oil and Gas Infrastructure (topside and subsea)	Surface hydrocarbon (1–10 g/m²)	Accumulated hydrocarbons (10–100 g/m²)	Surface Hydrocarbons (≥ 10 g/m²)[28]	Entrained Hydrocarbons (≥ 100 ppb)	Dissolved Hydrocarbons (≥50 ppb)	Accumulated Hydrocarbons (≥ 100 g/m²)
	Exmouth Reefs and Shoals	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓			✓	✓		✓	✓	✓	✓	✓		✓	✓					26	3	
	Glomar Shoal	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓							3	
	Barrow - Montebello Reefs and Shoals	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓					21	21	
	Pilbara Reefs and Shoals	✓	✓	✓	✓					✓				✓		✓	✓		✓	✓	✓	✓		✓	✓			✓		✓				26	1	
	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			8			10	100	

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Summary of Potential Impacts to Environmental Values

Openwater Environment (Near Spill Area)

Air Quality

A hydrocarbon release during a loss of well containment has the potential to result in localised, temporary reduction in air quality and contribution of greenhouse gases to the global concentration of these gases in the atmosphere. Potential impacts from reduced air quality are expected to be minor, short-term and predominantly localised.

There is 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 the 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.

Due to the unlikely occurrence of a loss of well containment; the temporary nature of any methane or VOC emissions (from either gas surfacing or weathering of liquid hydrocarbons from a loss of well containment); 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 130 km away), the potential impacts are expected to be minor and short-term.

Water Quality

Water quality would be affected in the offshore environment within the EMBA due to hydrocarbon contamination from entrained, dissolved and surface hydrocarbons. Due to the weathering processes of the hydrocarbons, impacts to water quality are anticipated to be minor long term and/or significant short term as a result of hydrocarbon contamination above background levels.

Marine Sediment Quality

Studies of hydrocarbon concentrations in deep sea sediments in the vicinity of a major well blowout indicate hydrocarbon from the blowouts can be incorporated into marine sediments (Romero et al. 2015). Proposed mechanisms for hydrocarbon contamination of sediments include sedimentation of hydrocarbons and direct contact between submerged plumes and the seabed (Romero et al. 2015). 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 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 as a consequence of hydrocarbon contamination for a small area within the immediate release site for a long to medium term.

Pelagic and Demersal Fish

Demersal and pelagic fish species are associated with the following offshore features within the EMBA (described in **Appendix C, Section 5.3**):

- Ancient coastline at the 125 m depth contour KEF - overlaps the Operational Area;
- Continental slope demersal fish communities KEF – 25 km west-south west of the Operational Area;
- Glomar Shoal KEF – about 42 km east of the Operational Area and 67 km from the GWA platform;
- Glomar Shoal – about 60 km east of the Operational Area and 90 km from the GWA platform; and
- Rankin Bank – about 3 km west of the Operational Area and 33 km from the GWA platform.

These KEFs and geomorphic features may host relatively diverse or abundant fish assemblages compared to the otherwise relatively featureless continental shelf habitats of the NWMR.

Fish mortalities are rarely observed to occur as a result of hydrocarbon spills (International Tanker Owners Pollution Federation 2011b). 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 spill 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 historically, 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 hydrocarbon 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 polyaromatic hydrocarbon (PAH) concentrations (Hjermann et al. 2007). While modelling of the loss of well containment indicates the potential EMBA for dissolved hydrocarbons is relatively extensive, no time-integrated

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exposure metrics were modelled; given the oceanographic environment within the 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 exposure of early life stages to hydrocarbons include disruption to complex behaviours 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.

Sub-lethal effects may impact populations located near to the release location for the worst-case spill scenario with lethal impacts not considered likely in this offshore environment. Sub-lethal impacts may also occur within the EMBA for entrained/dissolved aromatic hydrocarbons.

Protected Places

Receptors

The AMPs listed in **Section 4.8** may be affected by a worst-case spill scenario. No floating hydrocarbons were modelled to contact the AMPs. The closest AMP, the Montebello Marine Park which is located 13 km south from the Operational Area, would receive entrained hydrocarbons (≥100 ppb) and dissolved hydrocarbons (≥50 ppb), as well as surface contact at ≥ 1 g/m^2.

Impacts

Montebello Marine Park

The Montebello Marine Park comprises an area about 3,413 km^2, all of which is zoned as a Multiple Use Zone (IUCN VI). This AMP ranges in depth from less than 15 m up to 150 m.

The Montebello Marine Park is significant because it contains habitats, species and ecological communities associated with the NWS Province. It includes one KEF: the ancient coastline at the 125-m depth contour, however impacts to this KEF and in particular its valued unique seafloor feature with ecological properties of regional significance, are expected to be limited to the immediate location of a potential release (See KEF above).

The Marine Park provides connectivity between deeper waters of the shelf and slope, and the adjacent Barrow Island and Montebello Islands State Marine Parks. A prominent seafloor feature in the Marine Park is Trial Rocks consisting of two close coral reefs. The reefs are emergent at low tide. There is potential for impacts to shallow coral reef communities, particularly at Montebello Islands due to its proximity to the potential release location, and these are considered in nearshore impacts below.

- **Natural values -** The bioregion includes diverse benthic and pelagic fish communities, and ancient coastline thought to be an important seafloor feature and migratory pathway for humpback whales. A key ecological feature KEF of the Marine Park is the ancient coastline at the 125-m depth contour where rocky escarpments are thought to provide biologically important habitat in areas otherwise dominated by soft sediments. The Marine Park supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. Biologically important areas BIAs within the Marine Park include breeding habitat for seabirds, internesting, foraging, mating, and nesting habitat for marine turtles, a migratory pathway for humpback whales and foraging habitat for whale sharks. While the benthic habitat of the ancient coastline at the 125-m depth contour KEF is not expected to be impacted by a spill due to the buoyant nature of hydrocarbons, the potential impacts to each of the other natural values are discussed throughout the sections below and range from moderate midterm potential impact to major long-term potential impacts.
- **Cultural values** - There is limited information about the cultural significance of this Marine Park, however it is noted that sea country is valued for Indigenous cultural identity, health and wellbeing. Across Australia, Indigenous people have been sustainably using and managing their sea country for tens of thousands of years. Potential impacts to cultural values of the Marine park will closely tie in with the impacts to the natural values of the Marine Park as addressed above and below and range from moderate midterm potential impact to major long term potential impacts.

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- **Heritage values** - There are no international, Commonwealth or national listings apply to the Marine Park. Two historic shipwrecks are located within the Marine Park. Shipwrecks occurring in the subtidal zone may be exposed to entrained/dissolved hydrocarbons, and marine life that shelter and take refuge in and around these wrecks may be affected by in-water toxicity of dispersed hydrocarbons. Potential impacts to each of these natural values are discussed throughout the sections below and range from moderate midterm potential impact to major long-term potential impacts.
- **Social and economic values** - Tourism, commercial fishing, mining and recreation are important activities in the Marine Park. These activities contribute to the wellbeing of regional communities and the prosperity of the nation. A hydrocarbon spill that results in visible slicks in coastal waters and on shorelines will disrupt recreational activities, particularly tourism, recreation and supporting services. In the event of a well blowout, surface hydrocarbons reach up to 13 km from the release location, which may enter the Montebello Marine Park. There is the potential for stakeholder perception that this environment would be contaminated over a large area and for the longer term, resulting in a prolonged period of tourism decline, however this is expected to be limited due the very minor concentrations predicted. Therefore, a worst-case hydrocarbon spill scenario has the potential to result in moderate, medium-term impacts to major, long-term impacts to Social and economic values within the Marine Park, with consequence severity dependent on the actual timing, duration and extent of a spill.

Key Ecological Features

Ancient coastline at 125 m depth contour

KEFs located within the EMBA are listed in **Section 4.7** (described in **Appendix C, Section 9**) and may be impacted by a worst-case hydrocarbon spill.

The Ancient Coastline, Continental Slope Demersal Fish Communities, Exmouth Plateau and Canyons linking the Cuvier Abyssal Plane and the Cape Range Peninsula are KEFs primarily defined by seabed geomorphological features and have been classified as KEFs in recognition of the potential for increased biological productivity and, therefore, ecological significance. Potential impacts to these KEFs include the contamination of marine sediments, direct and indirect impacts to benthic fauna / habitats and associated impacts to demersal fish populations.

Notably, no features indicative of the Ancient coastline have been identified within the portion of this KEF overlapping the Operational Area (as per **Section 4.5)**. The other KEFs are also quite a significant distance from the Operational Area (42 to 247 km) and given the nature of the hydrocarbon, it is likely to be significantly weathered prior to reaching these receptors.

Glomar Shoal (essentially a buffer applied to Glomar Shoal which has been discussed above) features marine primary producer habitat and site attached fishes, and provides foraging habitat for a number of species, as discussed under the respective sections above. The Commonwealth waters adjacent to Ningaloo Reef are similarly important habitat for these animal groups. Contamination of marine sediments with hydrocarbons or impacted water quality from entrained and dissolved hydrocarbons may cause flow on effects within these ecosystems.

These KEFs cover extensive areas (as listed in **Appendix C, Section 9**) and, should impacts to receptors within the KEFs (e.g. marine sediment, benthic communities) occur these would be anticipated to be short lived, with no permanent impacts to the KEF.

Protected Species

Cetaceans

A number of cetaceans were identified as potentially occurring with the Operational Area and the EMBA (see **Section 4.6.3**). In the event of a loss of well containment; surface, entrained and dissolved hydrocarbons exceeding environmental impact threshold concentrations may drift across habitat for oceanic cetacean species and the migratory routes and/or BIAs of cetaceans considered to be MNES (e.g. humpback whale and pygmy blue whale north and southbound migrations).

Cetaceans that have direct physical contact with surface, entrained or dissolved aromatic hydrocarbons may suffer surface fouling, ingestion of hydrocarbons (including from prey, water and sediments), aspiration of oily water or droplets and inhalation of toxic vapours (Deepwater Horizon 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 (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016).

Given cetaceans maintain thick skin and blubber, external exposure to hydrocarbons is more likely to result in irritation to the more exposed skin and eyes. Entrained hydrocarbons may also be ingested, particularly by baleen whales which feed by filtering large volumes of water. Fresh hydrocarbons (i.e. typically in the vicinity of the release location) may have a higher potential to cause toxic effects when ingested, while weathered hydrocarbons are considered to be less likely to result in toxic effects.

Given the non-persistent nature of the hydrocarbons relevant to this EP (see **Section 6.8.1.1** – Hydrocarbon Characteristics) and the relatively small floating hydrocarbon EMBA (see **Figure 4-1**), the area where potential impacts from inhalation and physical contact with surface slicks may occur would be localised around the release location. Impacts would most likely be expected to be limited to individuals that contact the slick, as discussed above.

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In a review of the impacts of large-scale hydrocarbon spills on cetaceans, it was found that exposure to oil from the Deepwater Horizon resulted in increased mortality to cetaceans in the Gulf of Mexico (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016), and long-term population level impacts to killer whales were linked to the Exxon Valdez tanker spill (Matkin et al. 2008). Given the nature of the condensate (compared with crude oil from these two spills) and relatively small nature of the surface slick, such exposure impacts to cetaceans may not eventuate.

Geraci (1988) has identified 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 also recorded larger whales (both mysticetes and odontocetes) and smaller delphinids traveling through and feeding in oil slicks. During the Deepwater Horizon spill cetaceans were routinely seen swimming in surface slicks offshore (and nearshore) (Aichinger Dias et al. 2017).

Suitable habitat for oceanic toothed whales (e.g. sperm whales) and dolphins (e.g. long-snouted spinner dolphin) is broadly distributed throughout the NWMR and, as such, whilst these species may be present within the EMBA, impacts from a spill are unlikely to affect an entire population. Notably, there are no known aggregation areas or BIAs for dolphins or whales within the Operational Area.

EIO Pygmy Blue Whale and Humpback Whale

EIO pygmy blue whales and humpback whales are known to migrate seasonally through the EMBA. Notably, the migration BIAs in the NWMR for both species do not overlap the Operational Area. A major spill event in June through to November would coincide with the humpback whale migration through the waters off the Pilbara, North West Cape and Shark Bay. A major spill in April to July or October to January would coincide with EIO pygmy blue whale migration. Both the pygmy blue and humpback whales are baleen whales and are therefore most likely to be significantly impacted by toxic effects when feeding. However, feeding during migrations is typically low level and opportunistic, with most feeding for both species occurring in the Southern Ocean. Subsequently the risk of ingestion of hydrocarbons through feeding is low.

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 a loss of well integrity (MEE-01) is not considered likely to affect an entire population.

Dugong

There are no BIAs or known areas of aggregation in the offshore waters of the EMBA for the dugong.

Summary

A worst-case hydrocarbon spill scenario has the potential to result in moderate, medium-term impacts to offshore cetacean species, with consequence severity dependent on the actual timing, duration and extent of a spill in relation to species' migratory movements and distributions.

Marine Turtles

Five of the six marine turtle species were identified as potentially occurring within the EMBA, with BIAs and Habitat Critical areas identified within the EMBA (see **Section 4.6.2**).

Adult marine turtles exhibit no avoidance behaviour when they encounter hydrocarbon spills (National Oceanic and Atmospheric Administration 2010). Contact with surface slicks, or entrained hydrocarbon can therefore result in hydrocarbon adherence to body surfaces (Gagnon and Rawson 2010) causing irritation of mucous membranes in the nose, throat and eyes leading to inflammation and infection (National Oceanic and Atmospheric Administration 2010). Oiling can also irritate and injure skin, which is most evident on pliable areas such as the neck and flippers (Lutcavage et al. 1995). 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 glands (Lutcavage et al. 1995).

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 (National Oceanic and Atmospheric Administration 2010).

Given the hydrocarbon is expected to weather rapidly when released to the environment, relatively fresh entrained hydrocarbons (which are typically relatively close to the release location) are considered to have the greatest potential for impact. Given the non-persistent nature of the hydrocarbons and the relatively small floating hydrocarbon EMBA, the area where potential impacts from inhalation may occur would be localised around the release location.

Due to the offshore location and water depths within the Operational Area, this area is unlikely to represent important habitat for marine turtles. It is, however, acknowledged that an internesting BIA for the flatback turtle associated with the Montebello Islands overlaps the Operational Area. Individuals may, therefore, be present within the Operational Area during their internesting period.

The EMBA also overlaps a number of BIAs and some habitat critical areas for marine turtles (see **Section 4.6.2**). Marine turtles are, therefore, likely to be present in the offshore waters of the EMBA, particularly as they are a migratory species which often travel large distances during migration periods. Important areas of aggregation for

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foraging, nesting and mating are typically associated with nearshore islands along the Pilbara and Gascoyne coastlines, as opposed to offshore waters.

Summary

In the event of a loss of well containment there is potential that surface, entrained and dissolved hydrocarbons exceeding environmental impact threshold concentrations will be present in offshore waters. Therefore, a hydrocarbon spill may disrupt a portion of marine turtle populations for the green, flatback, hawksbill, loggerhead and/or leatherback turtle. However, there is considered to be no threat to overall population viability given the non-persistent nature of predicted hydrocarbons.

Seasnakes

A number of seasnake species which are listed Marine under the EPBC Act were identified by the PMST as potentially occurring within the EMBA. No listed Threatened and/or Migratory seasnake species were identified.

Impacts to seasnakes 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 2011a). They may also be impacted when they return to the surface to breathe and inhale the toxic vapours associated with the hydrocarbons, resulting in damage to their respiratory system.

In general, seasnakes frequent the waters of the continental shelf area around offshore islands and potentially submerged shoals (water depths <100 m). It is acknowledged that seasnakes may be present in the Operational Area and will be present within the EMBA, however; their abundance is not expected to be high in the offshore environment. Exclusions may apply to the yellow-bellied seasnake which is known to be pelagic.

A hydrocarbon spill may have a minor disruption to some individuals in the offshore environment. Population level impacts to seasnake species are not considered credible.

Sharks and Rays

A number of sharks and ray species were identified as potentially occurring within the Operational Area and/or EMBA (see **Section 4.6.1**). Two foraging BIAs for one of these, the whale shark, overlap with the project areas; foraging (northward from Ningaloo along the 200 m isobath; Operational Area, EMBA) and foraging (high prey density - Ningaloo Marine Park; EMBA). Whale sharks are, therefore, likely to transit the open offshore waters within the EMBA whilst they migrate to and from Ningaloo Reef between July and November.

Other listed Threatened pelagic species identified in the PMST report as potentially occurring within the EMBA include the white shark and grey nurse shark. There are no known areas of aggregation for these species in the offshore waters of the EMBA.

Impacts to sharks and rays may occur through direct contact with hydrocarbons and contaminate the tissues and internal organs either through direct contact or via the food chain (i.e. 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). In the offshore environment, it is probable that pelagic shark species, such as the whale shark, are able to detect and avoid surface waters underneath hydrocarbon spills by swimming into deeper water or away from the affected areas.

Impacts to whale sharks from a hydrocarbon spill will depend on the timing of the spill, however; whale sharks as a pelagic species are expected to demonstrate avoidance behaviour and population level impacts are not anticipated.

Seabirds

A number of EPBC Act listed Threatened and/or Migratory seabird and shorebird species were identified by the PMST as potentially occurring within the Operational Area and/or EMBA, including the wedge-tailed shearwater, fairy tern, lesser crested tern, lesser frigatebird and roseate tern which have BIAs within the EMBA.

Seabirds and migratory shorebirds are particularly vulnerable to contact with floating hydrocarbons, which may mat their feathers. This may lead to hypothermia from loss of insulation and ingestion of hydrocarbons when preening to remove hydrocarbons; both impacts may result in mortality (Hassan and Javed 2011). Notably, the credible loss of well containment scenarios result in a relatively small floating hydrocarbon EMBA which is centred around the release location. Subsequently, the potential for seabird exposure to floating hydrocarbons is considered to be low. Migratory shorebirds are considered unlikely to interact with spilled hydrocarbons as they are not expected to stop over within the offshore waters surrounding the Operational Area during their migrations between mainland/island areas. Many seabirds and migratory shorebirds forage over extensive areas (some hundreds of kilometres out to sea) so individuals may be present. Seabirds roosting or resting on the GWA platform is not common, however those that do may also be impacted, however, these would be individuals and not populations.

Seabirds which plunge dive to feed on prey may also contact entrained or dissolved hydrocarbons, most likely through ingestion of prey which are contaminated. Impacts to prey abundance as a result of hydrocarbons may also indirectly impact individuals.

There are several breeding BIAs for seabirds and migratory shorebirds that overlap with the EMBA, which are associated with breeding and nesting at locations along the Gascoyne and Pilbara coastlines (including near-shore islands). The outer edge of a breeding BIA for the wedge-tailed shearwater overlaps with the Operational Area, and

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another is less than a kilometre away. It is likely that individual birds may, therefore, transit the Operational Area. Other species' BIAs are at least 47 km away and these species are less likely to occur within the Operational Area.

Given the relatively low area of floating hydrocarbons and the lack of key aggregation areas for migratory shorebirds and seabirds within the Operational Area, impacts at the population level are not anticipated. Individual animals may, however, be impacted with potential fatalities occurring from oiling. Indirect impacts to seabirds in offshore waters are expected to consist of ecosystem-scale effects, such as reduced prey abundance.

Nearshore Waters (Mainland and Islands)

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 (see **Table 6-17**). Shoreline hydrocarbons may also reach the Muiron Islands and Muiron Islands MMA. Such hydrocarbon contact may lead to reduced marine sediment quality by several processes, such as adherence to sediment and deposition shores or seabed habitat.

Protected Species

Cetaceans and Dugongs

Coastal populations of small cetaceans (e.g. the spotted dolphin) and dugongs are known to reside or frequent nearshore waters along the WA coastline and nearshore islands, including the Ningaloo Coast and at the Muiron Islands, Montebello / Barrow / Group, and the Pilbara Southern Island Groups.

These species may be impacted by entrained and dissolved hydrocarbons exceeding threshold concentrations (surface hydrocarbons were not modelled to reach these coastal waters) in the event of a loss of well containment. The potential impacts of exposure from hydrocarbons are as discussed above. Nearshore populations of cetaceans and dugongs are known to exhibit site fidelity and are often resident populations. Therefore, avoidance behaviour may have greater impacts to population functioning. Notably, Geraci (1988) observed relatively little impacts beyond behavioural disturbance.

The humpback whale resting area in the Exmouth Gulf lies just within the EMBA (due to modelled contact by entrained hydrocarbons at 100 ppb), however, it is about 250 km south-west of the Operational Area and the EMBA is not representative of any one hydrocarbon spill. The likelihood of impacts occurring within this BIA are, therefore, considered low.

Impacts in addition to those noted above include ingestion of hydrocarbons by dugongs that feed on oiled seagrass and indirect impacts to dugongs should seagrass habitats be damaged by a hydrocarbon spill. As noted for the humpback whale resting BIA, the EMBA just includes a small northern portion of the Exmouth Gulf and it is considered a low likelihood that the dugong BIAs located here and along the Ningaloo Coast (BIAs for calving, nursing, breeding and foraging) would be impacted by a hydrocarbon spill.

Summary

A hydrocarbon spill may impact coastal cetaceans through site displacement and damage to food source, however, due to the non-persistent nature of the hydrocarbon it is not predicted to result in impacts on overall population viability of either dugongs or coastal cetaceans.

Marine Turtles

Marine turtles are known to utilise nearshore waters and shorelines for foraging and breeding activities (including internesting), with significant nesting beaches along the WA mainland coast and nearshore islands in locations that may be impacted by a loss of well containment spill scenario (including the Muiron Islands, Montebello / Barrow Islands group and Pilbara Southern Islands Group).

Seasonal timings for breeding, nesting and hatchling dispersal for each marine turtle species is provided in **Section 4.6.2**, as are the known BIAs and habitat critical areas. The nearshore waters of these marine turtle habitat areas may be exposed to surface, entrained or dissolved hydrocarbons exceeding threshold concentrations, and accumulated hydrocarbons above threshold concentrations (Muiron Islands only).

The potential impacts of exposure are as previously discussed. In the nearshore environment, turtles can ingest hydrocarbons when feeding and/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 on turtles during the breeding season at nesting beaches. Contact with gravid adult females or with hatchlings may occur on nesting beaches (accumulated hydrocarbons) or in nearshore waters (entrained hydrocarbons) where hydrocarbons are predicted to make shoreline contact. Males waiting in nearshore areas to mate with adult females may also be impacted by entrained hydrocarbons. Accumulated hydrocarbons above impact thresholds were identified as potentially occurring at the Muiron Islands

Marine turtles aggregating near nesting beaches within the EMBA during the mating and nesting seasons are most vulnerable to hydrocarbons, due to greater turtle densities and the possible disruption to important life cycle behaviours. Potential impacts may occur at the population level due to the presence of a high number of breeding individuals and hatchlings (during hatchling dispersal) and may impact on overall population viability of marine turtle

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species. However, given the volatile nature of the hydrocarbons and low levels of shoreline accumulation predicted (relatively small areas at the Muiron Islands only modelled), population level impacts are not anticipated to occur.

Sharks and Rays

Whale sharks and manta rays (reef manta ray and giant manta ray) are known to frequent Ningaloo Reef (forming feeding aggregations March through July) and the nearshore waters of the Muiron Islands (located 227 km south-south west of the Operational Area). Whale sharks and manta rays generally transit along the nearshore coastline in these areas and are vulnerable to surface, entrained and dissolved aromatic hydrocarbon spill impacts, with both taxa having similar modes of feeding. Notably, surface hydrocarbons were not modelled to reach these areas of the EMBA.

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 with the mouth partially open (Taylor 2007). These feeding methods would result in the potential for individuals that are present in worse affected spill areas to ingest potentially toxic amounts of 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 also cause displacement of whale sharks from important feeding and resting areas at Ningaloo Reef, potentially disrupt migration and aggregations to these areas in subsequent seasons. Whale sharks may also be affected indirectly by entrained or dissolved aromatic hydrocarbons through the contamination of their prey. The preferred food of whale sharks are planktonic organisms 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 a worse-case 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 coastal shark species (e.g. dwarf, narrow and/or green sawfish) to be impacted directly from hydrocarbon contact and/or indirectly through contaminated prey or loss of habitat. Excluding sawfish, which may exhibit high site fidelity, it is most likely that shark species (as mobile animals) will move away from spill affected areas and suffer minimal direct impact.

A spill reaching the Ningaloo coastline during key aggregation periods and impacting important whale shark foraging areas may have severe impacts to the local whale shark population, including possible mortality of individuals and impacts to life cycle habitats such as migration patterns. Most species of shark and ray (including whale sharks) are, however, expected to move away from spill affected areas with minimal impacts.

Seabirds

In the event of a loss of well containment, there is the potential for seabirds, and resident/non-breeding overwintering shorebirds that use the nearshore waters for foraging and resting, to be exposed to entrained and dissolved hydrocarbons.

Impacts may include both lethal or sub-lethal effects, as discussed above. Although breeding oceanic seabird species can travel long distances to forage in offshore waters, most breeding seabirds tend to forage in nearshore waters near to 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.

Migratory shorebirds may be exposed to stranded hydrocarbon when foraging or resting in intertidal habitats, however, direct oiling is typically restricted to relatively small portion of birds, and such oiling is typically restricted to the birds' feet. Unlike seabirds, shorebird mortality due to hypothermia from matted feathers is relatively uncommon (Henkel et al. 2012). Indirect impacts, such as reduced prey availability, may occur (Henkel et al. 2012).

Notably, the nearest land mass to the Operational Area is the Montebello Islands, which is 53 km south-south west and floating hydrocarbons are anticipated to only travel up to 30 km from the release location. There are also no known key foraging locations within or surrounding the Operational area. It is considered unlikely, therefore, that animals nesting or breeding at near-shore islands or along the mainland would be impacted by surface hydrocarbons.

Impacts are more likely to occur through the ingestion of contaminated fish (nearshore waters) or invertebrates (intertidal foraging grounds such as beaches, mudflats and reefs) which have been exposed to entrained or dissolved hydrocarbons within the EMBA. Ingestion of contaminated prey can also lead to internal injury to sensitive membranes and organs (International Petroleum Industry Environmental Conservation Association 2004). Whether the toxicity of ingested hydrocarbons is lethal or sub-lethal will depend on the weathering stage and its inherent toxicity. 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.

Notably, shoreline contact has been modelled to occur at the Muiron Islands. The Muiron Islands are a well known and studied location for their bird colonies. Shoreline accumulation of hydrocarbons was modelled to take a minimum of 638 hours (more than 26 days) meaning the hydrocarbons will be highly weathered. Birds utilising the nearshore waters and intertidal areas for foraging and resting at Muiron Islands may, therefore, suffer sub-lethal and/or lethal impacts. Seabirds also typically nest above the high water mark, meaning nesting areas would not be expected to be

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directly impacted. As the contact was modelled to be at two small isolated areas of the islands and as the hydrocarbons would be highly weathered, impacts to population viability are not anticipated.

Submerged Shoals and Banks

Protected Species

Marine Turtles

Whilst there are no shoal, bank or reef features within the Operational Area, there is the potential for marine turtles to be present at submerged shoals and banks within the EMBA, including Rankin Bank and Glomar Shoal. These shoals and banks may, at times, be foraging habitat for marine turtles, given the coral and filter feeding biota associated with these areas (see **Appendix C, Section 4.4**).

Notably, there are no known key aggregation areas (i.e. BIAs or habitat critical areas) associated with Glomar Shoal or Rankin Bank.

Impacts to marine turtles at submerged shoals and banks are as previously discussed above. Marine turtles would be expected to be foraging, resting and breathing at the surface at these geomorphic features. Ingestion of hydrocarbons whilst foraging through prey is also possible.

Marine turtles may be present at shoals and banks within the EMBA and, therefore, may be impacted by entrained and/or dissolved hydrocarbons present at concentrations greater than the relevant thresholds. Impacts would be expected to be limited to the individuals that may be transiting these areas. Subsequently, impacts at the population level are not anticipated for any of the five marine turtle species that may frequent shoals and banks within the EMBA.

Seasnakes

It is likely that seasnakes will be present at submerged shoals and banks, such as Rankin Bank and Glomar Shoal. No key areas of aggregation have been identified for seasnakes within the Operational Area or EMBA. Seasnakes may also be present at near-shore islands and reef areas.

The potential impacts of exposure to hydrocarbons are as discussed above.

Seasnake species in Australia generally show strong habitat preferences (Heatwole and Cogger 1993); species that have preferred habitats associated with submerged shoals and oceanic atolls may be disproportionately affected by a hydrocarbon spill affecting such habitat. However, population level impacts are not anticipated.

Sharks and Rays

Pelagic sharks and rays may frequent submerged shoals and banks (such as Rankin Bank and Glomar Shoal) within the EMBA to feed. Some species may also exhibit site fidelity to these geomorphic features.

There is the potential for resident shark and ray populations to be impacted directly from hydrocarbon contact or indirectly through contaminated prey or loss of habitat.

Spill modelling results indicated that entrained hydrocarbons may reach Rankin Bank (located 3 km from the Operational Area) between 18 and 42 hours after a worst-case spill event (i.e. potentially within the first day), therefore there is the potential for sharks and rays at these features to be exposed to fresh unweathered hydrocarbons which may have potential for toxic impacts. Species which are resident to or exhibit site-fidelity to Rankin Bank may subsequently be severely impacted and/or displaced. Indirect impacts through ingestion of prey that has been exposed to hydrocarbons and/or the loss of marine flora habitats may also impact sharks and rays.

Glomar Shoal is a greater distance (60 km) from the Operational Area, and entrained hydrocarbons are not anticipated to reach this feature until between 275 and 397 hours after a spill event. Hydrocarbons will, therefore, be significantly more weathered and impacts to individuals much less severe.

Pelagic 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 banks may or may not be displaced/exhibit behavioural avoidance 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. It is expected that there will be no impacts at the population level.

All Settings

Coral Reefs

Receptors

There are no coral reef habitats located within the Operational Area. Within the EMBA, coral reef habitats exist at Rankin Bank, Glomar Shoal, Muiron Islands, the Montebello and Barrow Island groups and numerous receptors associated with Ningaloo Reef, including the reef itself.

As discussed in ‘Benthic Fauna’, entrained and/or dissolved hydrocarbons are anticipated to reach Rankin Bank and Glomar Shoal. Impacts to coral reef habitat at these features are anticipated to be similar in nature to benthic

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communities and of similarly low probability due to the water depths they exist at. However, potential biological impacts to sensitive corals could include sub-lethal stress and in some instances total or partial mortality of corals.

Hydrocarbons were modelled to reach Barrow Island (entrained); Barrow Island AMP and Marine Management Area (entrained and dissolved); and the Boodie, Double and Middle Islands Nature Reserves (entrained only). Entrained and dissolved hydrocarbons were also modelled to contact the Montebello AMP.

Entrained, dissolved and shoreline accumulation of hydrocarbons were predicted at the Muiron Islands, including the Marine Management Area. Shoreline accumulation was modelled to occur at small discrete locations of the islands. Spill modelling indicated the entrained and dissolved hydrocarbons would also reach the Ningaloo Reef, Commonwealth and State Ningaloo MPs, as well as the Ningaloo Coast World Heritage Area.

Impacts

Exposure to entrained hydrocarbons/dissolved aromatic hydrocarbons (≥100 ppb) 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 this 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 result in impacts to the shallow water fringing coral communities/reefs of the offshore islands (e.g. Muiron Islands, Barrow and Montebello Island groups) and also the mainland coast (e.g. Ningaloo).

With reference to Ningaloo Reef, wave-induced water circulation flushes the lagoon and may promote removal of entrained and dissolved 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.

Shoreline Accumulation

As mentioned, shoreline accumulation was modelled at discrete areas of the Muiron Islands shoreline (including within the Marine Management Area). No other shoreline contact at ecological thresholds (100 g/m^2) was modelled.

Shallow coral habitats (i.e. nearshore and intertidal waters) are most vulnerable to hydrocarbons through coating by direct contact with surface slicks during periods when corals are tidally-exposed at spring low tides. Water soluble hydrocarbon fractions associated with surface slicks are known to cause high coral mortality (Shigenaka 2001) via direct physical contact of hydrocarbon droplets to sensitive coral species (such as the branching coral species).

There is, therefore, potential for lethal impacts due to the physical hydrocarbon coating of sessile benthos (including by entrained hydrocarbons), with likely significant mortality of corals (adults, juveniles and established recruits) at the small spill affected areas. These impacts are particularly applicable to branching corals which are reported to be more sensitive than massive corals (Shigenaka 2001).

Recruitment / Spawning

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 the potential for a significant reduction in successful fertilization 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) will be entirely dependent on actual hydrocarbon concentration, duration of exposure and water depth of the affected communities. Coral community live cover, structure and composition may reduce in hydrocarbon impacted areas, manifested by loss of corals and associated sessile biota.

Recovery of impacted reef areas from a range of stressors typically 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, 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).

A hydrocarbon spill may result in large-scale impacts to coral reefs within the EMBA, particularly Ningaloo Reef and Muiron Islands, with long-term effects (recovery >10 years) likely.

Productivity

Primary production by plankton (supported 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

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phytoplankton (cyanobacteria and other microalgae) and secondary consuming zooplankton, such as crustaceans (e.g. copepods), and the eggs and larvae of fish and invertebrates (meroplankton).

Plankton exposure to hydrocarbons in the water column can result in changes in 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 toxicity, 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 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 (International Tanker Owners Pollution Federation 2011a). Therefore, any impacts to exposed planktonic communities present within the EMBA are anticipated to be short-term.

Seagrass Beds, Macroalgae and Mangroves

Depending on the trajectory of the entrained and dissolved hydrocarbon plume, macroalgal / seagrass communities including those along the Ningaloo Coast (patchy and low cover associated with the shallow limestone lagoonal platforms), Muiron Islands (associated with limestone pavements), the Barrow and Montebello Island groups, the Pilbara Southern Island Group (documented as low and patchy cover) have the potential to be exposed (refer **Table 6-17**).

Seagrass in the subtidal and intertidal zones have different degrees of tolerance to exposure of hydrocarbons. Subtidal seagrass is generally considered much less vulnerable to hydrocarbon spills than intertidal seagrass, primarily because freshly spilled hydrocarbons, including crude oil, float under most circumstances. Dean et al. (1998) found that hydrocarbons mainly affect flowering, therefore, species that are able to spread through apical meristem growth are not as affected (e.g. 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.

Minimum time to contact for entrained hydrocarbons with the nearest receptor that may host seagrasses is 416 hours (Scenario 2; Montebello Islands Marine Park). As such, hydrocarbons released in the event of a loss of well containment are expected to be weathered prior to any credible contact with seagrasses. Exposure to entrained hydrocarbons may result in mortality, depending on actual entrained 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.

As mentioned, 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 to entrained hydrocarbons. Hydrocarbon coating of the prop roots of mangroves can occur when entrained hydrocarbons are deposited on the aerial roots. Hydrocarbons deposited on the aerial roots can block the pores used to breathe or interfere with the trees' salt balance, resulting in sub-lethal and potential lethal effects. Mangroves can also be impacted by entrained/dissolved 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 (National Oceanic and Atmospheric Administration 2014). Given the non-persistent nature of the hydrocarbons, however, no significant effects to mangrove habitat are expected to occur.

Entrained/dissolved 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 indirectly 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 utilise these intertidal habitat areas for breeding, feeding and nursery habitat purposes.

Benthic Fauna

In the event of a loss of well containment at the seabed, the spill modelling predicted hydrocarbon droplets would be entrained in a gas plume, transporting them through the water column and to the sea surface. As a result, the low sensitivity benthic communities associated with the unconsolidated, soft sediment habitat within the Operational Area are generally not expected to be exposed to released hydrocarbons. A localised area of impact relating to the hydrocarbon plume at the point of release is however predicted, which would result in a small area of seabed and any associated epifauna and infauna being exposed to hydrocarbons. Impacts to benthic communities within the Operational Area would subsequently be limited to the immediate area around the release site and may include lethal or sub-lethal impacts.

Within the offshore waters of the EMBA, impacts to benthic fauna on the seafloor are not anticipated as hydrocarbons are not expected to gravitate toward the seafloor (as described above). Geomorphic features located within the water column such as shoals and banks, however, may be impacted by dissolved and/or entrained hydrocarbons (refer to receptors in **Table 6-17**). Spill modelling indicates that Glomar Shoal and Rankin Bank, for example, would be

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contacted by entrained and/or dissolved hydrocarbons. These features support benthic communities that may be impacted by hydrocarbons. Minimum time to these receptors for entrained hydrocarbons for a subsea release is 397 hours (Glomar Shoal) and 17 hours (Rankin Bank). Entrained hydrocarbons reaching Rankin Bank within the first day may, therefore, present toxic impacts to benthic communities as they will not have had a chance to weather significantly. The worst-case modelling replicate indicated entrained hydrocarbon concentrations of 153 ppb at Rankin Bank.

Notably, given the depths of Rankin Bank and Glomar Shoal, the potential for impacts to benthic communities is considered to be significantly reduced given hydrocarbons will primarily feature in the upper water column.

Summary of Potential Impacts to Socio-economic Values	
Setting	***Receptor Group***
All Settings	**Cultural Heritage** Entrained hydrocarbons above threshold concentrations are predicted to reach the Ningaloo Coast. It is acknowledged that this area contains numerous Indigenous 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 Indigenous groups. No shoreline contact was modelled for the Ningaloo Coast and, therefore, no impacts to these sites is anticipated. The Ningaloo Coast is also designated a National, Commonwealth and World Heritage Feature. Impacts to the Ningaloo Coast have been discussed in the respective receptor sections above. Whilst there are no shipwrecks within or near to the Operational Area, there are a number of shipwrecks within the EMBA. Shipwrecks occurring in the subtidal zone will be exposed to entrained and dissolved hydrocarbons, and the 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 displacement of larger fish species (i.e avoidance behaviours) and/or resident fish species and sessile benthos (such as hard corals) exhibiting sub-lethal and lethal impacts (which may range from physiological issues to mortality).
Offshore Waters	**Fisheries – Commercial** Please refer to **Section 4.9.2** for a list of the fisheries occurring within the EMBA, and for those considered to have potential for impact with the Petroleum Activities Program. A worst-case hydrocarbon spill, as modelled for this EP, is not considered likely to cause significant direct impacts on the target species of these commercial fisheries, as discussed below. Please see the above sections for a discussion of impacts to spawning. 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 comparably 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 fishers and can impact seafood markets long after any actual risk to seafood from a spill has subsided (Yender et al. 2002). A major hydrocarbon spill would result in the establishment of an exclusion zone around the spill affected area. There would also be a temporary prohibition on fishing activities for a period of time. Subsequently, there is potential for economic impacts to the affected commercial fishing operators. Additionally, hydrocarbon can foul fishing equipment such as traps and trawl nets, requiring cleaning or replacement. The impact to fishers would be dependant on the extent of the spill and resulting exclusion zone and may cause economic impacts as a result of fishing bans, damaged equipment and/or consumer perception of seafood safety. These impacts would not be expected to be long term or affect the viability of the fishery.
	Tourism and Recreation 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). Limited recreational fishing takes place in the offshore waters of the Operational Area due to the distance from land mass, however; fishing may take place at nearby Rankin Bank and also at Glomar Shoal.

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	Impacts on species that are recreationally fished are described above under 'Commercial Fisheries' and 'Pelagic and Demersal Fish'. A worst-case spill may lead to the exclusion of marine nature-based tourist activities, resulting in a loss of revenue for tour operators. These impacts would not be expected to be long term.
	Offshore Oil and Gas Infrastructure Surface hydrocarbons from a worst-case spill may affect production from existing offshore petroleum facilities (e.g. platforms and Floating production, storage, and offtake (FPSOs)). 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 activity support vessel access as well as tankers approaching facilities on the NWS. The impact on ongoing operations of regional production facilities would be determined by the nature and scale of the spill and the metocean conditions at the time. 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 oil and gas operation is the NRC platform (operated by Woodside). Other nearby facilities include the Chevron-operated Wheatstone platform and the Woodside-operated Pluto platform (**Section 4.9.6**). Operation of these facilities is likely to be affected in the event of a worst-case loss of well containment.
Nearshore Island and Mainland Coastal Areas (Nearshore Waters)	**Fisheries – Traditional** Although no designated traditional fisheries have been identified within the Operational Area or EMBA, it is recognised that Indigenous communities fish in the shallow coastal and nearshore waters of Ningaloo Reef and therefore may be impacted if a worst-case hydrocarbon spill were to occur. Impacts would be similar to those identified for commercial fishing, in the form of a potential fishing exclusion zone and possible contamination/tainting of fish stocks.
	Tourism and Recreation In the unlikely event of a major spill, the nearshore waters of the Ningaloo Coast (including the Ningaloo Coast Marine Park) could be reached by entrained and dissolved hydrocarbons, depending on the prevailing wind and current conditions. This location offers a number of amenities, such as fishing, swimming, snorkelling and other water-based activities, and 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 within the Ningaloo coastal area, there could be restricted access to beaches for a period of days to weeks, until natural weathering or tides and currents remove the hydrocarbons. Notably, shoreline contact at > 10 g/m2 was modelled along the Ningaloo Coastline. In the event of a major spill, tourists and recreational users may also avoid areas due to perceived impacts, including after the hydrocarbon spill has dispersed. There is also the potential for stakeholder perception that this remote environment will be contaminated over a larger 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 will depend on the size of the spill, effectiveness of the spill clean-up and change in any public misconceptions regarding the spill (Oxford Economics 2010). Other notable areas modelled to receive shoreline accumulation ≥ 10 g/m^2 include the Muiron Islands, Muiron Islands MMA, Southern Pilbara Islands, Exmouth coastline, Airlie Island, Ashburton Island, Barrow Island, Bessieres Island, Boodie Island, Direction Island, Middle Island, Montebello islands, Montebello Islands MP, Sunday Island and Thevenard Island. Impacts to these receptors would be as discussed above, although less significant due to the lower levels of tourism and recreation activities undertaken at these locations compared with the Ningaloo Coast.

MEE-01 Well Loss of Containment – Risk Analysis
A bowtie risk analysis was undertaken to assess MEE-01; refer to the below figures (**Figure 6-9** to **Figure 6-12**) for bowtie diagrams which were an output of Woodside's risk analysis process.

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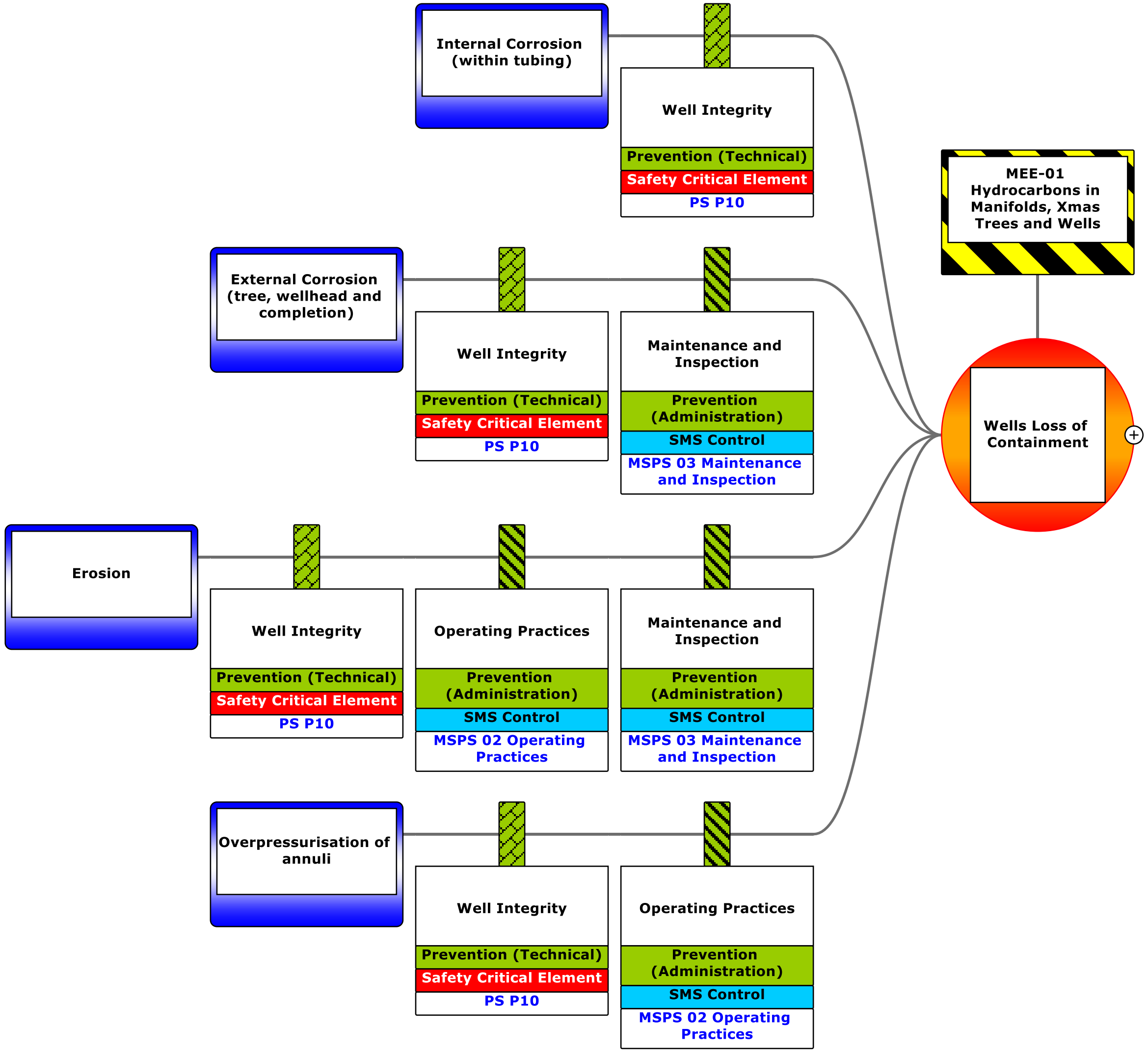

Figure 6-9: MEE-01 well loss of containment (cause 1-4)

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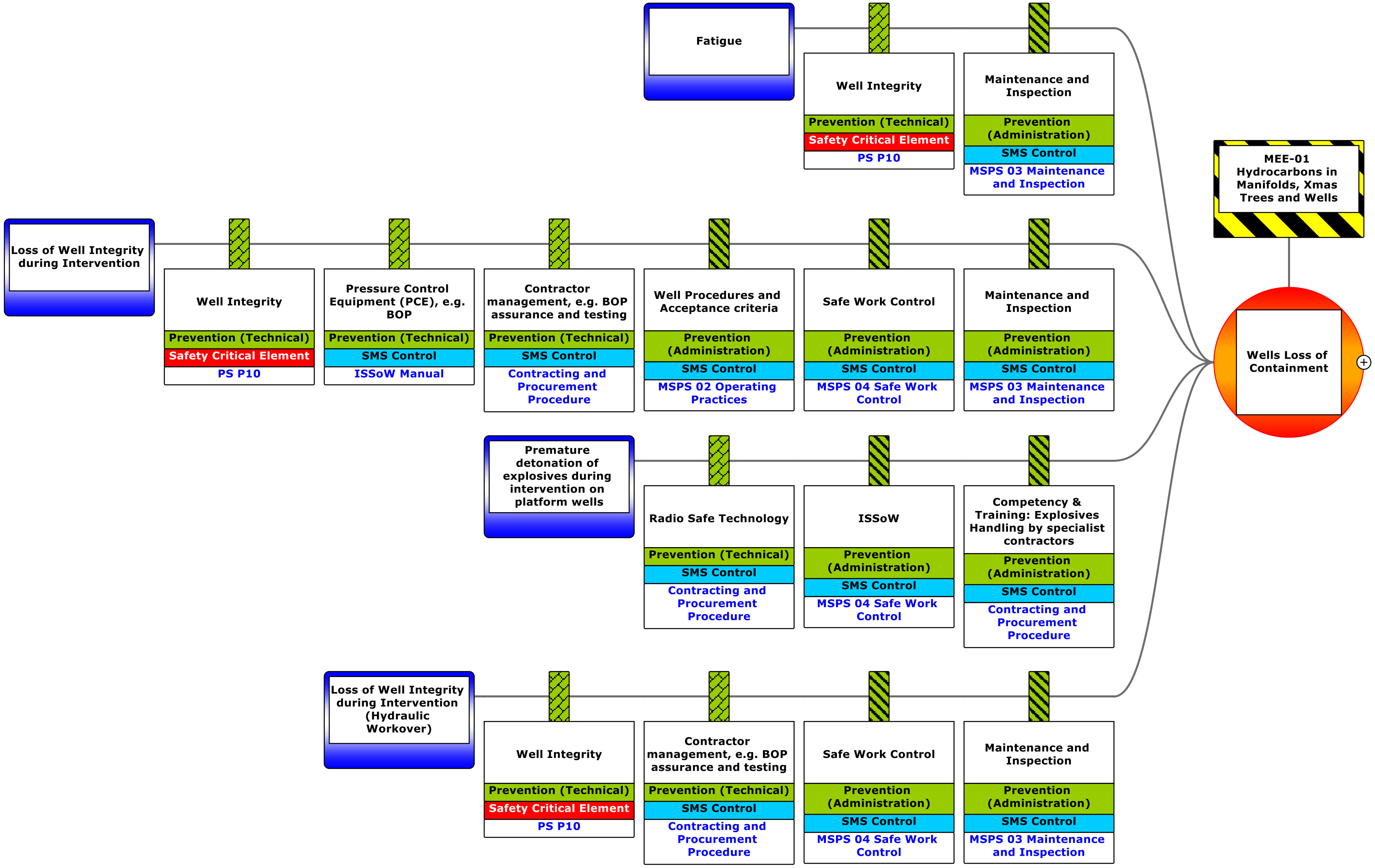

Figure 6-10: MEE-01 well loss of containment (causes 5-8)

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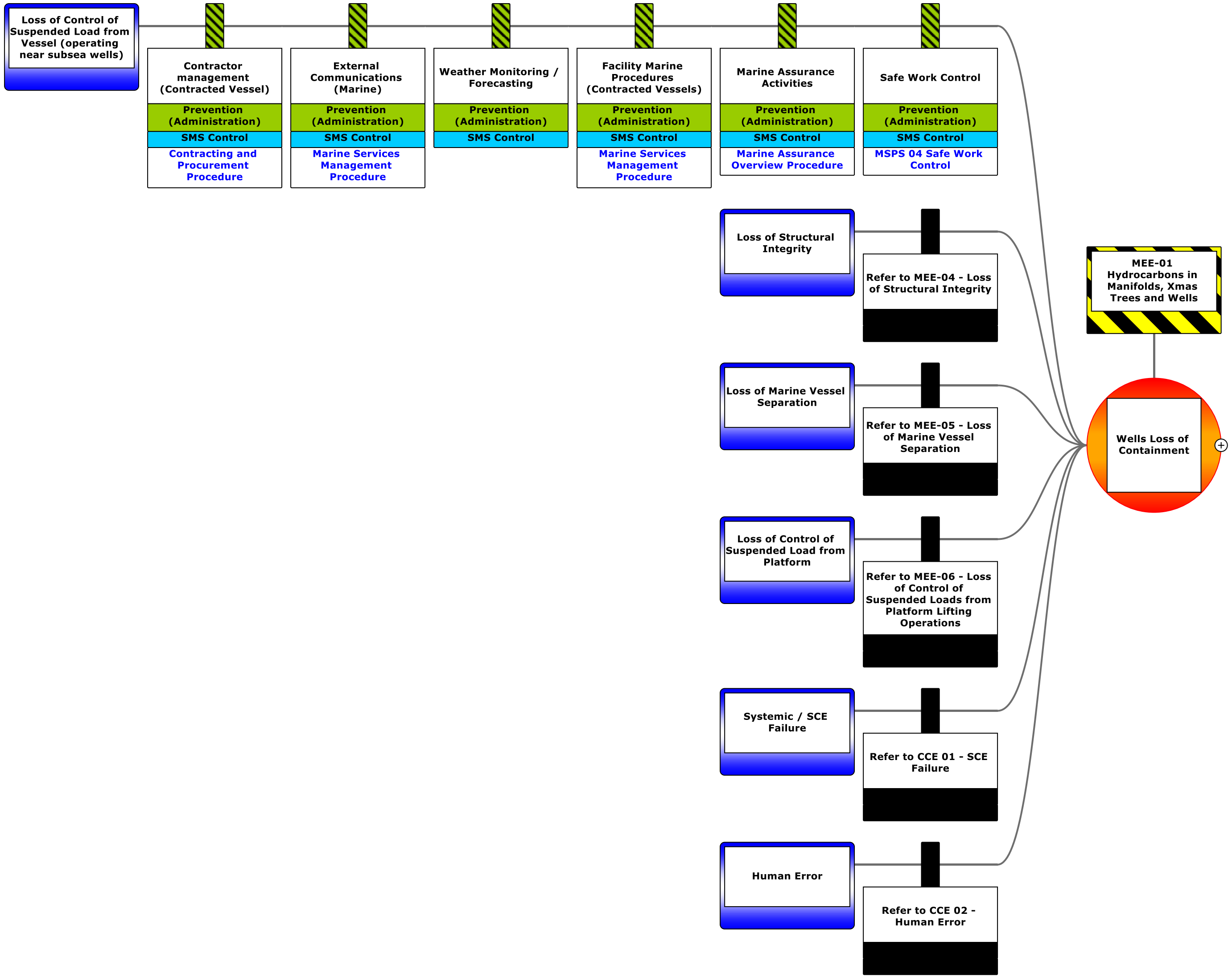

Figure 6-11: MEE-01 well loss of containment (cause 9-14)

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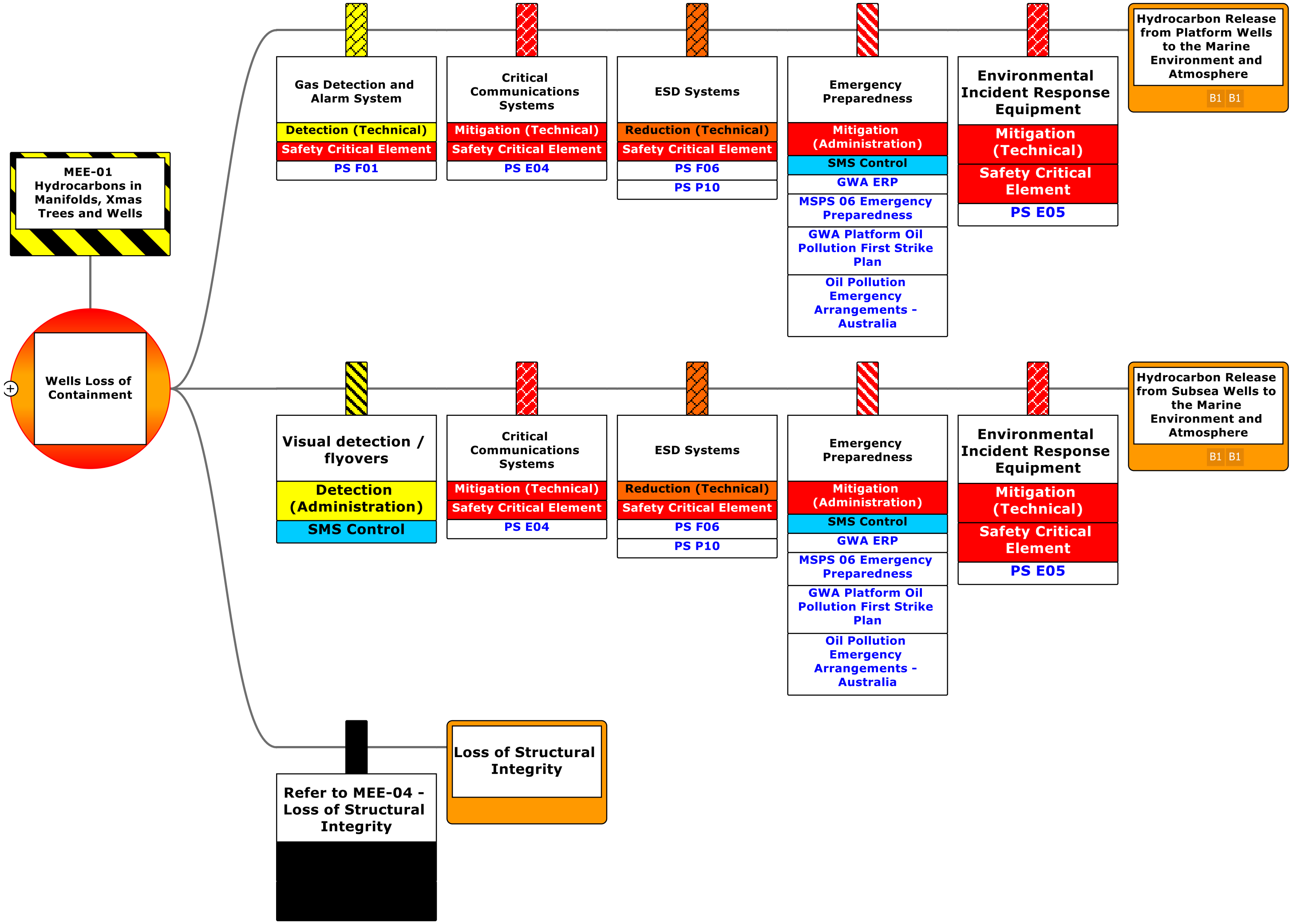

Figure 6-12: MEE-01 well loss of containment outcomes

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MEE-01 Well Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
Preventative Barriers – Safety and Environmental Critical Elements				
Elimination	n/a	No elimination or substitution controls were identified beyond those incorporated in design.		
Substitution				
Engineering Controls	Maintain well mechanical integrity to contain reservoir fluids within the well envelope to avoid a MEE	P10 – Wells P09 – Pipeline systems	Prevention (Technical)	Yes **C 13.1**
Mitigating Barrier – Safety and Environmental Critical Elements				
Engineering Controls	Maintain availability of critical external and internal communication systems to facilitate response to accidents and emergencies	E04 - Safety Critical Communication Systems	Mitigation (Technical)	Yes **C 13.2**
Engineering Controls	Maintain Fire and Gas Detection and Alarm Systems on GWA facility to prevent and response to fire or gas hazards	F01 – Fire and Gas Detection and Alarm Systems	Detection (Technical)	Yes **C 13.3**
Engineering Controls	Maintain Safety Instrumented System (Safety Instrumented Functions and ESD actions) to detect and respond to pre-defined initiating conditions and/or initiate responses that put the process plant, equipment, and the wells in a safe condition so as to prevent or mitigate the effects of a MEE	F06 – Safety Instrumented System P10 – Wells	Reduction / Control (Technical)	Yes **C 13.4**
Emergency Response	Maintain environmental incident response equipment to enact the GWA First Strike Plan	E05 – Environmental Incident Response Equipment	Mitigation (Technical)	Yes **C 13.5**
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: Accepted Well Operations Management Plan (WOMP) to demonstrate that the risks to well integrity are managed in accordance with sound engineering principles, standards, specifications, and good oilfield practice. It describes the systems	GWA Well Operations Management Plan (WOMP)	Prevention / Mitigation (Administration) Control based on legislative requirements – must be adopted)	Yes **C 13.6**

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MEE-01 Well Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
	that are in place to ensure well design and integrity is managed for the well lifecycle, thus contributing to management of associated potential environmental consequences of well integrity events.			
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: Accepted Safety Case for the GWA facility to; - identify hazards that have the potential to cause a MAE; - detail assessment of MAE risks; and - describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP; thus contributing to management of associated potential environmental consequences of MAEs.	GWA Safety Case	Prevention / Mitigation (Administration) Control based on legislative requirements – must be adopted	Yes **C 13.7**
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting and Investigation Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements	Yes **C 9.5**
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • M02 Operating Practices • M03 Maintenance and Inspections • M04 Safe Work Control • Management of Change – Assets Procedure (Temporary Equipment)	MSPS-02 Operating Practices MSPS-03 Maintenance and Inspections MSPS-04 Safe Work Control	Prevention (Administration)	Yes – See **Section 7.9** (Implementation Strategy)

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MEE-01 Well Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
	• Marine Services Management Procedure • Marine Assurance Overview Procedure • Contracting and Procurement Procedure			
Emergency Response and contingency planning	Implement management systems to maintain: • M06 - Emergency Preparedness • GWA Emergency Response Plan • Well Intervention Programme ESD Procedure • Goodwyn Alpha Oil Pollution First Strike Plan • Oil Pollution Emergency Arrangements - Australia	MSPS-06 Emergency Preparedness Well Intervention Programme ESD Procedure Goodwyn Alpha Oil Pollution First Strike Plan Oil Pollution Emergency Arrangements – Australia	Mitigation (Administration)	Yes – **C 13.8** **C 13.9** See **Section 7.9** (Implementation Strategy) Refer to **Appendix D** and **Appendix I** for discussion around the ALARP assessment of controls related to hydrocarbon spill response.

Risk Based Analysis

For risks identified as MEEs, a more detailed risk based Bowtie Analysis (as outlined in **Section 2.7**) has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event.

The application of Woodside's Risk Management Procedures and implementation of the WOMP ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:

- ongoing hazard identification, risk assessment and the identification of control measures
- ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability
- wells integrity codes and standards.

Well intervention activities are carried out to address maintenance issues with the wells but offer the potential for Loss of Containment from the wells. These activities are carried out using equipment specific to the task by specialist personnel under the Safe Work Control practices.

For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity.

Bowtie analysis was undertaken to assess MEE-01; refer to **Figure 6-9**, **Figure 6-10**, **Figure 6-11** and **Figure 6-12** for bowtie diagrams. A quantitative spill risk assessment was undertaken (refer **Section 6.8.1** for details of the method used).

Company Values

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MEE-01 Well Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
Corporate values require all personnel at Woodside to comply with appropriate policies, standards, procedures and processes while being accountable for their actions and holding others to account in line with the Woodside Compass. As detailed above, the Petroleum Activities Program will be undertaken in line with these policies, standards and procedures that include suitable controls to prevent loss of well containment, and response should a loss of well containment occur.				
Societal Values				
Due to the Petroleum Activities Program's proximity to sensitive receptors (e.g. Rankin Bank etc.) and the potential extent of the EMBA, the loss of well containment risk rating presents a Decision Type B in accordance with the decision support framework described in **Section 2.6.1**. Extensive consultation was undertaken for this program to identify the views and concerns of relevant stakeholders, as described in **Section 5**. Woodside has sent an Activity Factsheet to all identified relevant stakeholders regarding the Petroleum Activities Program (**Section 5** and **Appendix G**). Woodside has consulted with AMSA and WA Department of Transport (DoT) on spill response strategies. In accordance with the MoU between Woodside and AMSA, a copy of the Oil Pollution First Strike Plan was provided to AMSA.				
ALARP Statement: On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a very low likelihood unplanned hydrocarbon release as a result of a loss of well containment. The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of well integrity and ensuring the wells are operated within their design envelope through operating practices and assurance through maintenance and inspection. If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation. The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the GWA WOMP, SCE management procedures including technical performance standards for SCEs and Management System Performance Standards (MSPS) for Safety Critical Procedures. Given the controls in place to prevent and control loss of containment events and mitigate their consequences, alongside procedural control of well intervention activities, it is considered that MEE risk associated with Wells Loss of Containment at GWA and at subsea wells are managed to ALARP.				

Demonstration of Acceptability
Acceptability Statement Loss of well containment has been evaluated as having a 'high' risk rating. As per **Section 2**, Woodside considers 'high' risk ratings as acceptable if ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained. Acceptability is demonstrated with regard to the considerations below. **Principles of Ecologically Sustainable Development** Woodside has a strong history of exploration and development of oil and gas reserves in the North West of WA with an excellent environmental record, while providing revenue to State and Commonwealth Governments, returns to shareholders, jobs and support to local communities. Titles for oil and gas exploration are released based on commitments to explore with the aim of uncovering and developing resources. It is under the petroleum title lease agreement that Woodside has determined the potential to develop the hydrocarbon fields for which acceptance of this EP is sought under the Environment Regulations. Woodside has established a number of research projects in order to understand the marine environments in which they operate, notably in the Exmouth Region and the Kimberley Region, and also Rankin Bank, Glomar Shoal, Enfield Canyon and Scott Reef. Where scientific data do not exist, Woodside assumes that a pristine natural environment exists and therefore, implements all practicable steps to prevent damage. Woodside's corporate values (**Appendix A**) require that we consider the environment and communities in which we operate when making decisions. Woodside looks after the communities and environments in which it operates. Risks are inherent in petroleum activities; however, through sound management, systematic application of policies, standards, procedures and

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processes, Woodside considers that despite this risk, the extremely low likelihood of loss of well containment is acceptable.

Internal Context

The Petroleum Activities Program is consistent with Woodside corporate policies, standards, procedures, processes and training requirements as outlined in the Demonstration of ALARP and Environmental Performance Outcomes, including:

- Woodside Health, Safety and Environment Policy (**Appendix A)**
- Woodside Risk Management Policy (**Appendix A**)
- The SCE technical Performance Standards developed and implemented for the GWA facility
- Hydrocarbon 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**).

Woodside corporate values include working sustainably, with respect to the environment and communities in which we operate, listening to internal and external stakeholders and considering Health, Safety and Environment (HSE) when making decisions. Stakeholder consultation, outlined below, has been undertaken prior to the Petroleum Activities Program.

External Context - Societal Values

Woodside recognises that its licence to operate from a regulator and societal perspective is based on historical performance, complying with appropriate policies, standards and procedures, and understanding the expectations of external stakeholders. External stakeholder consultation, outlined below, has been undertaken prior to the Petroleum Activities Program:

- Woodside has consulted with AMSA and WA DoT on spill response strategies. In accordance with the MoU between Woodside and AMSA, a copy of the Oil Pollution First Strike Plan was provided to AMSA and DoT.
- Consultation with other relevant stakeholders (**Section 5**) and incorporation of stakeholder feedback (**Table 5-3**) into this EP where appropriate.
- By providing hydrocarbon spill response measures that are commensurate with the risk rating, location and sensitivity of the receiving environment (including social and aesthetic values), Woodside believes that this addresses societal concerns to an acceptable level.

Other Requirements (includes laws, policies, standards and conventions)

The Petroleum Activities Program is consistent with laws, policies, standards and conventions, including:

- accepted Safety Case (as per the requirements of the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009
- mutual aid MoU for relief well drilling is in place
- accepted WOMP as per the requirements of the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011
- Notification of reportable and recordable incidents to NOPSEMA, if required, in accordance with **Section 7.8**.
- The Petroleum Activities Program is consistent with the objectives in the Ningaloo management plans (Management Plan for Ningaloo Marine Park and Muiron Islands Marine Management Areas, Ningaloo Marine Park Management Plan) considerations to water quality, coral, shoreline and intertidal, macroalgal, seagrass, mangroves, seabirds and social and economic values is consistent with the management plans.

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 13 Well loss of containment risks to the environment limited to High during the Petroleum Activities Program.	**C 13.1** Maintain well mechanical integrity to contain reservoir fluids within the well envelope to avoid a MEE	**PS 13.1** Integrity will be managed in accordance with SCE Management Procedure (Section 6.1.5.2) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P10 – Wells to; – ensure that a well retains the mechanical integrity to contain reservoir fluids within the well envelope at all times to avoid a MEE. Including operate phase environmentally critical equipment for pressure containment, structures, monitoring and isolating systems associated with the well. • P09 – Pipeline systems to: – detect and support response (alarms and autonomous trips) to significant sand production for applicable systems to ensure the integrity of pressure equipment is not compromised.	Refer to **MC 1.6.1**
	C 13.2 Maintain availability of critical external and internal communication systems to facilitate prevention and response to accidents and emergencies	**PS 13.2** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5.2**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • E04 - Safety Critical Communication Systems to; – allow effective Emergency Response (ER) communications in emergencies, including; ○ Internal Communications such as audible and visual warning systems, and voice communications during emergency events ○ External Communications such as voice communications to adjacent facilities, aircraft and vessels, and external incident control centres during emergency events.	Refer to **MC 1.6.1**

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
	C 13.3 Maintain Fire and Gas Detection and Alarm Systems on GWA facility to facilitate prevention and response to fire or gas hazards	**PS 13.3** Integrity will be managed in accordance with SCE Management Procedure (Section 6.1.5.2) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F01 – Fire and Gas Detection and Alarm Systems to; – continuously monitor and alert for fire events and significant gas accumulations, initiate actions to minimise event escalation, and support Emergency Response by providing status of situation.	Refer to **MC 1.6.1**
	C 13.4 Maintain Safety Instrumented System (Safety Instrumented Functions and ESD actions) to detect and respond to pre-defined initiating conditions and/or initiate responses that put the process plant, equipment, and the wells in a safe condition so as to prevent or mitigate the effects of a MEE.	**PS 13.4** Integrity will be managed in accordance with SCE Management Procedure (Section 7.1.5.2) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F06 – Safety Instrumented System; • P10 – Wells to; together; – detect and respond to pre-defined initiating conditions and/or initiate responses that put the process plant, equipment, and the wells in a safe condition so as to prevent or mitigate the effects of a MEE.	Refer to **MC 1.6.1**
	C 13.5 Maintain environmental incident response equipment to enact the GWA First Strike Plan.	**PS 13.5** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5.1**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • E05 – Environmental Incident Response Equipment, including; – satellite tracking drifter buoy able to monitor spill movement; – provision of sufficient hydrocarbon spill response equipment for control and/or clean-up of liquid hydrocarbon spills to ocean; and	Refer to **MC 1.6.1**

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
		– minimum equipment coverage, to maintain adequate spill response capability.	
	C 13.6 Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011: Accepted WOMP.	**PS 13.6** An accepted WOMP is implemented, and well integrity notification and reporting is undertaken in accordance with the Regulations (as applicable).	**MC 13.6.1** Acceptance letter from NOPSEMA demonstrates acceptance of the WOMP. Records demonstrate applicable NOPSEMA notification and reporting.
	C 13.7 Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: Accepted Safety Case for the GWA facility	**PS 13.7** An accepted Safety Case is implemented, and safety notification and reporting is undertaken in accordance with the Regulations (as applicable).	**MC 13.7.1** Acceptance letter from NOPSEMA demonstrates acceptance of the Safety Case. Records demonstrate applicable NOPSEMA notification and reporting.
	C 13.8 In the event of a spill emergency response activities implemented in accordance with the OPEP	**PS 13.8** In the event of a spill the GWA Operations OPEP requirements are implemented.	**MC 13.8.1** Completed incident documentation
	C 13.9 Arrangements supporting the activities in the OPEP will be tested to ensure the OPEP can be implemented as planned	**PS 13.9a** Exercises/tests will be conducted in alignment with the frequency identified in **Table 7-7**.	**MC 13.9.1** Testing of arrangement records confirm that emergency response capability has been maintained.
		PS 13.9b Woodside's procedure demonstrates a minimum level of trained personnel, for core roles in the OPEP, are maintained.	**MC 13.9.2** Emergency Management dashboard confirms that minimum level of personnel trained for core OPEP roles are available.
	Refer to **C 9.5**	Refer to **PS 9.5**	Refer to **MC 9.5.1**

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6.8.4 Unplanned Hydrocarbon Release: Pipeline and Riser Loss of Containment (MEE-02)

Context		
Facility Layout and Description – **Section 3.5** Subsea Infrastructure – **Section 3.5.2** Platform Well Management and Maintenance Activities – **Section 3.11**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5** Protected Places – **Section 4.8** Socio-economic – **Section 4.9**	Stakeholder Consultation – **Section 5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Release of hydrocarbons resulting from loss of containment of subsea flowlines and infrastructure (GWF-1, GWF-2, PoG).		✓	✓	✓	✓	✓	✓	B	C	0	M	LCS RBA CV SV	Acceptable If ALARP	**EPO 14**
Release of hydrocarbons resulting from loss of export pipeline containment (IFL, including 2TL inventory).		✓	✓	✓	✓	✓	✓	B	B	1	M			

Description of Source of Impact

The GWA facility is connected to the following facilities:

- NRC via the 23 km, 30” IFL from the GWA RESDV via the GWA SSIV with tie-in to upstream weld to the IFL / 2TL tie-in tee. There is no fail closed or actuated isolation of the GWA IFL from 2TL;
- PoG subsea production wells via the 24.2 km, 16” diameter PoG pipeline; PoG SSIV approximately 75 m from GWA and the PoG riser;
- GWF-1 subsea production wells via the 14.4 km, 16” diameter GWF-1 pipeline; GWF-1 SSIV assembly approximately 80 m from GWA and the GWF-1 riser;
    - GWF-3 subsea production wells, tied in via the existing manifold on the GWF-1 flowline;
- GWF-2 subsea production wells via the 35.4 km, 16” diameter GWF-2 pipeline which ties into the GWF-1 flowline at the GWF-1 SSIV assembly; and

A subsea loss of containment of these components may result in the release of large volumes of hydrocarbon inventory. Due to the potential consequence of a worst-case subsea loss of containment, this risk is considered to be

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a MEE (MEE-02), with the exception of a loss of containment from PoG pipeline; the consequence of this scenario was not considered to be an MEE.

The pipeline, flowline and riser design include a range of measures that specifically aid in minimising the risk of external damage. These include:

Material selection for strength and corrosion resistant properties;

- subsea and surface valves to isolate pipelines from the facility and vice versa;
- subsea shutdown system closes on loss of hydraulic pressure;
- construction and installation techniques such as stabilisation and self-burial;
- design of subsea equipment which takes into consideration snag potential and, where practicable, is snag resistant;
- installation of flowline LP alarms (set above minimum operating pressure); and
- flowline specifications upgraded in line with changing technologies.

The potential hazard sources that could instigate a loss of containment from the GWA pipelines and risers are:

- anchor impacts/dragging;
- vessel impacts;
- pipeline stability and free spans;
- pipeline assembly and fittings;
- internal or external corrosion;
- erosion (for flowlines PoG, GWF-1 and GWF-2);
- operational activities;
- overpressure;
- exceedance of design temperature (for IFL);
- equipment fatigue (risers and structural supports);
- Loss of control of suspended load from vessel during IMR or other activities / dropped objects;
- design and other defects; and
- human management/error.

Although anchor impact/dragging are potential hazard sources, typical commercial trawling practices are not considered credible to result in pipeline loss of containment, given structural protection frames are in place for key subsea infrastructure (e.g. manifolds) according to design risk based analysis. Notably, the Operational Area is located outside of the North-west Slope Trawl Fishery and the Western Deepwater Trawl Fishery fishery areas (demersal trawl fishing areas within proximity of the NWS). Whilst the Operational Area overlaps the Pilbara Trawl Interim Managed Fishery, this portion of the fishery is closed to trawling.

Maintenance of subsea infrastructure structural protection frames are included in mechanical integrity controls set out for pipeline integrity performance standard P09-Pipeline System.

A number of common failure causes due to human error and Safety Critical Equipment (SCE) failures are presented in the generic Human Error and SCE failure bowties in **Section 6.8.9**.

Escalation from other MEEs can cause Pipeline and Riser Loss of Containment:

- Loss of Structural Integrity (MEE-04) (**Section 6.8.6**);
- Loss of Marine Vessel Separation (MEE-05) (**Section 6.8.7**); and
- Loss of Control of Suspended Load from facility lifting operations (MEE-06) (**Section 6.8.8**).

Subsea Loss of Containment – Credible Scenarios

Three credible worst-case subsea loss of containment scenarios were identified:

- Scenario 3 - Flowlines (GWF-1 / GWF-2) subsea release outboard of SSIV;
- Scenario 4 - Subsea release from IFL (including 2TL inventory) downstream of SSIV but within 500 m of GWA facility; and
- Scenario 5 - Surface release from IFL (including 2TL inventory) from rupture of riser at GWA facility.

Each worst-case scenario assumes the subsea loss of the entire hydrocarbon inventory of the pipework; no additional supply of hydrocarbons to the compromised infrastructure is assumed (i.e. assumed that the ESD system has functioned correctly). The release location for Scenario 3 was based on the closest proximity to a sensitive receptor (Rankin Bank); this location is the western end of the GWF-2 pipeline (at the LPA PLET). The release location for Scenarios 4 and 5 is situated at the GWA facility; this location was considered to be the most likely location for a subsea loss of containment of the IFL (due to loss of suspended load, refer to **Section 6.8.8**) and the release volume would be larger than a release from GWF3 infrastructure, due to the GWF3 wells tying into an existing GDA manifold. The subsea loss of containment scenarios parameters are summarised in **Table 6-18**.

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Table 6-18: Summary of worst-case subsea loss of containment hydrocarbon release scenarios

Scenario	Hydrocarbon	Duration (hrs)	Depth (m)	Latitude (D°M'S'' S)	Longitude (D°M'S'' E)	Total Release Volume (m^3)
Scenario 3 - Flowlines (GWF-1 / GWF-2) subsea release outboard of SSIV	GWF-2 condensate	< 4 hrs	78	19° 49' 42"	115° 39' 30"	237
Scenario 4 - Subsea release from IFL (including 2TL inventory) downstream of SSIV but within 500 m of GWA facility	GWA condensate	< 6 hrs	131	19° 39' 8"	115° 55' 46"	8,090
Scenario 5 - Surface release from IFL (including 2TL inventory) from rupture of riser at GWA facility	GWA condensate	< 6 hrs	Surface	19° 39' 8"	115° 55' 46"	7,623

Decision Type, Risk Analysis and ALARP Tools

Woodside has a good history of implementing industry standard practice in subsea system design and construction. In the company's recent history, it has not experienced any subsea integrity events that have resulted in significant environmental impacts. The GWA facility has never experienced a worst-case subsea loss of containment in its operational history.

Decision Type

A decision type 'B' has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications should the event be realised. To align with this decision type, a further level of analysis has been applied using risk based tools including the Bowtie methodology (described in **Section 2**) and hydrocarbon spill trajectory modelling. Company were also considered in the demonstration of ALARP and acceptability.

The release of hydrocarbons as a result of subsea loss of containment is considered a Major Environment Event (MEE-02). The hazard associated with this MEE is hydrocarbons in subsea infrastructure (pipelines, flowlines, manifolds etc.) tied to or originating from the GWA facility.

Quantitative Spill Risk Assessment

Spill modelling of each of the subsea loss of containment credible spill scenarios was undertaken by RPS, on behalf of Woodside, to determine the fate of hydrocarbon released in each scenario based on the assumptions in **Table 6-18**. Modelling was undertaken over all seasons to address year-round operations. This is considered to provide a conservative estimate of the EMBA and the potential impacts from the identified worst-case credible release volumes for all subsea loss containment scenarios.

Hydrocarbon Characteristics

GWA condensate blend has been used for the modelling as it is considered representative of a blend when GWF3 is online. Refer to **Section 6.8.1.1** for a description of the GWA Condensate hydrocarbon characteristics.

Subsea Plume Dynamics

The subsea loss of containment scenarios (Scenarios 3 and 4) would result in a buoyant plume of hydrocarbons, which has been modelled using the OILMAP-Deep numerical model (summarised in **Table 6-19**).

Table 6-19: Inputs and outputs for OILMAP-Deep model for Scenarios 3 and 4

	Parameter	Scenario 3	Scenario 4
Inputs	Release depth (m below sea level)	78.0	131.0
	Oil density (g/cm^3) (at 15°C)	0.791	0.738
	Oil viscosity (cP) (at 15°C)	1.175	0.529
	Oil temperature (°C)	50	25
	Gas:Oil ratio (m^3/m^3) [scf/barrel]	3,600 [20,211]	6,066 [34,055]

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	Oil flow rate (m^3/d)	237 [1491]	2,191 [13,781]
	Hole diameter (m) [in]	0.350 [13.763]	0.723 [28.472]
Outputs	Plume diameter (m)	10.1	16.9
	Plume height (m above sea level)	78.0 (Surface)	131.0 (Surface)
	Plume initial rise velocity (m/s)	12.8	19.8
	Plume terminal rise velocity (m/s)	10.4	16.1
Predicted oil droplet size distribution	21.4% droplets of size (µm)	18.4	5.9
	31.1% droplets of size (µm)	36.9	11.9
	24.7% droplets of size (µm)	55.3	17.8
	15.1% droplets of size (µm)	73.8	23.8
	7.7% droplets of size (µm)	92.2	29.7

Likelihood

In accordance with the Woodside Risk Matrix, given prevention and mitigation measures in place (i.e., design, inspection and maintenance, pipeline marked on marine charts), the likelihood has been taken as 1 (Highly Unlikely). The likelihood of release due to dropped object impact is also taken as 0 (Remote) because the flowlines outboard of the SSIVs are outside the drop range for lifting activities taking place on the facility.

Consequence

The spatial extent and fate (including weathering) of the spilled hydrocarbon were considered during the impact assessment for a worst-case subsea or riser loss of containment (presented in the following section). These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (**Section 4**) and relevant literature and studies considering the effects of hydrocarbon exposure.

Consequence Assessment

Environment that May Be Affected

Surface Hydrocarbons

Quantitative spill modelling for Scenarios 3 and 4 did not indicate surface hydrocarbons at concentrations > 10 g/m^2. Hence, there are no receptors predicted to be contacted by floating hydrocarbons for these scenarios. Modelling of Scenario 5 indicated the potential for floating oil > 10 g/m^2 in the vicinity of the release location. Floating hydrocarbons above impact thresholds were not predicted to contact key surface receptor locations.

Entrained Hydrocarbons

Modelling results indicated a number of environmental sensitivities may be contacted by entrained hydrocarbons above impact thresholds, with time to contact ranging from 1 day (Rankin Bank) to 39 days (Montebello Shoals). In the event of a worst-case subsea loss of containment scenario occurring, entrained hydrocarbons at or above 100 ppb are forecast to potentially extend up to 446 km from the release site. The most likely direction of drift is south-westerly around the Ningaloo Coast, reflecting the prevailing current patterns. Results also indicate that entrained oil may also be likely to drift towards the northeast and in the offshore directions at lower probabilities.

Dissolved Hydrocarbons

Modelling results indicated a number of environmental sensitivities may be contacted by dissolved hydrocarbons above impact thresholds (> 50 ppb). In the event of a subsea loss of containment scenario occurring, dissolved hydrocarbons at or above 50 ppb are forecast to potentially occur up to 639 km from the release site.

Accumulated Hydrocarbons

No accumulated hydrocarbons above impact thresholds were predicted by modelling for the release scenarios considered in MEE-02.

Consequence Assessment Summary

The credible worst-case hydrocarbon spill scenarios that may arise from MEE-02 may impact upon a range of environmental receptors; refer to **Table 6-20** for a summary of receptors identified by the stochastic spill modelling studies. Potential impacts of a hydrocarbon spill to these receptors are considered in MEE-01; refer to **Section 6.8.3** for a description of potential impacts. The credible worst-case hydrocarbon volumes that can credibly be released by MEE-02 are significantly smaller than the credible worst-case loss of well containment volumes considered in MEE-01 and durations are significantly shorter (**Section 6.8.3**).

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However, the EMBA for MEE-02 extends further south than MEE-01 and therefore additional receptors were identified that may be affected in the event of a pipeline or riser loss of containment. These included:

- Western demersal slope and associated fish communities of the Central Western Province – about 713 km south-west of the Operational Area
- short-nose seasnake
- leaf-scaled seasnake

The expected impacts to these receptors, KEFs and seasnakes, are as described in **Section 6.8.3**.

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Table 6-20: Environment that May Be Affected - key receptor locations and sensitivities with the summary hydrocarbon spill contact for a pipeline loss of containment

Environmental Setting	Receptor	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure0																													Probability of hydrocarbon contact and fate (%)[30]					
		Physical		Biological																						Socio-economic and Cultural										
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species									Other Species							Socio-cultural EMBA		EMBA			
		Open Water (Pristine)	Marine Sediment (Pristine)	Coral Reef	Seagrass Beds / Macroalgae	Mangroves	Spawning / Nursery Areas	Open water – Productivity / Upwelling	Non-biogenic 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 / Fur Seals)	Marine Turtles (Foraging, Internesting Areas, Significant Nesting Beaches)	Sea Snakes	Whale Sharks	Sharks and Rays	Seabirds and Migratory Shorebirds	Pelagic Fish Populations	Demersal Fish Populations	Fisheries - Commercial	Fisheries - Traditional	Tourism and Recreation	Protected Areas / Heritage – European / Indigenous / Underwater Cultural Heritage	Offshore Oil and Gas Infrastructure (topside and subsea)	Surface hydrocarbon (1–10 g/m²)	Accumulated hydrocarbons (10–100 g/m²)	Surface Hydrocarbons (≥ 10 g/m²)	Entrained Hydrocarbons (≥ 100 ppb)	Dissolved Hydrocarbons (≥50 ppb)	Accumulated Hydrocarbons (≥ 100 g/m²)
Offshore[31]	Ningaloo AMP										✓	✓	✓	✓					✓					✓				✓	✓					1.5	2	
	Argo-Rowley Terrace MP	✓						✓							✓	✓			✓			✓	✓	✓		✓			✓					0.5		
	Gascoyne AMP	✓	✓												✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓				1	2	
	Montebello AMP	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓					16.5	2	
	Shark Bay AMP	✓	✓		✓					✓					✓	✓			✓	✓			✓	✓	✓	✓	✓	✓	✓					0.5	0.5	
Coastlines	Exmouth	✓	✓	✓	✓	✓	✓					✓			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓					2	0.5	
Submerged Shoals	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			4			35.5	34.5	

[30] *Worst case probability*

[31] *Note: hydrocarbons cannot accumulate on open ocean, submerged receptors, or receptors not fully emergent*

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Environmental Setting	Receptor	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure0)																													Probability of hydrocarbon contact and fate (%)[30]					
		Physical		Biological																						Socio-economic and Cultural										
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species									Other Species							Socio-cultural EMBA		EMBA			
		Open Water (Pristine)	Marine Sediment (Pristine)	Coral Reef	Seagrass Beds / Macroalgae	Mangroves	Spawning / Nursery Areas	Open water – Productivity / Upwelling	Non-biogenic 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 / Fur Seals)	Marine Turtles (Foraging, Internesting Areas, Significant Nesting Beaches)	Sea Snakes	Whale Sharks	Sharks and Rays	Seabirds and Migratory Shorebirds	Pelagic Fish Populations	Demersal Fish Populations	Fisheries - Commercial	Fisheries - Traditional	Tourism and Recreation	Protected Areas / Heritage – European / Indigenous / Underwater Cultural Heritage	Offshore Oil and Gas Infrastructure (topside and subsea)	Surface hydrocarbon (1–10 g/m²)	Accumulated hydrocarbons (10–100 g/m²)	Surface Hydrocarbons (≥ 10 g/m²)	Entrained Hydrocarbons (≥ 100 ppb)	Dissolved Hydrocarbons (≥50 ppb)	Accumulated Hydrocarbons (≥ 100 g/m²)
	Northern Pilbara Reefs and Shoals	✓	✓				✓	✓		✓						✓				✓		✓		✓	✓	✓		✓						0.5		
	Glomar Shoals	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓							1	
	Barrow and Montebello Reefs and Shoals	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓					0.5	1	
	Exmouth Reefs and Shoals										✓	✓	✓	✓					✓				✓					✓	✓					2	1	
	Pilbara Reefs and Shoals	✓	✓	✓	✓					✓				✓		✓	✓		✓	✓	✓	✓		✓	✓			✓						35.5		
Islands	Pilbara Islands Southern Island Group	✓	✓		✓		✓		✓			✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓					0.5	0.5	
	Barrow – Montebello Islands	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓				1	1.5	

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Environmental Setting	Receptor	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure0)																													Probability of hydrocarbon contact and fate (%)[30]					
		Physical		Biological																						Socio-economic and Cultural										
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species										Other Species							Socio-cultural EMBA		EMBA			
		Open Water (Pristine)	Marine Sediment (Pristine)	Coral Reef	Seagrass Beds / Macroalgae	Mangroves	Spawning / Nursery Areas	Open water – Productivity / Upwelling	Non-biogenic 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 / Fur Seals)	Marine Turtles (Foraging, Internesting Areas, Significant Nesting Beaches)	Sea Snakes	Whale Sharks	Sharks and Rays	Seabirds and Migratory Shorebirds	Pelagic Fish Populations	Demersal Fish Populations	Fisheries - Commercial	Fisheries - Traditional	Tourism and Recreation	Protected Areas / Heritage – European / Indigenous / Underwater Cultural Heritage	Offshore Oil and Gas Infrastructure (topside and subsea)	Surface hydrocarbon (1–10 g/m²)	Accumulated hydrocarbons (10–100 g/m²)	Surface Hydrocarbons (≥ 10 g/m²)	Entrained Hydrocarbons (≥ 100 ppb)	Dissolved Hydrocarbons (≥50 ppb)	Accumulated Hydrocarbons (≥ 100 g/m²)
State Marine Parks and Nature Reserves	Barrow Island MP (State)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓				0.5	1.5	
	Barrow Island MMA	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓				1	1.5	
	Montebello Islands MP	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓					0.5	2	
	Murion islands MMA	✓	✓	✓	✓		✓	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓					0.5		
	Ningaloo Coast WH										✓	✓	✓	✓					✓				✓					✓	✓					2	2	
	Ningaloo MP (State)										✓	✓	✓	✓					✓				✓					✓	✓					2	1	

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MEE-02 Pipeline and Riser Loss of Containment – Risk Analysis
Bowtie risk analysis was undertaken to assess MEE-02; refer to **Figure 6-13, Figure 6-14, Figure 6-15 and Figure 6-16**

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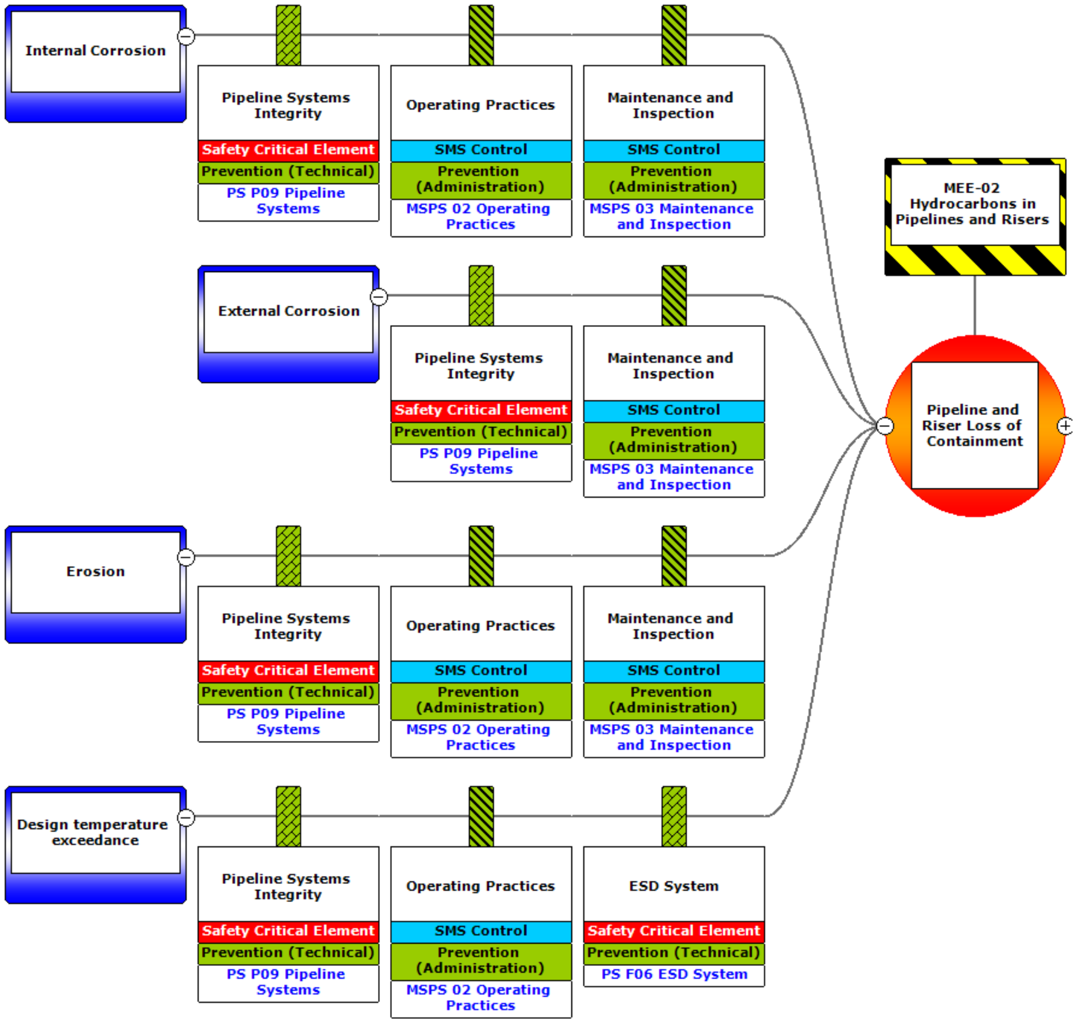

Figure 6-13: MEE-02 pipeline and riser loss of containment (causes 1-5)

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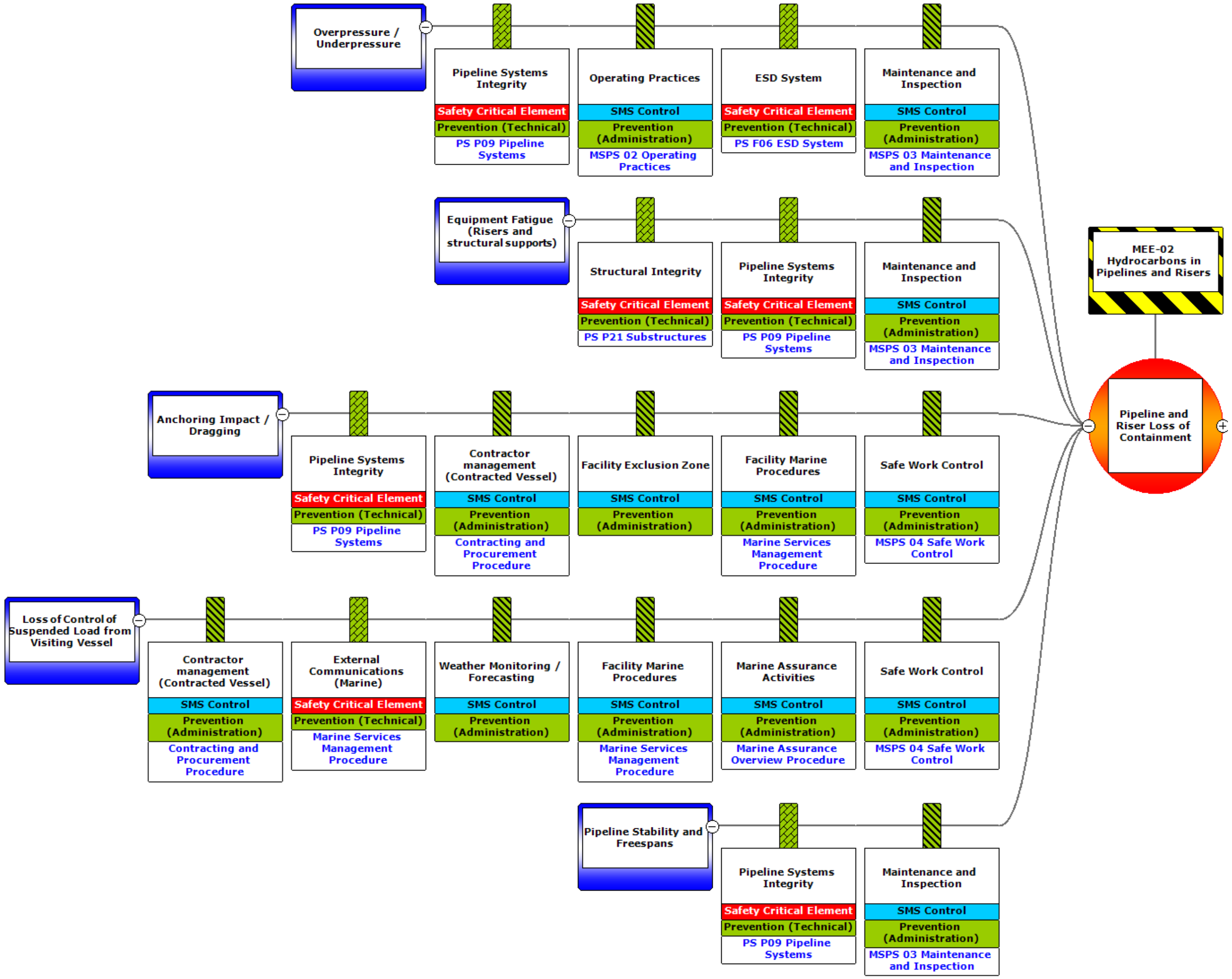

Figure 6-14: MEE-02: pipeline and riser loss of containment (causes 6-10)

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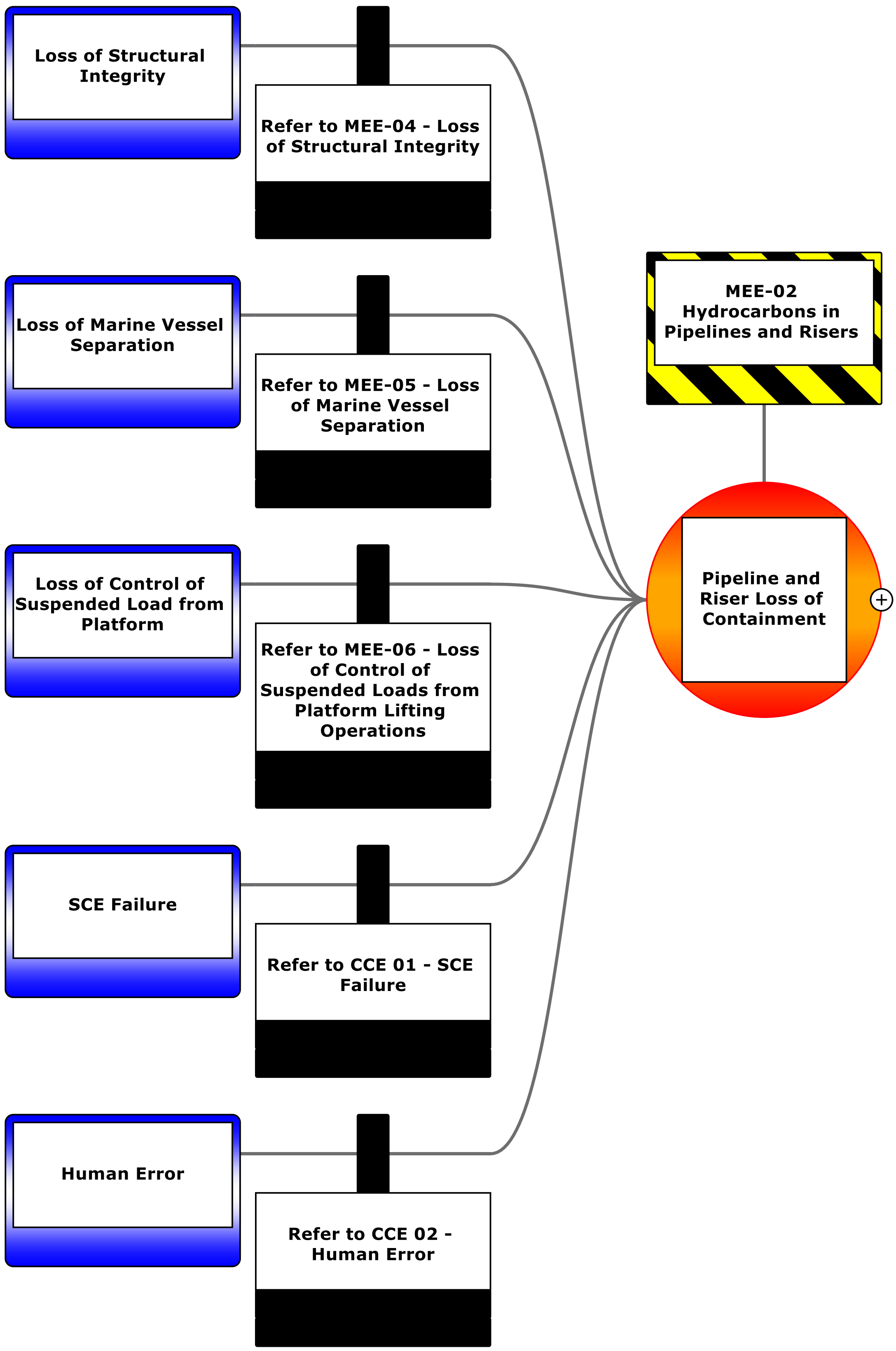

Figure 6-15: MEE-02 Pipeline and riser loss of containment (cause 11-15)

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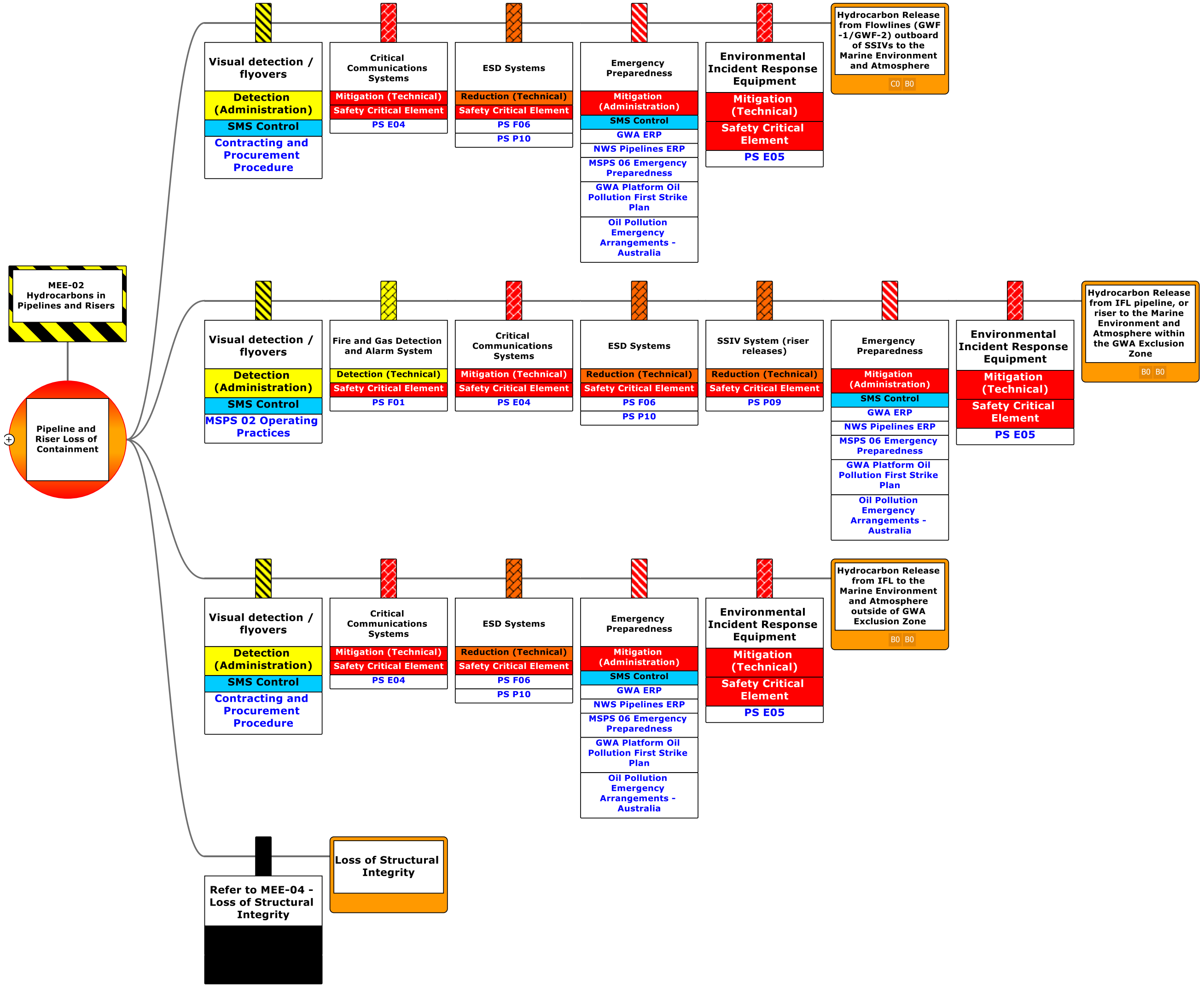

Figure 6-16: MEE-02 Pipeline and riser loss of containment (outcomes 1-4)

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MEE-02 Pipeline and Riser Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
Preventative Barriers – Safety and Environmental Critical Elements				
Elimination Substitution	N/A	No elimination or substitution controls were identified beyond those incorporated in design.		
Engineering Controls	Maintain pipeline, riser and hydrocarbon-containing infrastructure integrity to avoid a MEE	F06 – Safety Instrumented System P09 – Pipeline Systems P21 – Substructures	Prevention (Technical)	Yes **C 14.1**
Mitigating Barrier – Safety and Environmental Critical Elements				
Engineering Controls	Maintain Fire and Gas Detection and Alarm Systems on GWA facility to facilitate prevention and response to fire or gas hazards	F01 – Fire and Gas Detection and Alarm Systems	Detection (Technical)	Yes **C 13.3**
Engineering Controls	Maintain availability of critical external and internal communication systems to facilitate prevention and response to accidents and emergencies	E04 - Safety Critical Communication Systems	Mitigation (Technical)	Yes **C 13.2**
Engineering Controls	Maintain Safety Instrumented System (Safety Instrumented Functions and ESD actions) to detect and respond to pre-defined initiating conditions and/or initiate responses that put the process plant, equipment, and the wells in a safe condition (e.g. through appropriate isolation of hazardous inventories) so as to prevent or mitigate the effects of a MEE	F06 – Safety Instrumented System P09 – Pipeline Systems P10 – Wells	Reduction / Control (Technical)	Yes **C 14.2**
Emergency Response	Maintain environmental incident response equipment to enact the GWA First Strike Plan	E05 – Environmental Incident Response Equipment	Mitigation (Technical)	Yes **C 13.5**
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: Accepted Safety Case for the GWA facility to;	GWA Safety Case	Prevention / Mitigation (Administration) Control based on legislative requirements – must be adopted.	Yes **C 13.7**

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MEE-02 Pipeline and Riser Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
	• identify hazards that have the potential to cause a MAE; • detail assessment of MAE risks; and • describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP; thus contributing to management of associated potential environmental consequences of MAEs.			
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: Accepted Safety Case for the NWS Pipelines to; • identify hazards associated with pipeline operations that have the potential to cause a MAE; • provide a detailed description for each pipeline; • detail assessment of MAE risks; and • describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP; thus contributing to management of associated potential environmental consequences of pipeline related MAEs.	NWS Pipelines Safety Case	Prevention / Mitigation (Administration) Control based on legislative requirements – must be adopted	Yes **C 14.3**

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MEE-02 Pipeline and Riser Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting, Investigating and Learning Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements	Yes **C 9.5**
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • M02 Operating Practices • M03 Maintenance and Inspections • M04 Safe Work Control • Marine Services Management Procedure • Marine Assurance Overview Procedure • Contracting and Procurement Procedure	MSPS-02 Operating Practices MSPS-03 Maintenance and Inspections MSPS-04 Safe work Control Marine Services Management Procedure Marine Assurance Overview Procedure Contracting and Procurement Procedure	Prevention (Administration)	Yes – See **Section 7.9** Implementation Strategy.
Emergency Response and contingency planning	Implement management systems to maintain: M02 Operating Practices M06 - Emergency Preparedness GWA Emergency Response Plan NWS Pipelines ERP Goodwyn Alpha Oil Pollution First Strike Plan Oil Pollution Emergency Arrangements – Australia Contracting and Procurement Procedure	MSPS-02 Operating Practices MSPS-06 Emergency Preparedness GWA Emergency Response Plan Pipelines Emergency Response Plan Goodwyn Alpha Oil Pollution First Strike Plan Oil Pollution Emergency Arrangements – Australia Contracting and Procurement Procedure	Mitigation (Administration)	Yes – **C 13.8** **C 13.9** See **Section 7.9** Refer to **Appendix D Appendix I** for discussion around the ALARP assessment of controls related to hydrocarbon spill response.
Risk Based Analysis				
For risks identified as MEEs, a more detailed risk based Bowtie Analysis (as outlined in **Section 2**, has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event. Application of Woodside Risk Management Procedures, and implementation of the NWS Pipelines and GWA Safety Cases ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:				

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MEE-02 Pipeline and Riser Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***

- ongoing hazard identification, risk assessment and the identification of control measures; and
- ongoing integrity management of hardware control measures in accordance with the technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.

For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity.

Bowtie analysis was undertaken to assess MEE-02; refer to **Figure 6-13, Figure 6-14, Figure 6-15 and Figure 6-16** for bowtie diagrams.

A quantitative spill risk assessment was undertaken (refer **Section 6.8.1** for details of spill modelling approach).

Company Values

Refer to Company Values in demonstration of ALARP for MEE-01 (**Section 6.8.3**).

Societal Values

Refer to Societal Values in demonstration of ALARP for MEE-01 (**Section 6.8.3**).

ALARP Statement:

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a highly unlikely unplanned hydrocarbon release as a result of a loss of pipeline or riser containment.

The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of pipeline and riser integrity and ensuring the systems are operated within their design envelope through operating practices and assurance through maintenance and inspection. If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation.

The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the GWA Safety Case and NWS Pipelines Safety Case, SCE management procedures including technical performance standards for Safety Critical Elements (SCEs) and MSPS for Safety Critical Procedures.

Given the controls in place to prevent and control loss of containment events and mitigate their consequences, it is considered that MEE risk associated with Pipeline or Riser Loss of Containment at GWA is managed to ALARP.

Demonstration of Acceptability

Acceptability Statement

Loss of pipeline or riser containment has been evaluated as having a ‘moderate’ level of risk rating. As per **Section 2**, Woodside considers ‘moderate’ risk ratings as broadly acceptable if the adopted controls are implemented. Due to the consequence associated with MEE-02, Decision Type B has been applied, and ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained.

Acceptability is demonstrated with regard to the considerations described in **Section 6.8.3** (MEE-01) (the considerations include principles of Ecological Sustainable Development, internal context, external context and other requirements (includes laws, policies, standards and conventions)).

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 14 Subsea loss of containment risks to the environment limited to High during the Petroleum Activities Program.	**C 14.1** Maintain pipeline, riser and hydrocarbon-containing infrastructure integrity to avoid a MEE.	**PS 14.1** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F06 – Safety Instrumented System • P09 – Pipeline Systems • P21 – Substructures; to together; - maintain the minimum required mechanical and structural integrity to prevent loss of containment that may result in a MEE; and - detect and respond to pre-defined initiating conditions to protect mechanical integrity.	Refer to **MC 1.6.1**
	Refer to **C 13.3**	Refer to **PS 13.3**	Refer to **MC 1.6.1**
	Refer to **C 13.2**	Refer to **PS 13.2**	Refer to **MC 1.6.1**
	C 14.2 Maintain Safety Instrumented System (Safety Instrumented Functions and ESD actions) to detect and respond to pre-defined initiating conditions and/or initiate responses that put the process plant, equipment, and the wells in a safe condition (e.g. through appropriate isolation of hazardous inventories) so as to prevent or mitigate the effects of a MEE.	**PS 14.2** Integrity will be managed in accordance with SCE Management Procedure (Section 6.1.5.2) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F06 – Safety Instrumented System • P09 – Pipeline Systems • P10 – Wells; to together; - detect and respond to pre-defined initiating conditions and/or initiate responses that put the process plant, equipment, and the wells in a safe condition so as to prevent or mitigate the effects of a MEE.	Refer to **MC 1.6.1**
	Refer to **C 13.5**	Refer to **PS 13.5**	Refer to **MC 1.6.1**
	Refer to **C 13.7**	Refer to **PS 13.7**	Refer to **MC 1.6.1**

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EPOs, EPSs and MC			
	C 14.3 Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: Accepted Safety Case for NWS Pipelines.	**PS 14.3** An accepted Safety Case is implemented, and notification and reporting is undertaken in accordance with the Regulations (as applicable).	Refer to **MC 13.7.1**
	Refer to **C 13.8**	Refer to **PS 13.8**	Refer to **MC 13.8.1**
	Refer to **C 13.9**	Refer to **PS 13.9a**	Refer to **MC 13.9.1a**
		Refer to **PS 13.9b**	Refer to **MC 13.9.1b**
	Refer to **C 9.5**	Refer to **PS 9.5**	Refer to **MC 9.5**

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6.8.5 Unplanned Hydrocarbon Release: Topsides Loss of Containment (MEE-03)

Context		
Topsides – **Section 3.5.1** Process Description – **Section 3.6.2** Hydrocarbon and Chemical Inventories and Selection – **Section 3.9**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5** Protected Places – **Section 4.8** Socio-economic – **Section 4.9**	Stakeholder Consultation – **Section 5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Hydrocarbon release from topside process equipment to the marine environment and atmosphere.			✓	✓	✓	✓	✓	B	C	1	M	LCS RBA CV SV	Acceptable if ALARP	**EPO 15**
Hydrocarbon release from topsides non-process equipment to the marine environment.			✓	✓	✓	✓	✓	B	D	1	M			

Description of Source of Impact

The hydrocarbon processing equipment on the GWA facility contains a considerable volume of hydrocarbons. The hydrocarbon inventory of this processing equipment may be released, potentially resulting in hydrocarbons being released to the marine environment. Topside process and non-process hydrocarbon inventories are provided in **Table 3-7** and **Table 3-8.**

Due to the potential consequences of a worst-case topsides loss of containment, this risk is considered to be a MEE (MEE-03). The following events could lead to loss of containment from the topsides:

- internal corrosion
- external corrosion
- erosion
- material defect
- welding defect
- piping/equipment repair defect
- vibration fatigue failure
- equipment overpressure
- catastrophic turbine failure
- loss of structural integrity
- loss of marine vessel separation
- loss of control of suspended load
- human/management error
- low temperature
- overstress of topsides equipment

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- equipment fatigue
- rotating equipment failure / uncontrolled transfer (including overflow)
- extreme weather.

A number of common failure causes due to human error and Safety Critical Equipment (SCE) failures are presented in the generic Human Error and SCE failure bowties in **Section 6.8.9**.

Escalation from other MEEs can also potentially lead to cause Topsides Loss of Containment:

- Loss of Structural Integrity (MEE-04) (**Section 6.8.6**)
- Loss of Marine Vessel Separation (MEE-05) (**Section 6.8.7**)
- Loss of Control of Suspended Load from facility lifting operations (MEE-06) (**Section 6.8.8**).

GWA's diesel storage tanks (194 m^3 and 149 m^3) are housed within the East and West crane pedestals and are integral into the structure which supports the crane. As such the tank structures have a low probability of failure. Diesel distribution draws from storage and a stainless steel Break Tank (0.8 m^3), and feeds the stainless steel diesel fire pump day tank (5.4 m^3), Emergency Diesel Generator (5.9 m^3) incorporated into the base frame Manual diesel transfer occurs for day tanks for both cranes situated within the crane structure (1.6 m^3 and 2 m^3 respectively) and small inventories to survival craft storage tanks.

Topsides Loss of Containment – Credible Hydrocarbon Spill Scenario

The following hydrocarbon inventories were considered as the worst-case topsides loss of containment scenario:

- Scenario 6 – Instantaneous release from the GWA facility of:
  - Gas and GWA Condensate: 135 m^3;
  - GWA Condensate: 403 m^3; and
  - Marine Diesel: 343 m^3.

The locations, hydrocarbon types and volumes for Scenario 6 are provided in **Table 6-21**.

Table 6-21: Summary of worst-case topsides loss of containment hydrocarbon release scenario

Scenario	Hydrocarbon	Duration (hrs)	Depth (m)	Latitude (D°M'S'' S)	Longitude (D°M'S'' E)	Total Release Volume (m^3)
Scenario 6 – Topsides loss of containment	Gas and condensate	Instantaneous	Surface	19° 39' 8"	115° 55' 46"	135
	Condensate					403
	Marine diesel					343

Decision Type, Risk Analysis and ALARP Tools

Woodside has a good history of implementing industry standard practice in topsides design and construction. In the company's recent history, it has not experienced any topside integrity events that have resulted in significant releases or significant environmental impacts. The GWA facility has never experienced a worst-case topsides loss of containment in its operational history.

Decision Type

A decision type 'B' has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications should the event be realised. To align with this decision type, a further level of analysis has been applied using risk based tools including the Bowtie Methodology (described in **Section 2**) and hydrocarbon spill trajectory modelling (**Section 6.8.1**). Company values were also considered in the demonstration of ALARP and acceptability.

The release of hydrocarbons as a result of topsides loss of containment is considered a Major Environment Event (MEE-03). The hazard associated with this MEE is hydrocarbon inventory on the GWA facility in process and non-process equipment. Note that Woodside has assessed the environment consequence of a worst-case credible loss of containment from process and non-process equipment as 'C' as per the Woodside Risk Matrix. Woodside has also assessed the reputational and brand consequences associated with this release and concluded that the event results in a 'B' level consequence, and hence meets Woodside's definition of a MEE (refer **Section 2.7.2**)

Quantitative Spill Risk Assessment

Spill modelling of the marine diesel component of Scenario 6 was undertaken by RPS, on behalf of Woodside, to determine the fate of hydrocarbon based on the assumptions in **Table 6-21**. Note that modelling of the gas and condensate components of Scenario 6 was not undertaken; the modelling used to inform Scenario 5 has been considered as a worst case analogue for these components in Scenario 6. Note also that the release location for Scenario 5 is consistent with Scenario 6, and the credible volumes are significantly larger.

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Modelling was undertaken over all seasons to address year-round operations. This is considered to provide a conservative estimate of the EMBA and the potential impacts from the identified worst-case credible release from a topsides loss of containment.

Hydrocarbon Characteristics

Refer to **Section 6.8.1** for a discussion of condensate and marine diesel characteristics relevant to this section.

Likelihood

In accordance with the Woodside Risk Matrix, a worst-case topsides loss of containment has been defined as a 'highly unlikely event as it is 'has occurred once or twice in the industry' (experience based likelihood) and aligns with a frequency of a '1 in 10,000 to 1 in 100,000 year' event.

Consequence

The spatial extent and fate (including weathering) of the spilled hydrocarbon were considered during the impact assessment for a worst-case topsides loss of containment (presented in the following section). These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (**Section 4**) and relevant literature and studies considering the effects of hydrocarbon exposure.

Consequence Assessment

Environment that May Be Affected

Surface Hydrocarbons

The gas and condensate components of a worst case topsides loss of containment are not expected to result in surface hydrocarbons above impact thresholds (> 10 g/m^2). The diesel component of Scenario 6 may result in floating hydrocarbons beyond the immediate vicinity of the release location. No contact of floating hydrocarbons above impact thresholds with key receptor locations was indicated by the modelling.

Entrained Hydrocarbons

Entrained hydrocarbons from the condensate component of a topsides release may become entrained and hence, extend beyond the vicinity of the release location. Refer to the entrained hydrocarbon description for a loss of containment from the GWA export riser (Scenario 4) for context (**Section 6.8.4**); note the credible volume for a topsides loss of containment is considerably smaller and hence, the potential EMBA above entrained impacts thresholds is expected to be smaller. The diesel component of Scenario 6 has the potential to become entrained and may extend beyond the release location. No contact of entrained hydrocarbons above impact thresholds with key receptor locations was indicated by the modelling.

Dissolved Hydrocarbons

Dissolved hydrocarbons above impact thresholds from a topsides loss of containment are expected to be localised to the immediate area around the release location. Modelling of subsea loss of containment indicated dissolved hydrocarbons above impact threshold would be in the immediate vicinity of the release location. Modelling of the diesel component of Scenario 6 did not indicate dissolved hydrocarbons above impact thresholds would occur. No contact with key receptor locations above impact thresholds is expected to occur.

Accumulated Hydrocarbons

No accumulated hydrocarbons above impact thresholds were predicted by modelling for the release scenarios considered in MEE-03.

Consequence Assessment Summary

The credible worst-case hydrocarbon spill scenario that may arise from MEE-03 may impact upon the open water environment in the vicinity of the GWA platform. Hydrocarbon spill modelling of the marine diesel component of the credible worst-case scenario did not indicate contact above impact thresholds for any sensitive environmental receptors. As such, potential environmental impacts are expected to be restricted to open water sensitivities such as marine fauna; refer to **Section 6.8.3** for a description of potential impacts to open-water sensitivities.

The credible worst-case hydrocarbon volumes that can credibly be released by MEE-03 are significantly smaller than the credible worst-case loss of well containment volumes considered in MEE-01 (**Section 6.8.3**). Additionally, the credible release durations are instantaneous rather than protracted. These considerations are pertinent when considering the potential environmental impacts described in **Section 6.8.3** in relation to MEE-03.

MEE-03 Topsides Loss of Containment – Risk Analysis

Bowtie analysis was undertaken to assess MEE-03; refer to **Figure 6-17, Figure 6-18, Figure 6-19 and Figure 6-20**

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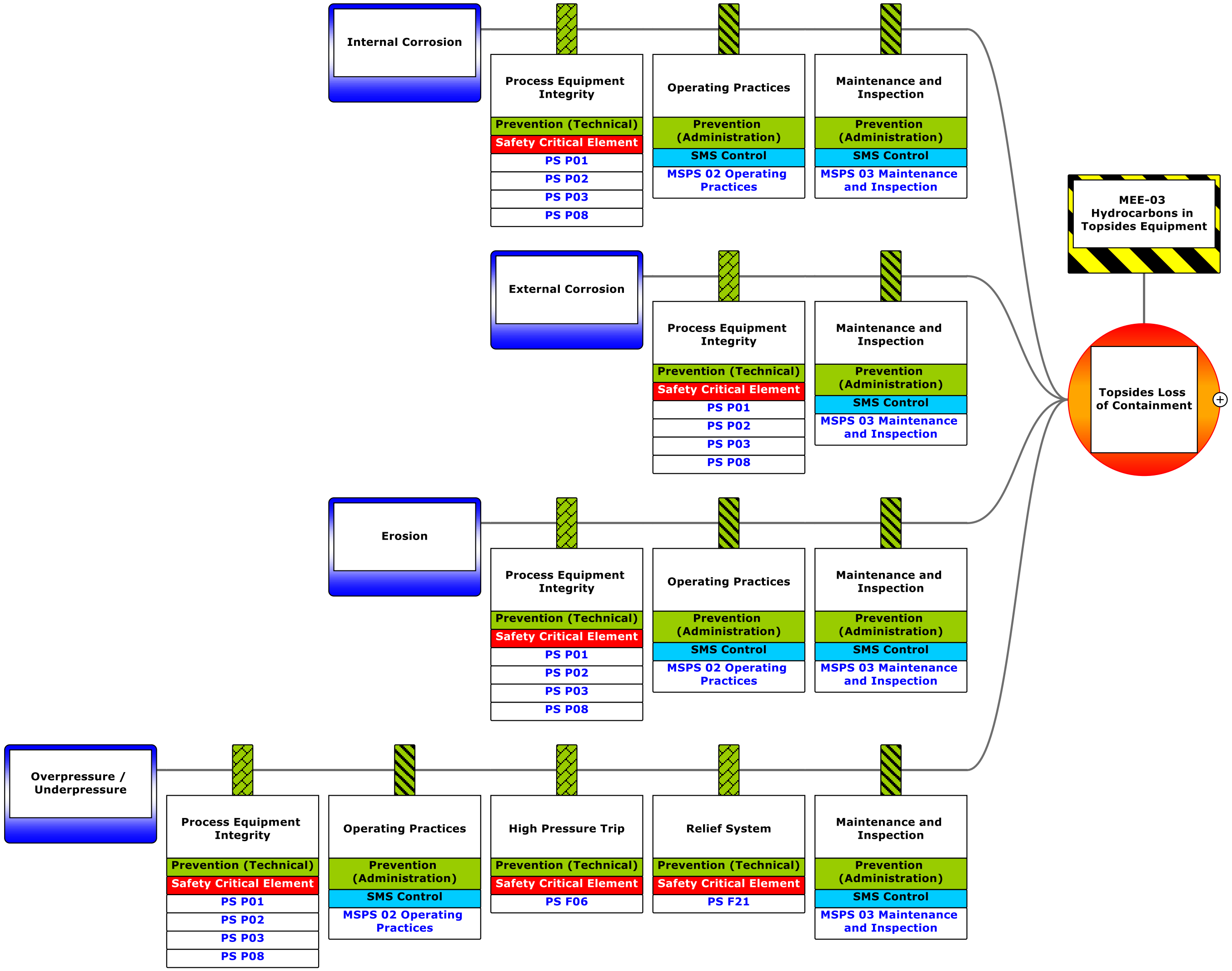

Figure 6-17: MEE-03 Topsides loss of containment (cause 1-4)

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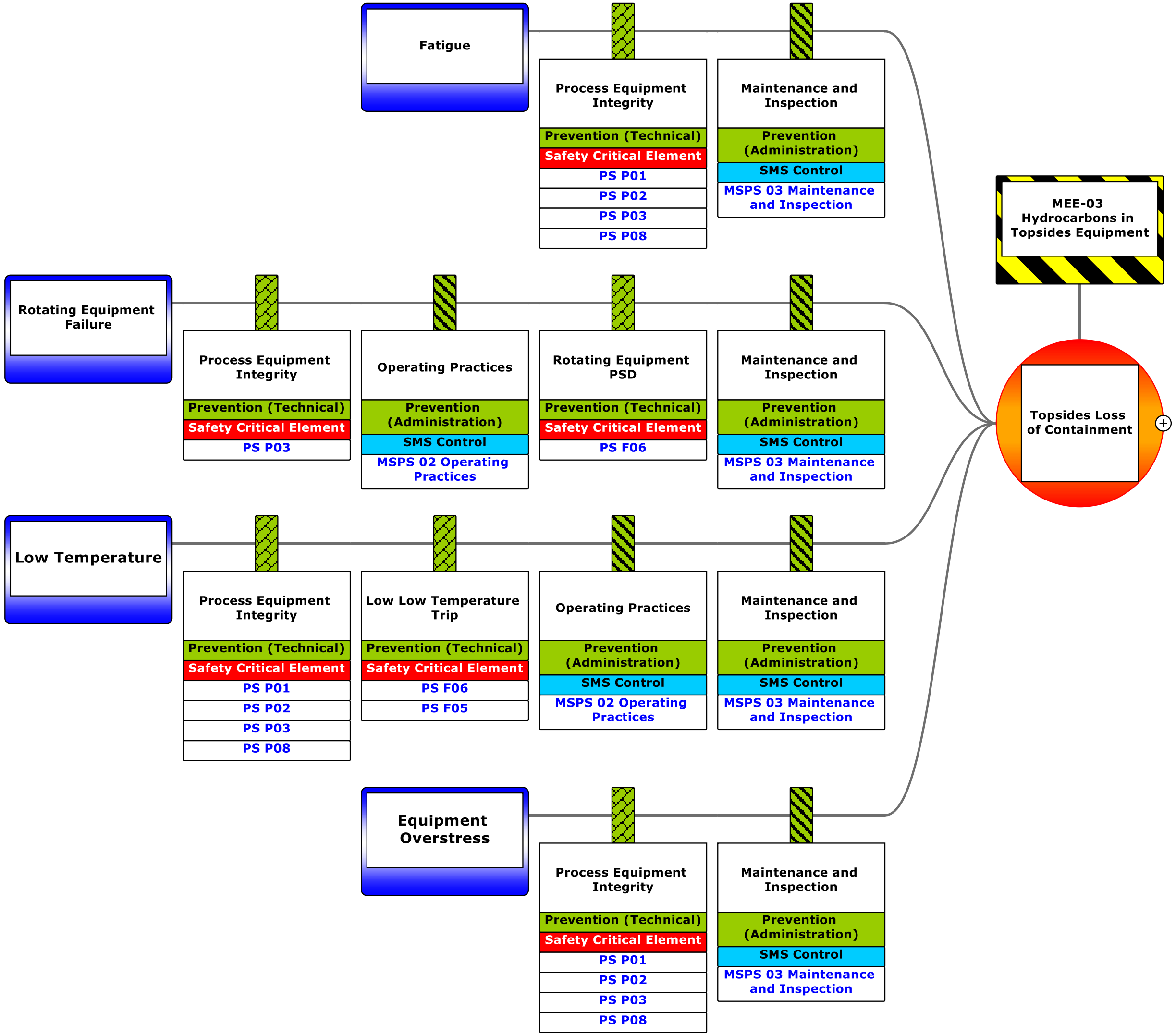

Figure 6-18: MEE 03- Topsides loss of containment (cause 5-8)

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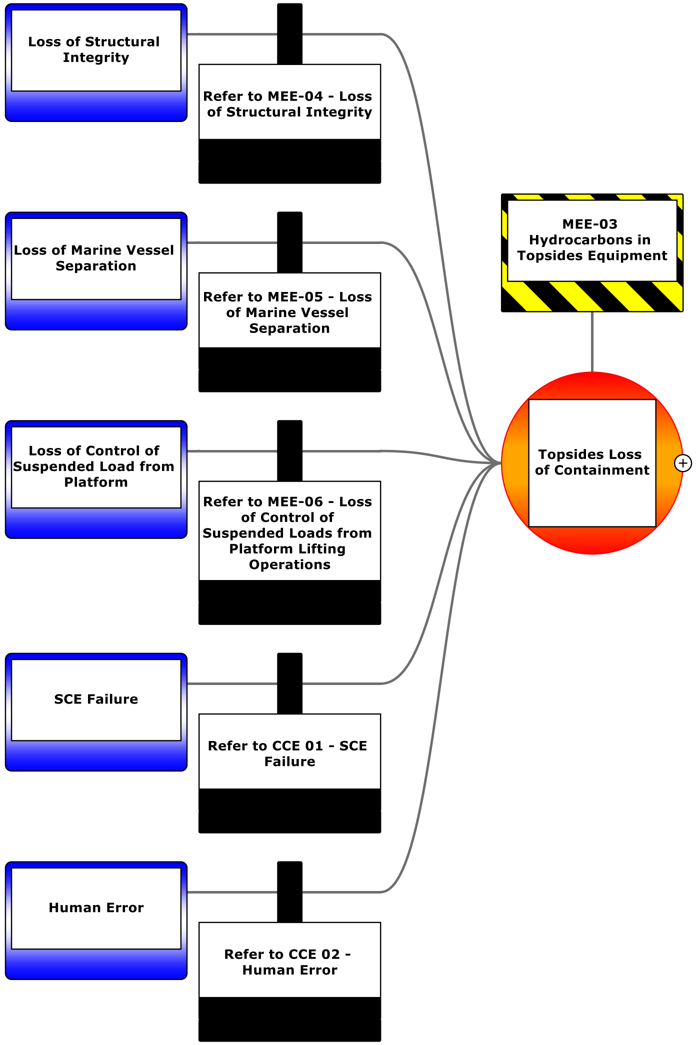

Figure 6-19: MEE-03 Topsides loss of containment (causes 9-13)

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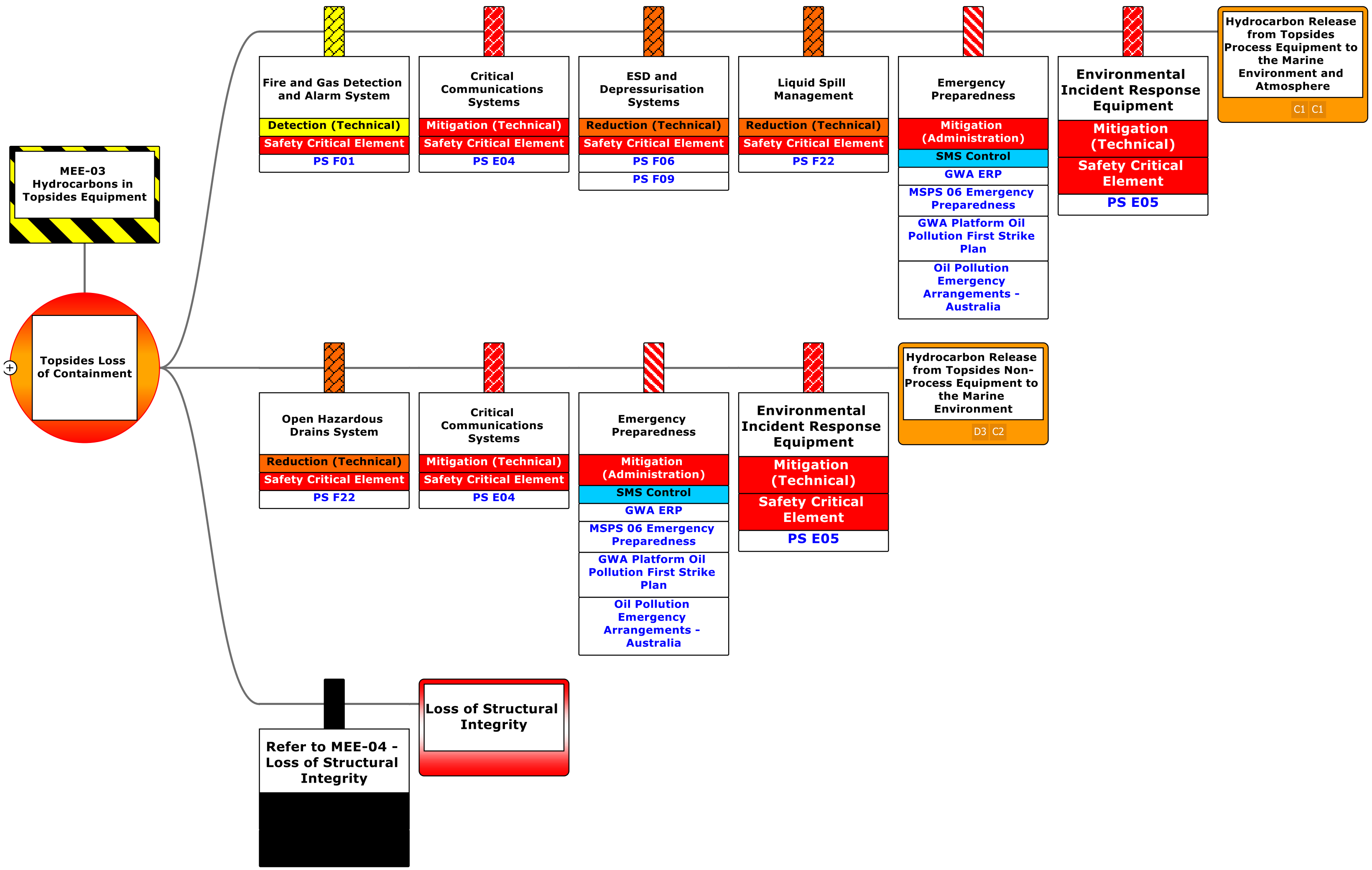

Figure 6-20: MEE 03 - Topsides loss of containment (outcomes)

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MEE-03 Topsides Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
Preventative Barriers – Safety and Environmental Critical Elements				
Elimination Substitution	N/A	No elimination or substitution controls were identified beyond those incorporated in design.		
Engineering Controls	Maintain topsides hydrocarbon-containing infrastructure integrity.	P01 – Pressure Vessels P02 – Heat Exchangers P03 – Rotating Equipment P08 – Piping Systems	Prevention (Technical)	Yes **C 15.1**
Engineering Controls	Maintain Safety Instrumented Systems and Relief System to prevent hydrocarbon loss of containment in order to prevent a MEE.	F06 – Safety Instrumented System F21 – Relief Systems	Prevention (Technical)	Yes **C 15.2**
Mitigating Barrier – Safety and Environmental Critical Elements				
Engineering Controls	Maintain availability of critical external and internal communication systems to facilitate prevention and response to accidents and emergencies.	E04 - Safety Critical Communication Systems	Mitigation (Technical)	Yes **C 13.2**
Engineering Controls	Maintain Fire and Gas detection and Alarm Systems on GWA facility to facilitate prevention and response to fire or gas hazards.	F01 – Fire and Gas Detection and Alarm Systems	Detection (Technical)	Yes **C 13.3**
Engineering Controls	Maintain Safety Instrumented Systems (e.g ESD and safety instrumented functions) system, Blowdown and Open Hazardous Drains system to isolate, remove and control hazardous inventories so as to mitigate the effects of a MEE/ prevent escalation to a MEE.	F06 – Safety Instrumented System F09 – Depressurisation (Blowdown) to; F22 – Open Hazardous Drains	Reduction / Control (Technical)	Yes **C 15.3**
Emergency Response	Maintain environmental incident response equipment to enact the GWA First Strike Plan.	E05 – Environmental Incident Response Equipment	Mitigation (Technical)	Yes **C 13.5**

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MEE-03 Topsides Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: Accepted Safety Case for the GWA facility to; • identify hazards that have the potential to cause a MAE; • detail assessment of MAE risks; and • describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP; thus contributing to management of associated potential environmental consequences of MAEs.	GWA Safety Case	Prevention (Administration) Control based on legislative requirements – must be adopted	Yes **C 13.7**
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting, Investigating and Learning Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements	Yes **C 9.5**
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • M02 Operating Practices • M03 Maintenance and Inspections • Maintain Assets Procedure	MSPS-02 Operating Practices MSPS-03 Maintenance and Inspections Maintain Assets Procedure	Prevention (Administration)	Yes – See **Section 7.9** Implementation Strategy.

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<table>
<tr><th colspan="5">MEE-03 Topsides Loss of Containment – Demonstration of ALARP
ALARP Control Measures</th></tr>
<tr><th>Hierarchy</th><th>Control / Barrier</th><th>SCE / Management System Reference</th><th>Type of Effect (Refer to Table 6-13)</th><th>Control Adopted</th></tr>
<tr><td>Emergency Response and contingency planning</td><td>Implement management systems to maintain:
M06 - Emergency Preparedness
GWA Emergency Response Plan
Goodwyn Alpha Oil Pollution First Strike Plan
Oil Pollution Emergency Arrangements - Australia</td><td>MSPS 06 - Emergency Preparedness
GWA Emergency Response Plan
Goodwyn Alpha Oil Pollution First Strike Plan
Oil Pollution Emergency Arrangements – Australia</td><td>Mitigation
(Administration)</td><td>Yes –
C 13.8
C 13.9
See Section 7.9
Refer to Appendix D and Appendix I for discussion around the ALARP assessment of controls related to hydrocarbon spill response.</td></tr>
<tr><td colspan="5">Risk Based Analysis</td></tr>
<tr><td colspan="5">For risks identified as MEEs, a more detailed risk based Bowtie Analysis (as outlined in Section 2.7) has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event.
Application of Woodside Risk Management Procedures, and implementation of the GWA Safety Case ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:
ongoing hazard identification, risk assessment and the identification of control measures
ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.
For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity.
Bowtie analysis was undertaken to assess MEE-03; refer to Figure 6-17, Figure 6-18, Figure 6-19 and Figure 6-20 for bowtie diagrams.
A quantitative spill risk assessment was undertaken (refer Section 6.8.1).</td></tr>
<tr><td colspan="5">Company Values</td></tr>
<tr><td colspan="5">Refer to Company Values in demonstration of ALARP for MEE-01 (Section 6.8.3).</td></tr>
<tr><td colspan="5">Societal Values</td></tr>
<tr><td colspan="5">Refer to Societal Values in demonstration of ALARP for MEE-01 (Section 6.8.3).</td></tr>
<tr><td colspan="5">ALARP Statement:
On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a highly unlikely likelihood unplanned hydrocarbon release as a result of a loss of topsides containment.
The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of topsides integrity and ensuring the systems are operated within their design envelope through operating practices and assurance through maintenance and inspection. If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation.
The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the GWA Safety Case, SCE management procedures including technical performance standards for Safety Critical Elements (SCEs) and MSPS for Safety Critical Procedures.
Given the controls in place to prevent and control loss of containment events and mitigate their consequences, it is considered that MEE risk associated with Topsides Loss of Containment at GWA is managed to ALARP.</td></tr>
</table>

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Demonstration of Acceptability
Topsides loss of containment has been evaluated as having a 'moderate' level of risk rating. As per **Section 2**, Woodside considers 'moderate' risk ratings as broadly acceptable if the adopted controls are implemented. Due to the consequence associated with MEE-03, Decision Type B has been applied, and ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained. Acceptability is demonstrated with regard to the considerations described in **Section 6.8.3** (MEE-01) (the considerations include principles of ecological sustainable development, internal context, external context and other requirements (includes laws, policies, standards and conventions)).

EPOs, EPSs and MC

Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 15 Topsides loss of containment risks to the environment limited to High during the Petroleum Activities Program	**C 15.1** Maintain topsides hydrocarbon-containing infrastructure integrity.	**PS 15.1** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P01 – Pressure Vessels • P02 – Heat Exchangers • P03 – Rotating Equipment • P08 – Piping Systems; to together; – provide minimum required mechanical integrity for identified SCE systems (piping, heat exchangers, rotating equipment, and pressure vessel) for operation within defined integrity limits so as to prevent a loss of containment that may result in a MEE.	Refer to **MC 1.6.1**
	C 15.2 Maintain Safety Instrumented Systems and relief system to prevent hydrocarbon loss of containment in order to prevent a MEE.	**PS 15.2** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F06 – Safety Instrumented System to; – detect and respond to pre-defined initiating conditions to protect mechanical integrity and prevent loss of containment (including uncontrolled diesel transfer/overflow) • F21 – Relief Systems to; – protect pressurised equipment, equipment exposed to HPs and piping from a loss of containment to prevent escalation to a MEE.	Refer to **MC 1.6.1**

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EPOs, EPSs and MC			
	Refer to **PS 13.2**	Refer to **PS 13.2**	Refer to **MC 1.6.1**
	Refer to **C 13.3**	Refer to **PS 13.3**	Refer to **MC 1.6.1**
	C 15.3 Maintain Safety Instrumented Systems (e.g. ESD and safety instrumented functions) system, Blowdown and Open Hazardous Drains system to isolate, remove and control hazardous inventories so as to mitigate the effects of a MEE/ prevent escalation to a MEE.	**PS 15.3** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F06 – Safety Instrumented System to; – detect and respond to pre-defined initiating conditions and initiate responses that function to put the process plant, equipment, and the wells in a safe condition through appropriate isolation of hazardous inventories so as to prevent or mitigate the effects of a MEE. • F09 – Depressurisation (Blowdown) to; – safely depressurise the installation in order to avoid or minimise the escalation of an uncontrolled loss of containment. • F22 – Open Hazardous Drains to; – prevent escalation of an incident following loss of containment, fire and/or explosion by removing or containing flammable liquid from hazardous areas; and – support appropriate containment and disposal of environmentally hazardous liquids to avoid damage to the environment. – closed drain and open hazardous drain caisson pumps available to support hydrocarbon recovery	Refer to **MC 1.6.1**
	Refer to **C 13.5**	Refer to **PS 13.5**	Refer to **MC 1.6.1**
	Refer to **C 13.7**	Refer to **PS 13.7**	Refer to **MC 13.7.1**
	Refer to **C 13.8**	Refer to **PS 13.8**	Refer to **MC 13.8.1**
	Refer to **C 13.9**	Refer to **PS 13.9a**	Refer to **MC 13.9.1a**
		Refer to **PS 13.9b**	Refer to **MC 13.9.1b**
	Refer to **C 9.5**	Refer to **PS 9.5**	Refer to **MC 9.5**

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6.8.6 Unplanned Hydrocarbon Release: Loss of Structural Integrity (MEE-04)

Context		
Topsides – **Section 3.5.1** Process Description – **Section 3.6.2** Hydrocarbon and Chemical Inventories and Selection – **Section 3.9**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5** Protected Places – **Section 4.8** Socio-economic – **Section 4.9**	Stakeholder Consultation – **Section 5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Hydrocarbon release from platform well to the marine environment and atmosphere.		✓	✓	✓	✓	✓	✓	B	B	1	M	LCS RBA CV SV	Acceptable if ALARP	**EPO 16**
Hydrocarbon release from pipeline and riser to the marine environment and atmosphere.		✓	✓	✓	✓	✓	✓	B	B	0	M			
Hydrocarbon release from topsides equipment to the marine environment and atmosphere.			✓	✓	✓	✓	✓	B	C	1	M			
Marine environment footprint and associated hydrocarbon and chemical release associated with structural collapse of GWA.		✓	✓	✓	✓	✓	✓	B	C	0	M			

Description of Source of Risk

Extreme environmental conditions, or other causes which result in an exceedance of the design criteria and a catastrophic failure of the facility and individual equipment (e.g., cranes, flare tower, etc.), has been identified as a potential MEE (MEE-04).

Catastrophic structural failure of the GWA facility could lead to the release of hydrocarbons from platform wells; topsides process and non-process hydrocarbon inventories; and pipeline / IFL inventories.

The following causes of structural failure of GWA were identified:

- excessive environmental loading (e.g. from cyclone, high waves)
- seismic events / seabed instability
- fire and blast / overpressure event
- external corrosion
- internal corrosion (e.g. of caissons)
- fatigue
- material defect

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- marine growth weight and wave loading
- subsea loss of containment
- loss of marine vessel separation (refer to MEE-05, **Section 6.8.7**).

There is a possibility of platform collapse ('slow' or 'rapid') caused by the extreme loads induced by strong winds and extreme waves. Extreme weather may induce fracture of pipework due to vibration/fatigue and loosen/dislodge objects/projectiles causing impact to equipment/pipework and subsequently result in a loss of containment.

Structural damage to the platform resulting from the causes listed above could be minor or could, in the most extreme situation, result in total loss of the platform. The type of structural failure considered here is restricted to major structural damage (e.g. catastrophic collapse of the jacket or release of hydrocarbons on or adjacent to the platform). Such events are, by definition, beyond the design basis for the platform. Structural damage can affect any area of the platform.

Loss of Structural Integrity – Credible Hydrocarbon Spill Scenario

A loss of structural integrity could result in a significant release of hydrocarbons. Hydrocarbon releases may result in a spill to the marine environment, as described in **Section 6.8.3** (MEE-01 - Well Loss of Containment), **Section 6.8.4** (MEE-02 - Pipeline and Riser Loss of Containment) and **Section 6.8.5** (MEE-03 - Topsides Loss of Containment). In addition, vessel cargo, including diesel inventory could be spilled if the cause of the loss of platform integrity was a collision from a support vessel as per **Section 6.8.7** (MEE-05 - Loss of Marine Vessel Separation).

Worst case hydrocarbon release scenarios for platform well loss of containment, subsea loss of containment, topsides loss of containment that could result from loss of structural integrity of the GWA platform are discussed in the relevant sections referenced above. Relevant trajectory modelling as applicable to these scenarios is also discussed in the above-mentioned sections.

Decision Type, Risk Analysis and ALARP Tools

Woodside has a good history of implementing industry standard practice in structural design and construction. The GWA facility has never experienced a worst-case loss of containment due to structural failure in its operational history.

Decision Type

A decision type 'B' has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications should the event be realised. To align with this decision type, a further level of analysis has been applied using risk based tools including the Bowtie Methodology (described in **Section 2**) and hydrocarbon spill trajectory modelling. Company and societal values were also considered in the demonstration of ALARP and acceptability, through peer review, benchmarking and stakeholder consultation.

The loss of structural integrity is considered a Major Environment Event (MEE-04). The hazards associated with this MEE are hydrocarbons in platform wells, pipelines, process and non-process inventories and potentially vessels, wellheads, and the GWA facility structure itself.

Quantitative Spill Risk Assessment

Credible worst-case hydrocarbon scenarios 2, 3, 4, 5 and 6 are considered to apply to a loss of structural integrity (MEE-04). Refer to the **Section 6.8.3** (MEE-01; Scenario 2), **Section 6.8.4** (MEE-02; Scenarios 3,4 and 5) and **Section 6.8.5** (MEE-03; Scenario 6) for a discussion of these credible spill scenarios.

Likelihood

In accordance with the Woodside Risk Matrix, the following likelihoods have been assigned to the sources of risk:

- hydrocarbon release from platform well to the marine environment and atmosphere / hydrocarbon release from topsides equipment to the marine environment and atmosphere
  - 'highly unlikely' event as it 'has occurred once or twice in the industry' (experience based likelihood) and aligns with a frequency of a '1 in 10,000 to 1 in 100,000 year' event; and
- marine environment footprint and associated hydrocarbon and chemical release associated with structural collapse of GWA
  - 'remote' event as it is 'unheard of on the industry' (experience based likelihood) and aligns with a frequency of a '1 in 100,000 to 1 in 1,000,000 year' event.

Consequence

The spatial extent and fate (including weathering) of the spilled hydrocarbon and the potential seabed disturbance footprint from the GWA facility were considered during the impact assessment for a worst-case loss of structural integrity. These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (**Section 4**) and relevant literature and studies considering the effects of hydrocarbon exposure.

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Consequence Assessment
Environment that May Be Affected As discussed under Description of Source of Risk, the potential impacts from hydrocarbon release caused by a loss of structural integrity are those which would result from: • Well Loss of Containment, **Section 6.8.3** (MEE-01) • Subsea Loss of Containment, **Section 6.8.4** (MEE-02) • Topsides Loss of Containment, **Section 6.8.5** (MEE-03) • Loss of Marine Vessel Separation, **Section 6.8.7** (MEE-05). The potential impacts are therefore discussed in the above mentioned sections. **Seabed Disturbance** In the event of loss of structural integrity there is the potential for collapse of the platform leading to an incremental increase of the facility's footprint on the seabed. The potential area that would be affected can conservatively be defined as the existing GWA facility footprint plus 100 m in all directions, that is approximately 300 m by 350 m (0.105 km^2). The benthic habitats surrounding the GWA facility have been subject to historical disturbance (e.g. GWA construction, discharge of drill cuttings) and are considered to be of low ecological value (although it is acknowledged that the GWA facility provides artificial hard substrate, which has formed the basis of relatively high biodiversity communities when compared to the surrounding seabed). The physical disturbance to the seabed resulting from the collapse of the GWA facility would be localised, but result in long-term disturbance to benthic communities. The GWA platform could act as a source of environmental contaminants due to material onboard the platform (e.g. chemical / hydrocarbon inventories, corrosion of structural materials, debris etc.). The potential for contamination would diminish over time as the structure degrades. Depending on the nature of the loss of structural integrity, complete or partial salvage of the GWA platform may not be feasible. Any structures not able to be recovered would be left on the seabed indefinitely. These structures are expected to be colonized by marine organisms, and a reef habitat would develop over time on the structures.

MEE-04 Loss of Structural Integrity – Risk Analysis
Bowtie analysis was undertaken to assess MEE-04; refer to Figure 6-21, Figure 6-22 and Figure 6-23

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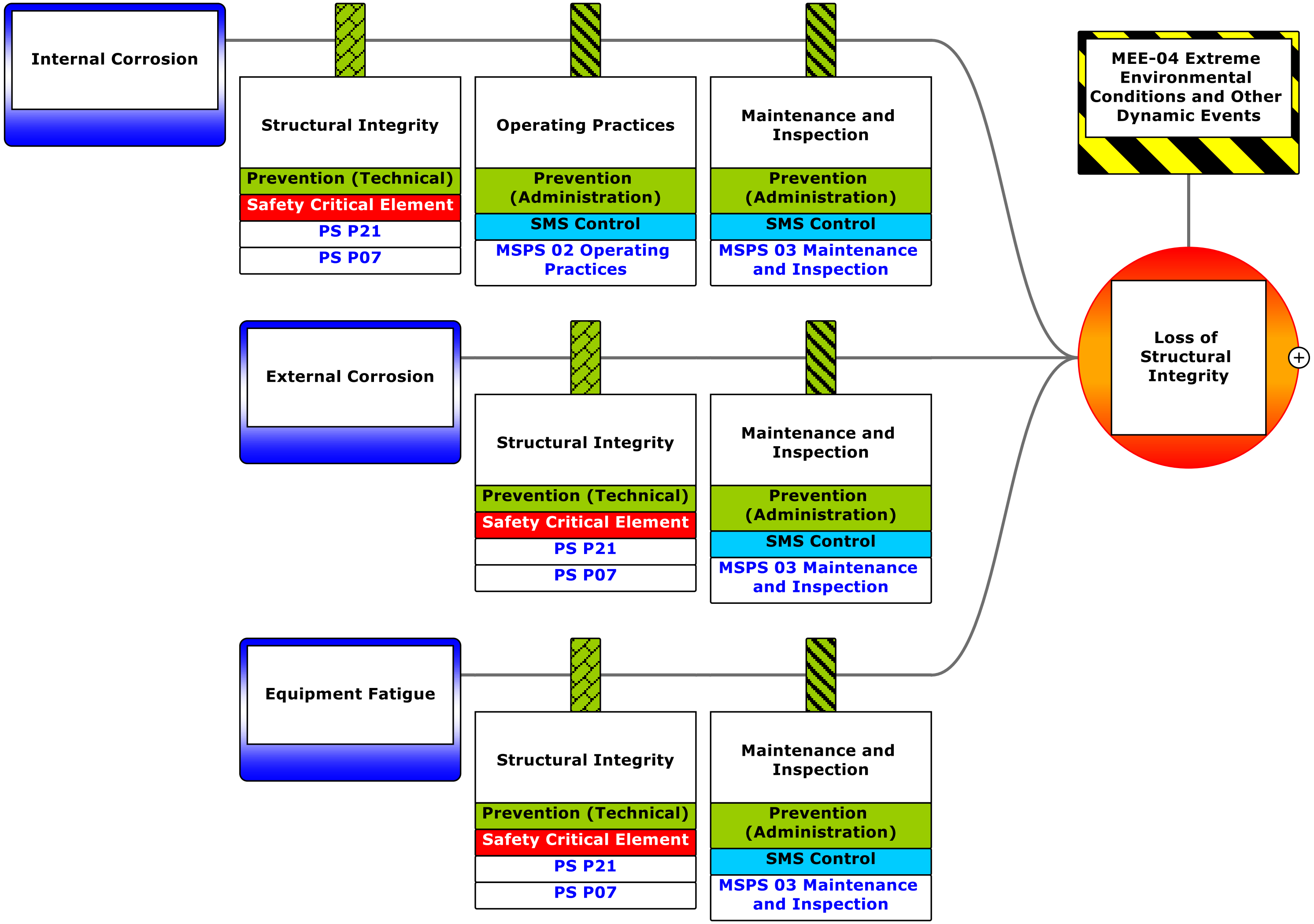

Figure 6-21: MEE-04 Loss of structural integrity (causes 1-3)

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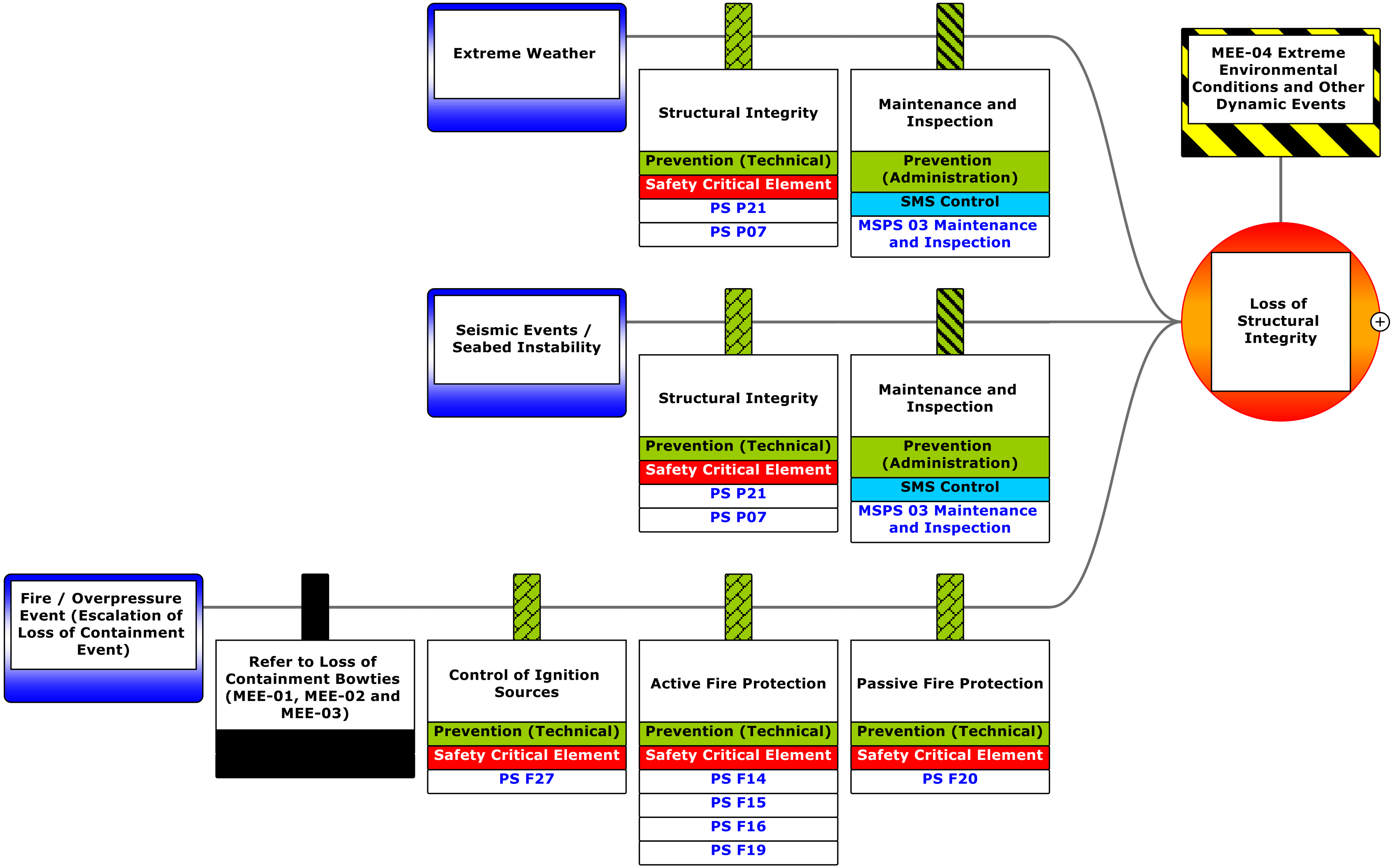

Figure 6-22: MEE-04 Loss of structural integrity (cause 4-6)

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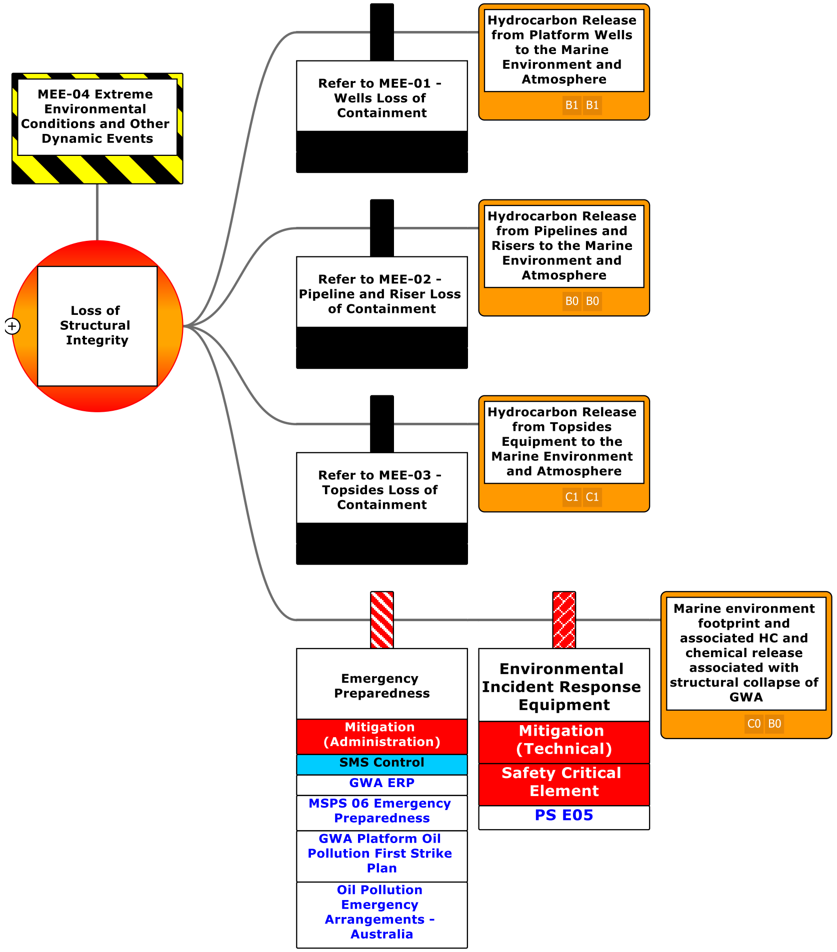

Figure 6-23: MEE-04 Loss of structural integrity (outcomes)

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MEE-04 Well Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
Preventative Barriers – Safety and Environmental Critical Elements				
Elimination	N/A	No elimination or substitution controls were identified beyond those incorporated in design.		
Substitution				
Engineering Controls	Maintain structural integrity to ensure availability of critical systems during a major accident or environment event, and prevent structural failures from contributing to escalation of a MEE.	P07 – Topsides / Surface Structures P21 – Substructures	Prevention (Technical)	Yes **C 16.1**
Engineering Controls	Maintain control of ignition sources and fire protection to prevent loss of structural integrity.	F27 – Control of Ignition Sources F14 – Fire Water System F19 – Gaseous Extinguishing System F15 – Manual Fire Fighting Equipment F20 – Passive Fire and Explosion Protection	Prevention (Technical)	Yes **C 16.2**
Mitigating Barrier – Safety and Environmental Critical Elements				
Emergency Response	Maintain environmental incident response equipment to enact the GWA First Strike Plan.	E05 – Environmental Incident Response Equipment	Mitigation (Technical)	Yes **C 13.5**
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: Accepted Safety Case for the GWA facility to; • identify hazards that have the potential to cause a MAE; • detail assessment of MAE risks; and • describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk	GWA Safety Case	Prevention (Administration) Control based on legislative requirements – must be adopted	Yes **C 13.7**

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MEE-04 Well Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
	to personnel associated with a MAE to ALARP; thus contributing to management of associated potential environmental consequences of MAEs.			
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting and Investigation Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements	Yes **C 9.5**
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • M02 Operating Practices • M03 Maintenance and Inspections	MSPS-02 Operating Practices MSPS-03 Maintenance and Inspections	Prevention (Administration)	Yes – See **Section 7.9** Implementation Strategy.
Emergency Response and Contingency Planning	Implement management systems to maintain: • M06 - Emergency Preparedness • GWA Emergency Response Plan • Goodwyn Alpha Oil Pollution First Strike Plan • Oil Pollution Emergency Arrangements - Australia	MSPS 06 GWA Emergency Response Plan Goodwyn Alpha Oil Pollution First Strike Plan Oil Pollution Emergency Arrangements – Australia	Mitigation (Administration)	Yes – **C 13.8** **C 13.9** See **Section 7.9** Refer to **Appendix D** and **Appendix I** for discussion around the ALARP assessment of controls related to hydrocarbon spill response.
Risk Based Analysis				
For risks identified as MEEs, a more detailed risk based Bowtie Analysis (as outlined in **Section 2.7**), has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event. Application of Woodside Risk Management Procedures, and implementation of the NWS Pipelines and GWA Safety Cases ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes: • Ongoing hazard identification, risk assessment and the identification of control measures; and • Ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.				

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MEE-04 Well Loss of Containment – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity. Bowtie analysis was undertaken to assess MEE-02; refer to Figure 6-21, Figure 6-22 and Figure 6-23 for bowtie diagrams. A quantitative spill risk assessment was undertaken (refer **Section 6.8.1** and **6.8.3**).				
Company Values				
Refer to Company Values in demonstration of ALARP for MEE-01 (**Section 6.8.3**).				
Societal Values				
Refer to Societal Values in demonstration of ALARP for MEE-01 (**Section 6.8.3**).				
ALARP Statement: On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a remote likelihood unplanned hydrocarbon release as a result of a loss of structural integrity. The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of pipeline and riser integrity and ensuring the systems are operated within their design envelope through operating practices and assurance through maintenance and inspection. If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation. The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the GWA Safety Case(s), SCE management procedures including technical performance standards for Safety Critical Elements (SCEs) and MSPS for Safety Critical Procedures. Given the controls in place to prevent and control loss of containment events and mitigate their consequences, it is considered that MEE risk associated with Loss of Structural Integrity at GWA is managed to ALARP.				

Demonstration of Acceptability
Loss of structural integrity has been evaluated as having a ‘moderate’ level of risk rating. As per **Section 2**, Woodside considers ‘moderate’ risk ratings as broadly acceptable if the adopted controls are implemented. Due to the consequence associated with MEE-02, Decision Type B has been applied, and ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained. Acceptability is demonstrated with regard to the considerations described in **Section 6.8.3** (MEE-01) (the considerations include principles of ecological sustainable development, internal context, external context and other requirements (includes laws, policies, standards and conventions)).

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 16 Structural integrity loss of containment risks to the environment limited to High during the Petroleum Activities Program.	**C 16.1** Maintain structural integrity to ensure availability of critical systems during a major accident or environment event, and prevent structural failures from contributing to escalation of a MEE.	**PS 16.1** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P07 – Substructures • P21 – Topsides / Surface Structures to both; – provide and maintain structural integrity to support SCE systems under all design conditions through service life; and to; – prevent structural failure from contributing to the escalation of a MEE by providing support/protection of SCE systems during an emergency event, and/or support containment of environmentally hazardous material (including hazardous and closed drain caissons).	Refer to **MC 1.6.1**
	C 16.2 Maintain control of ignition sources and fire protection to prevent loss of structural integrity.	**PS 16.2** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F27 – Control of Ignition Sources to; – prevent ignition of flammable or explosive atmospheres within identified Hazardous Areas. • F14 – Fire Water System • F15 – Manual Fire Fighting Equipment • F19 – Gaseous Extinguishing System; to together; – provide reliable and secure delivery of firefighting medium (e.g. firewater, gaseous suppressant, foam) at the required flows, pressures, coverage and discharge rates to reduce the likelihood of escalation; and	Refer to **MC 1.6.1**

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EPOs, EPSs and MC			
		– where safe to do so enable facility emergency response personnel to apply fire fighting medium to support fire control and limit escalation. • F20 – Passive Fire and Explosion Protection to; – mitigate the effects of a fire or explosion by maintaining the integrity of critical structure and equipment and limiting the potential for escalation.	
	Refer to **C 13.5**	Refer to **PS 13.5**	Refer to **MC 1.6.1**
	Refer to **C 13.7**	Refer to **PS 13.7**	Refer to **MC 13.7.1**
	Refer to **C 13.8**	Refer to **PS 13.8**	Refer to **MC 13.8.1**
	Refer to **C 13.9**	Refer to **PS 13.9a**	Refer to **MC 13.9.1a**
		Refer to **PS 13.9b**	Refer to **MC 13.9.1b**
	Refer to **C 9.5**	Refer to **PS 9.5**	Refer to **MC 9.5**

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6.8.7 Unplanned Hydrocarbon Release: Loss of Marine Vessel Separation (MEE-05)

Context		
Facility Layout and Description – **Section 3.5** Hydrocarbon Inventories – **Section 3.6.7** Vessels – **Section 3.7**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5** Protected Places – **Section 4.8** Socio-economic – **Section 4.9**	Stakeholder Consultation – **Section 5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Hydrocarbon release from platform well to the marine environment and atmosphere.		✓	✓	✓	✓	✓	✓	B	B	1	M	LCS RBA CV SV	Acceptable if ALARP	**EPO 17**
Hydrocarbon release from pipeline and riser to the marine environment and atmosphere.		✓	✓	✓	✓	✓	✓	B	B	0	M			
Hydrocarbon release from topsides equipment to the marine environment and atmosphere.			✓	✓	✓	✓	✓	B	C	1	M			
Marine environment footprint and associated hydrocarbon and chemical release associated with structural collapse of GWA.		✓	✓	✓	✓	✓	✓	B	C	0	M			
Loss of marine diesel from a vessel		✓	✓	✓	✓	✓	✓	B	C	0	M			

Description of Source of Impact

A loss of marine vessel separation between a vessel and the GWA facility may result in a loss of hydrocarbon containment from the GWA facility and / or the release of fuel from the vessel. A vessel collision with the GWA facility has been identified as a potential MEE (MEE-05). Vessel collisions can arise from:

- visiting vessel collisions associated with platform support vessels - ships which are visiting the platform can accidentally collide with the platform during approach to, or manoeuvring alongside, the platform; and
- errant passing vessel collision - ships which are not visiting the platform (i.e. passing vessels) can, for one reason or another, move off-course and collide with the platform.

The different collision hazards involve significantly different sized vessels and collision speeds, hence, differing impact energies and consequences, and have been assessed.

Visiting Vessels

Visiting vessels are defined as those which are routinely used to service the GWA facility. Operating procedures will dictate how vessels are operated, loaded and unloaded, but it will generally occur so that the prevailing winds move

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the vessel away from the facility. The primary causes of visiting vessel collisions are failure to follow safe procedures and communication errors between the marine vessels and platform operations. These errors could be worsened by the following:

- vessel station keeping failures; or
- vessel operations in adverse weather conditions;

A number of common failure causes due to human error and SCE failures are presented in the generic Human Error and SCE failure bowties in **Section 6.8.9**.

Errant Passing Vessels

Errant passing vessels are defined as third-party vessels that enter the platform's 500 m PSZ, but do not call at GWA or other installations (i.e. not platform or subsea support vessels). The collision can be powered or drifting. Either has the potential to cause significant damage to GWA.

The causes of errant passing vessel collisions include:

- failure of propulsion or steering systems;
- adverse weather conditions resulting in poor visibility;
- rough seas; and
- human error.

Woodside implement a range of control measures to mitigate the risk of errant vessel collision. In addition to the potential for large hydrocarbon releases following impact by a vessel with the GWA structure, powered collisions from large passing vessels or tankers could have sufficient impact energy to breach both skins of the vessel to the extent that there is a loss of containment of cargo or fuel oil with the potential for significant loss of inventory and consequent environmental impact.

Errant MODU collision

An errant MODU is a drilling unit that has a broken/failed mooring system and is drifting uncontrolled in the ocean. It may be a MODU contracted to Woodside, drilling in the area proximate to GWA, or a unit contracted to a third party. High energy weather events such as cyclones, while a 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 collision with other assets or infrastructure.

For a moored MODU, personnel from the MODU are typically evacuated during cyclones (and hence response capabilities in the event of a mooring failure may be limited). Woodside, for example, implements a risk-based assessment process to aid in decision making for cyclone evacuations, with the well suspended prior to MODU evacuation. Operational experience indicates cyclone evacuations typically last for seven days.

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).

Vessel Collision

A collision between a platform or subsea support vessel with a third party vessel (i.e. commercial shipping, other petroleum related vessels and commercial fishing vessels) was considered the only credible event that could release a significant quantity of marine diesel to the environment. This was assessed as being credible but highly unlikely given the platform support vessels typically operate in the GWA Operational Area, the presence of subsea vessels in the Operational Area is typically temporary (e.g. while undertaking IMR activities), vessels undertaking the Petroleum Activities Program typically operate of low speeds or are stationary, the standard vessel operations and equipment in place to prevent collision at sea, and the construction and placement of storage tanks.

The largest tank of a vessel within the Operations Area is 1000 m^3 on an installation vessel (HLV). As such, the worst-case credible spill of marine diesel from a vessel is considered to be an instantaneous loss of the content of a 1000 m^3 tank.

Loss of Vessel Separation – Credible Hydrocarbon Spill Scenario

The loss of marine vessel separation is considered a Major Environment Event (MEE-05). The hazards associated with this MEE is hydrocarbons in platform wells, pipelines, process and non-process inventories and potentially vessels, wellheads, and fuel onboard platform support vessels. A loss of marine vessel separation could result in a significant release of hydrocarbons. Hydrocarbon releases will result in a spill to the marine environment as described in **Section 6.8.3** (MEE-01 - Well Loss of Containment), **Section 6.8.4** (MEE-02 - Subsea Loss of Containment) and **Section 6.8.6** (MEE-03 - Topsides Loss of Containment). In addition, vessel cargo, including diesel inventory, could be spilled if the cause of the loss of platform integrity was a collision from a support vessel.

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Worst case hydrocarbon release scenarios for platform loss of well containment (MEE-01), subsea loss of containment (MEE-02) and topsides loss of containment (MEE-03) that could result from loss of marine vessel separation are discussed in the relevant sections referenced above. Relevant trajectory modelling as applicable to these scenarios is also discussed above.

A loss of vessel separation may lead to the accidental release of marine diesel from the fuel tanks on the vessel(s) involved. 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:

- 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 probability of the chain of events described above aligning, to result in a breach of fuel tanks resulting in a spill that could potentially affect the marine environment is considered highly unlikely.

Decision Type, Risk Analysis and ALARP Tools

Woodside has not experienced any loss of marine vessel separation events that have resulted in significant environmental impacts.

Decision Type

A decision type 'B' has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK 2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications should the event be realised. To align with this decision type, a further level of analysis has been applied using risk based tools including the Bowtie Methodology (described in **Section 2**) and hydrocarbon spill trajectory modelling. Company and societal values were also considered in the demonstration of ALARP and acceptability, through peer review, benchmarking and stakeholder consultation.

Quantitative Spill Risk Assessment

Credible worst-case hydrocarbon spill scenarios 2, 3, 5 and 6 are considered to apply to a loss of structural integrity (MEE-4). Refer to the **Section 6.8.3** (Scenario 2), **Section 6.8.4** (Scenarios 3,4 and 5) and **Section 6.8.5** (Scenario 6) for a discussion of these credible worst-case spill scenarios.

Modelling was undertaken by RPS Group (2019), 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 m^3 (largest fuel tank on installation vessel) for all seasons, using an historic sample of wind and current data for the region.

The modelling inputs for the release scenarios are summarised in **Figure 6-24**. Refer to **Section 6.8.1** for additional information on modelling methods and environmental impact, thresholds and hydrocarbon characteristics justifications.

Figure 6-24: 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	-	-

Likelihood

In accordance with the Woodside Risk Matrix, a likelihood of 'highly unlikely' event as it 'has occurred once or twice in the industry' (experience based likelihood) and aligns with a frequency of a '1 in 10,000 to 1 in 100,000 year' has been assigned to each of the following events:

- hydrocarbon release from platform well to the marine environment and atmosphere;
- hydrocarbon release from pipeline and riser to the marine environment and atmosphere; and
- hydrocarbon release from topsides equipment to the marine environment and atmosphere;

In addition, a 'Remote' likelihood with a frequency of a '1 in 100,000 to 1 in 1,000,000 year' has been assigned for:

- marine environment footprint and associated hydrocarbon and chemical release associated with structural collapse of GWA platform.

Consequence

The spatial extent and fate (incl. weathering) of the spilled hydrocarbon from the GWA facility and platform support vessels were considered during the impact assessment for a worst-case loss of marine vessel separation. These

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considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (**Section 4**) and relevant literature and studies considering the effects of hydrocarbon exposure experienced a worst-case loss of containment due to loss of vessel separation in its operational history.

Consequence Assessment

Environment that May Be Affected

As discussed under Description of Source of Risk, the potential impacts from hydrocarbon release caused by a loss of structural integrity are those which would result from:

- Well Loss of Containment, **Section 6.8.3** (MEE-01)
- Subsea Loss of Containment, **Section 6.8.4** (MEE-02)
- Topsides Loss of Containment, **Section 6.8.5** (MEE-03).

The potential impacts are therefore discussed in the above mentioned sections.

Potential impacts for the credible worst-case diesel spill from a vessel (1000 m^3) as discussed below

Environment that May Be Affected

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 48 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 6-22**).

Entrained Hydrocarbons

Entrained oil at concentrations equal to or greater than the 100 ppb threshold is predicted to be found up to around 619 km from the spill site. Contact by entrained hydrocarbons at concentrations equal to or greater than 100 ppb is predicted at Montebello AMP (20%) as well as a few other sensitive receptors with probabilities of equal to or less than 5% (**Table 6-22**). The maximum entrained oil concentration forecast for any receptor is predicted to be 267 ppb at Gascoyne MP.

Dissolved Hydrocarbons

Dissolved aromatic hydrocarbons at concentrations equal to or greater than the 50 ppb threshold are predicted to found 180 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 **6-22**).

Consequence Assessment Summary

The credible worst-case hydrocarbon spill scenarios that may arise from a 1000 m^3 may impact upon a range of environmental receptors; refer to **Table 6-22** or a summary of receptors identified by the stochastic spill modelling studies. Potential impacts of a hydrocarbon spill to these receptors are considered in MEE-01; refer to **Section 6.8.3** for a description of potential impacts.

The credible worst-case hydrocarbon volumes that can credibly be released by MEE-05 are significantly smaller than the credible worst-case loss of well containment volumes considered in MEE-01 (**Section 6.8.3**). Additionally, the credible release durations are significantly shorter.

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Table 6-22: Environment that May Be Affected – Key receptor locations / sensitivities that are predicted to be contacted by an instantaneous release of marine diesel under

Environmental Setting	Receptor	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure)																													Probability of hydrocarbon contact and fate (%)					
		Physical		Biological																						Socio-economic and Cultural										
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species										Other Species							Socio–cultural EMBA		EMBA			
		Open Water (Pristine)	Marine Sediment (Pristine)	Coral Reef	Seagrass Beds / Macroalgae	Mangroves	Spawning / Nursery Areas	Open water – Productivity / Upwelling	Non-biogenic 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 / Fur Seals)	Marine Turtles (Foraging and Internesting Areas and Significant Nesting Beaches)	Sea Snakes	Whale Sharks	Sharks and Rays	Seabirds and Migratory Shorebirds	Pelagic Fish Populations	Demersal Fish Populations	Fisheries - Commercial	Fisheries - Traditional	Tourism and Recreation	Protected Areas / Heritage – European and Indigenous / Underwater Cultural Heritage	Offshore Oil and Gas Infrastructure (topside and subsea)	Surface Hydrocarbons (1 – 10 g/m²)	Accumulated hydrocarbons (10-100 g/m²)	Surface Hydrocarbons (≥10 g/m)	Entrained Hydrocarbons(≥100 ppb)	Dissolved Hydrocarbons (≥50 ppb)	Accumulated Hydrocarbons (> 100 g/m²)
Offshore[32]	Montebello AMP	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		1			20	2	
	Gascoyne AMP	✓	✓												✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓				4		
	Montebello Islands (including State Marine Park)	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓					2	1	
	Argo-Rowley Terrace MP	✓						✓							✓	✓			✓			✓	✓	✓		✓			✓					4		
Submerged Shoals	Rankin Bank	✓	✓	✓			✓	✓		✓						✓				✓		✓		✓	✓	✓		✓			1				1	
	Rowley Shoals – Impervious Reef	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓			✓	✓		✓	✓	✓	✓	✓		✓	✓					1		

[32] Note: hydrocarbons cannot accumulate on open ocean, submerged receptors, or receptors not fully emergent

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Environmental Setting	Receptor	Environmental, Social, Cultural, Heritage and Economic Aspects presented as per the Environmental Risk Definitions (Woodside's Risk Management Procedure)																													Probability of hydrocarbon contact and fate (%)					
		Physical		Biological																						Socio-economic and Cultural										
		Water Quality	Sediment Quality	Marine Primary Producers			Other Communities / Habitats								Protected Species										Other Species							Socio–cultural EMBA		EMBA			
		Open Water (Pristine)	Marine Sediment (Pristine)	Coral Reef	Seagrass Beds / Macroalgae	Mangroves	Spawning / Nursery Areas	Open water – Productivity / Upwelling	Non-biogenic 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 / Fur Seals)	Marine Turtles (Foraging and Internesting Areas and Significant Nesting Beaches)	Sea Snakes	Whale Sharks	Sharks and Rays	Seabirds and Migratory Shorebirds	Pelagic Fish Populations	Demersal Fish Populations	Fisheries - Commercial	Fisheries - Traditional	Tourism and Recreation	Protected Areas / Heritage – European and Indigenous / Underwater Cultural Heritage	Offshore Oil and Gas Infrastructure (topside and subsea)	Surface Hydrocarbons (1 – 10 g/m^2)	Accumulated hydrocarbons (10-100 g/m^2)	Surface Hydrocarbons (≥10 g/m)	Entrained Hydrocarbons(≥100 ppb)	Dissolved Hydrocarbons (≥50 ppb)	Accumulated Hydrocarbons (> 100 g/m^2)
Islands	Pilbara Islands Southern Island Group	✓	✓		✓				✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		1			5		
	Murion Islands (including MMA- WHA)	✓	✓		✓		✓		✓			✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓					4		
Mainland (nearshore waters)	Ningaloo Coast										✓	✓	✓	✓					✓				✓					✓	✓			1		2		
	WA Coast	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓			1		5		

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MEE-05 Loss of Marine Vessel Separation - Risk Analysis
Bowtie analysis was undertaken to assess MEE-05; refer to **Figure 6-25** and **Figure 6-26**

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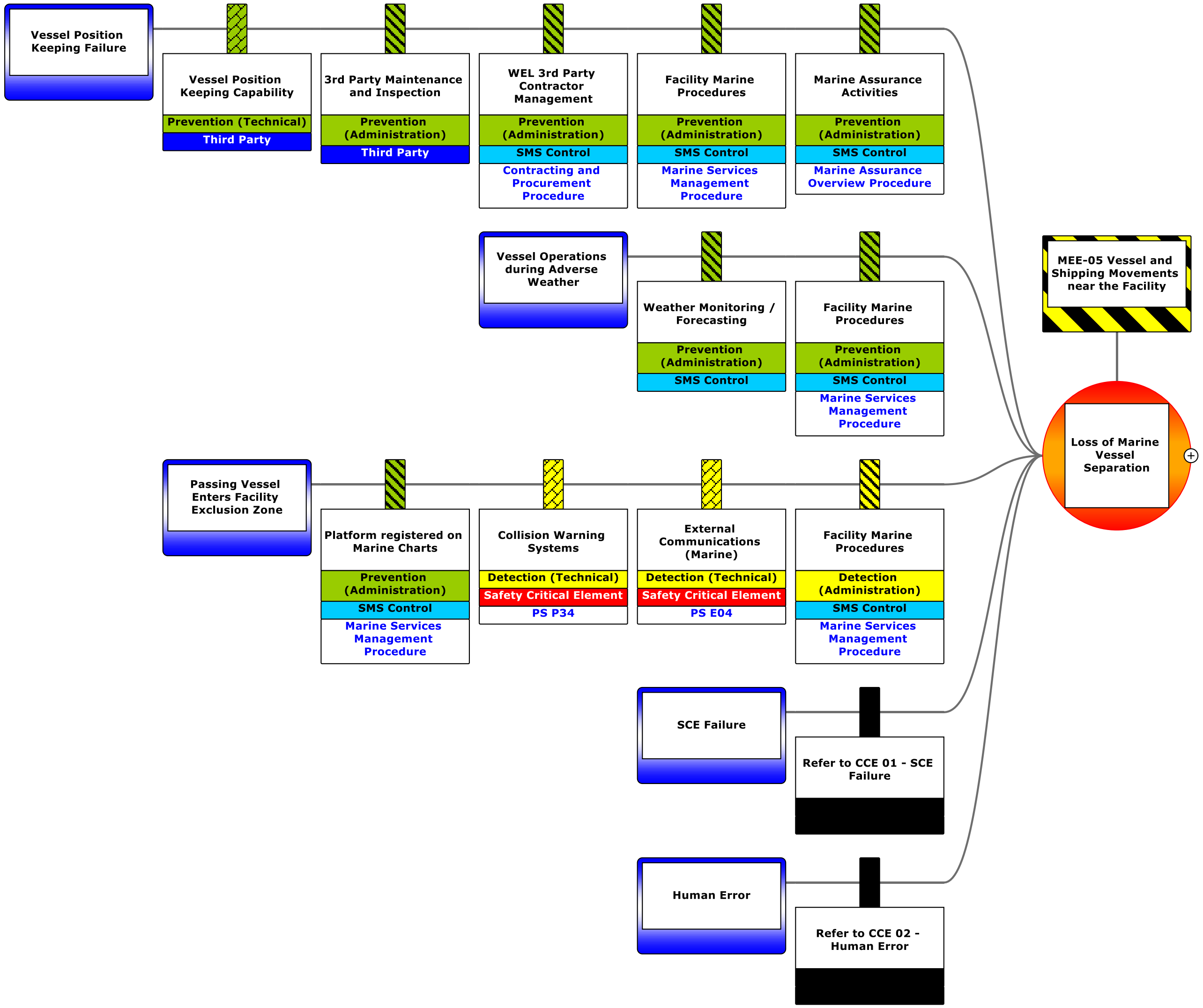

Figure 6-25: MEE-05 loss of vessel separation (causes)

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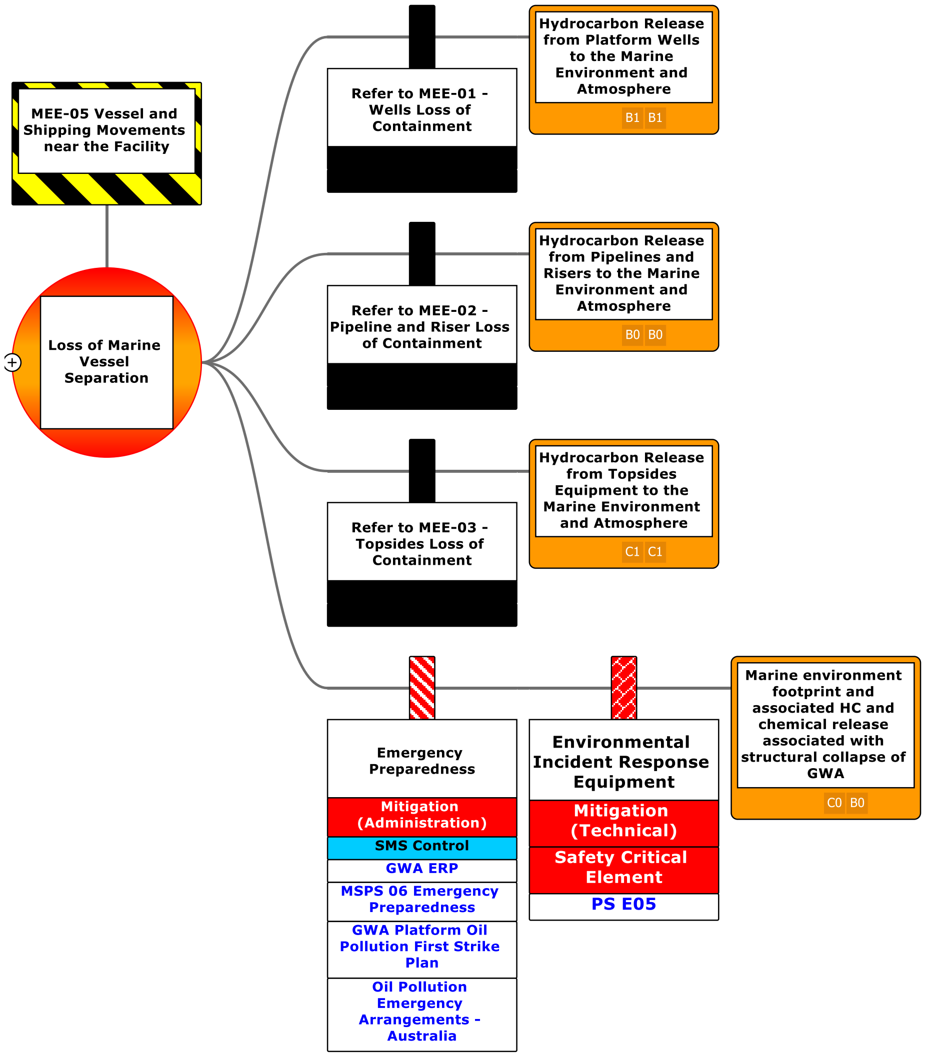

Figure 6-26: MEE-05 loss of vessel separation (outcomes)

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MEE-05 Loss of Marine Vessel Separation – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
Preventative Barriers – Safety and Environmental Critical Elements				
Elimination	N/A	No elimination or substitution controls were identified beyond those incorporated in design.		
Substitution				
Engineering Controls	Maintain collision warning systems and navigational aids to alert facility of a potential collision with marine vessels, and to alert marine vessels of facility location so that they may take timely action to avoid the facility and hence reduce likelihood of collision	P34 – Collision Prevention Systems	Detection (Technical)	Yes **C 17.1**
Engineering Controls	Maintain availability of critical external and internal communication systems to facilitate prevention and response to accidents and emergencies	E04 – Safety Critical Communications Systems	Detection (Technical)	Yes **C 13.2**
Mitigating Barrier – Safety and Environmental Critical Elements				
Emergency Response	Maintain environmental incident response equipment to enact the GWA First Strike Plan	E05 – Environmental Incident Response Equipment	Mitigation (Technical)	Yes **C 13.5**
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: Accepted Safety Case for the GWA facility to; • identify hazards that have the potential to cause a MAE; • detail assessment of MAE risks; and • describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP; thus contributing to management of associated potential environmental consequences of MAEs.	GWA Safety Case	Prevention (Administration) Control based on legislative requirements – must be adopted	Yes **C 13.7**

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<table>
<tr><th colspan="5">MEE-05 Loss of Marine Vessel Separation – Demonstration of ALARP
ALARP Control Measures</th></tr>
<tr><th>Hierarchy</th><th>Control / Barrier</th><th>SCE / Management System Reference</th><th>Type of Effect (Refer to Table 6-13)</th><th>Control Adopted</th></tr>
<tr><td>Procedures and Administration</td><td>Incident reports are raised for unplanned releases within event reporting system.</td><td>Woodside Health, Safety and Environment Event Reporting and Investigation Procedure</td><td>Prevention / Mitigation
(Administration)
Control based on Woodside standard and regulatory requirements</td><td>Yes
C 9.5</td></tr>
<tr><td colspan="5">Management System Specific Measures: Key Standards or Procedures</td></tr>
<tr><td>Procedures and Administration</td><td>Implement management systems to maintain:
• Contracting and Procurement Procedure
• Marine Assurance Overview Procedure
• Marine Services Management Procedure</td><td>Marine Services Management Procedure
Marine Assurance Overview Procedure
Contracting and Procurement Procedure</td><td>Prevention (Administration)</td><td>Yes – See Section 7.9 Implementation Strategy.</td></tr>
<tr><td>Emergency Response and contingency planning</td><td>Implement management systems to maintain:
M06 - Emergency Preparedness
GWA Emergency Response Plan
Goodwyn Alpha Oil Pollution First Strike Plan
Oil Pollution Emergency Arrangements - Australia</td><td>MSPS 06
GWA Emergency Response Plan
Goodwyn Alpha Oil Pollution First Strike Plan
Oil Pollution Emergency Arrangements – Australia</td><td>Mitigation
(Administration)</td><td>Yes – See Section 7.9
C 13.8
C 13.9
Refer to Appendix D and Appendix I for discussion around the ALARP assessment of controls related to hydrocarbon spill response.</td></tr>
<tr><td colspan="5">Risk Based Analysis</td></tr>
<tr><td colspan="5">For risks identified as MEEs, a more detailed risk based Bowtie Analysis (as outlined in Section 2.7), has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event.
Application of Woodside Risk Management Procedures, and implementation of the WOMP, NWS Pipelines and GWA Safety Cases ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes:
• Ongoing hazard identification, risk assessment and the identification of control measures
• Ongoing integrity management of hardware control measures in accordance with the SCE technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability.
For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity.
Bowtie analysis was undertaken to assess MEE-02; refer to Figure 6-25 and Figure 6-26 for bowtie diagrams.
A quantitative spill risk assessment was undertaken (refer Section 6.8.1).</td></tr>
<tr><td colspan="5">Company Values</td></tr>
<tr><td colspan="5">Refer to Company Values in demonstration of ALARP for MEE-01 (Section 6.8.3).</td></tr>
</table>

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MEE-05 Loss of Marine Vessel Separation – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
Societal Values				
Refer to Societal Values in demonstration of ALARP for MEE-01 (**Section 6.8.3**).				
ALARP Statement: On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a remote likelihood unplanned hydrocarbon release as a result of a loss of marine vessel separation. The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of pipeline and riser integrity and ensuring the systems are operated within their design envelope through operating practices and assurance through maintenance and inspection. If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation. The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the GWA Safety Case(s), SCE management procedures including technical performance standards for Safety Critical Elements (SCEs) and MSPS for Safety Critical Procedures. Given the controls in place to prevent and control loss of containment events and mitigate their consequences, it is considered that MEE risk associated with Loss of Marine Vessel Separation at GWA is managed to ALARP.				

Demonstration of Acceptability
Loss of marine vessel separation has been evaluated as having a ‘moderate’ level of risk rating. As per **Section 2**, Woodside considers ‘moderate’ risk ratings as broadly acceptable if the adopted controls are implemented. Due to the consequence associated with MEE-02, Decision Type B has been applied, and ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained. Acceptability is demonstrated with regard to the considerations described in **Section 6.8.3** (MEE-01) (the considerations include principles of ecological sustainable development, internal context, external context and other requirements (includes laws, policies, standards and conventions)).

EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 17 Loss of marine vessel separation risks to the environment limited to High during the Petroleum Activities Program.	**C 17.1** Maintain collision warning systems and navigational aids to alert facility of a potential collision with marine vessels, and to alert marine vessels of facility location so that they may take timely action to avoid the facility and hence reduce likelihood of collision.	Refer to **PS 1.6**	Refer to **MC 1.6.1**
	Refer to **C 13.2**	Refer to **PS 13.2**	Refer to **MC 1.6.1**
	Refer to **C 13.5**	Refer to **PS 13.5**	Refer to **MC 1.6.1**
	Refer to **C 13.7**	Refer to **PS 13.7**	Refer to **MC 13.7.1**
	Refer to **C 13.8**	Refer to **PS 13.8**	Refer to **MC 13.8.1**

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EPOs, EPSs and MC			
	Refer to **C 13.9**	Refer to **PS 13.9a**	Refer to **MC 13.9.1a**
		Refer to **PS 13.9b**	Refer to **MC 13.9.1b**
	Refer to **C 9.5**	Refer to **PS 9.5**	Refer to **MC 9.5**

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6.8.8 Unplanned Hydrocarbon Release: Loss of Control of Suspended Load from Platform (MEE-06)

Context		
Lifting Operations – **Section 3.6.6** Vessels – **Section 3.7**	Physical Environment – **Section 4.4** Biological Environment – **Section 4.5** Protected Places – **Section 4.8** Socio-economic – **Section 4.9**	Stakeholder Consultation – **Section 5**

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	Socio-economic	Decision Type	Consequence / Impact	Likelihood	Risk Rating	ALARP Tool	Acceptability	Outcome
Hydrocarbon release from pipeline and riser to the marine environment and atmosphere.		✓	✓	✓	✓	✓	✓	B	C	1	M	LCS RBA CV SV	Acceptable if ALARP	**EPO 18**
Hydrocarbon release from topsides equipment to the marine environment and atmosphere.		✓	✓	✓	✓	✓	✓	B	C	1	M			

Description of Source of Impact

Lifting activities on GWA can take place from one of two platform cranes between supply vessels and laydown areas, or between laydown areas. Lifting operations performed using the platform or visiting vessel cranes could potentially lead to dropped objects impacting assets (topsides equipment, subsea infrastructures) inside the GWA 500 m PSZ, potentially leading to a hydrocarbon loss of containment from topsides and subsea infrastructure. Loss of suspended load has been identified as a MEE (MEE-06). A loss of suspended load may arise from:

- lifting equipment failure
- facility lifting operations
- adverse weather conditions.

A number of common failure causes due to human error and Safety Critical Equipment (SCE) failures are presented in the generic Human Error and SCE failure bowties in **Section 6.8.9**.

Loss of Suspended Load – Credible Hydrocarbon Spill Scenario

The identified outcome of this MEE is a loss of containment of hydrocarbons due to impact of a dropped object on topsides equipment or subsea pipelines resulting in a release of the hydrocarbon inventory to the atmosphere or the marine environment; refer to **Section 6.8.4** (MEE-02 - Subsea Loss of Containment) and **Section 6.8.5** (MEE-03 - Topsides Loss of Containment) for a description of these credible loss of containment scenarios. It is not considered credible that loss of control of suspended load during topsides lifting operations would result in a MEE from the platform wells or IFL pipeline loss of containment.

Decision Type

A decision type 'B' has been applied to this risk under the Guidance on Risk Related Decision Making (Oil and Gas UK2014). This reflects the complexity of the risk, the higher potential consequence and stakeholder implications should the event be realised. To align with this decision type, a further level of analysis has been applied using risk based tools including the Bowtie methodology (described in **Section 2.7**) and hydrocarbon spill trajectory modelling. Company values were also considered in the demonstration of ALARP and acceptability.

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The release of hydrocarbons as a result of subsea loss of containment is considered a Major Environment Event (MEE-02). The hazard associated with this MEE is hydrocarbons in subsea infrastructure (flowlines, manifolds etc.) tied to, or originating from, the GWA facility.

Quantitative Spill Risk Assessment

Credible worst-case hydrocarbon Scenarios 3 (MEE-02) and Scenarios 5 and 6 (MEE-03) are considered to apply to the potential loss of containment that may occur in the event of a loss of a suspended load. Refer to **Section 6.8.4** (Scenarios 5) and **Section 6.8.5** (Scenario 6) for a discussion of these credible worst-case spill scenarios.

Likelihood

In accordance with the Woodside Risk Matrix, a likelihood of 'highly unlikely' event as it 'has occurred once or twice in the industry' (experience based likelihood) and aligns with a frequency of a '1 in 10,000 to 1 in 100,000 year' has been assigned to each of the following events:

- hydrocarbon release from pipeline and riser to the marine environment and atmosphere
- hydrocarbon release from topsides equipment to the marine environment and atmosphere.

Consequence

The spatial extent and fate (incl. weathering) of the spilled hydrocarbon were considered during the impact assessment for a worst-case loss of suspended load. These considerations were informed primarily by the outputs from the numerical modelling studies undertaken by RPS, available information on environmental sensitivities that may credibly be impacted in the event of a worst-case spill (**Section 4**) and relevant literature and studies considering the effects of hydrocarbon exposure.

Consequence Assessment

Environment that May Be Affected

As discussed under Description of Source of Risk, the potential impacts from hydrocarbon release caused by a loss of structural integrity are those which would result from:

- Subsea Loss of Containment, **Section 6.8.4** (MEE-02)
- Topsides Loss of Containment, **Section 6.8.5** (MEE-03).

The potential impacts are therefore discussed in the above-mentioned sections.

MEE-06 Loss of Control of Suspended Load from Platform - Risk Analysis

Bowtie analysis was undertaken to assess MEE-06; refer to **Figure 6-27** and **Figure 6-28**

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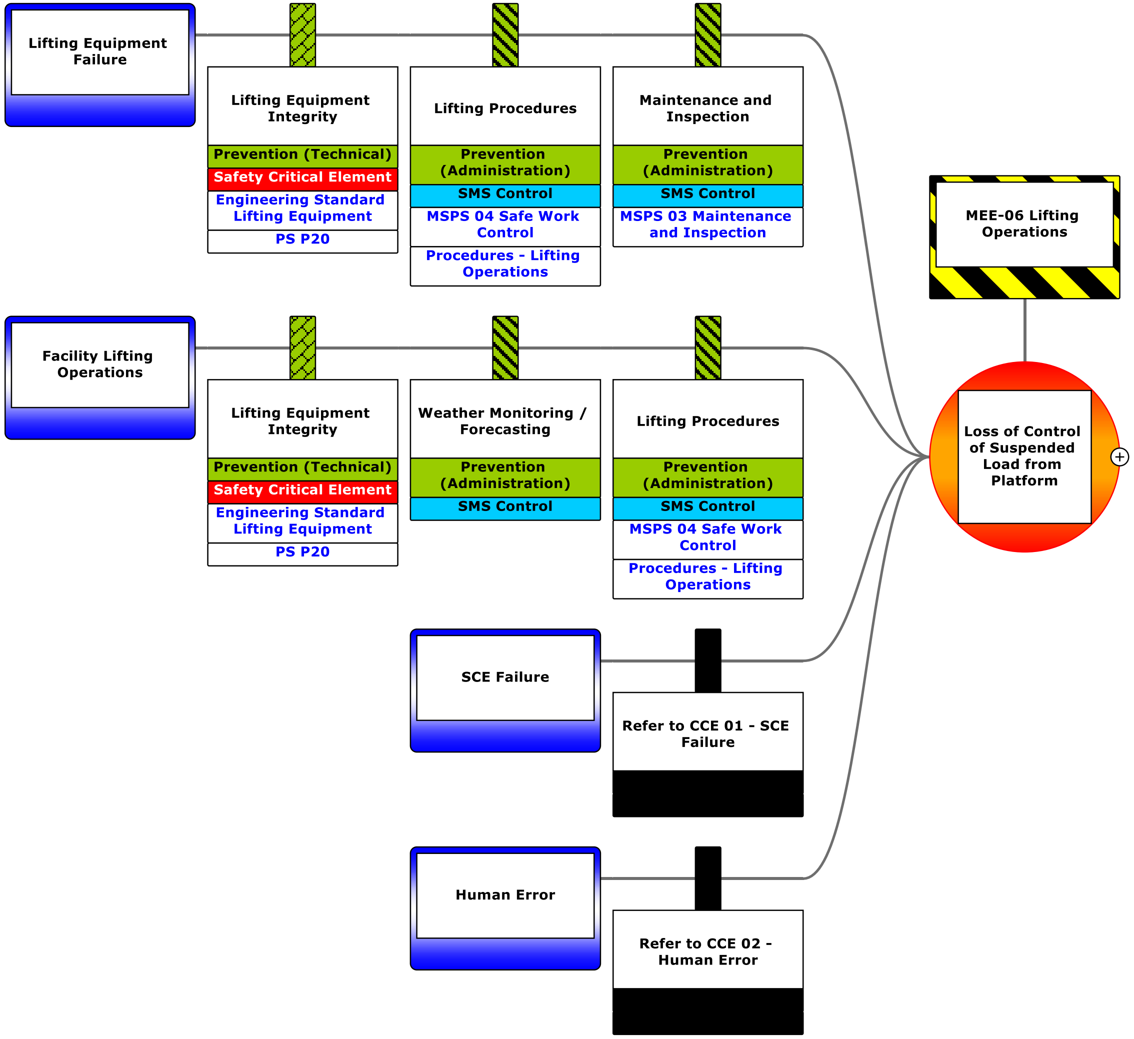

Figure 6-27: MEE-06 loss of control of suspended load from facility lifting operations (causes)

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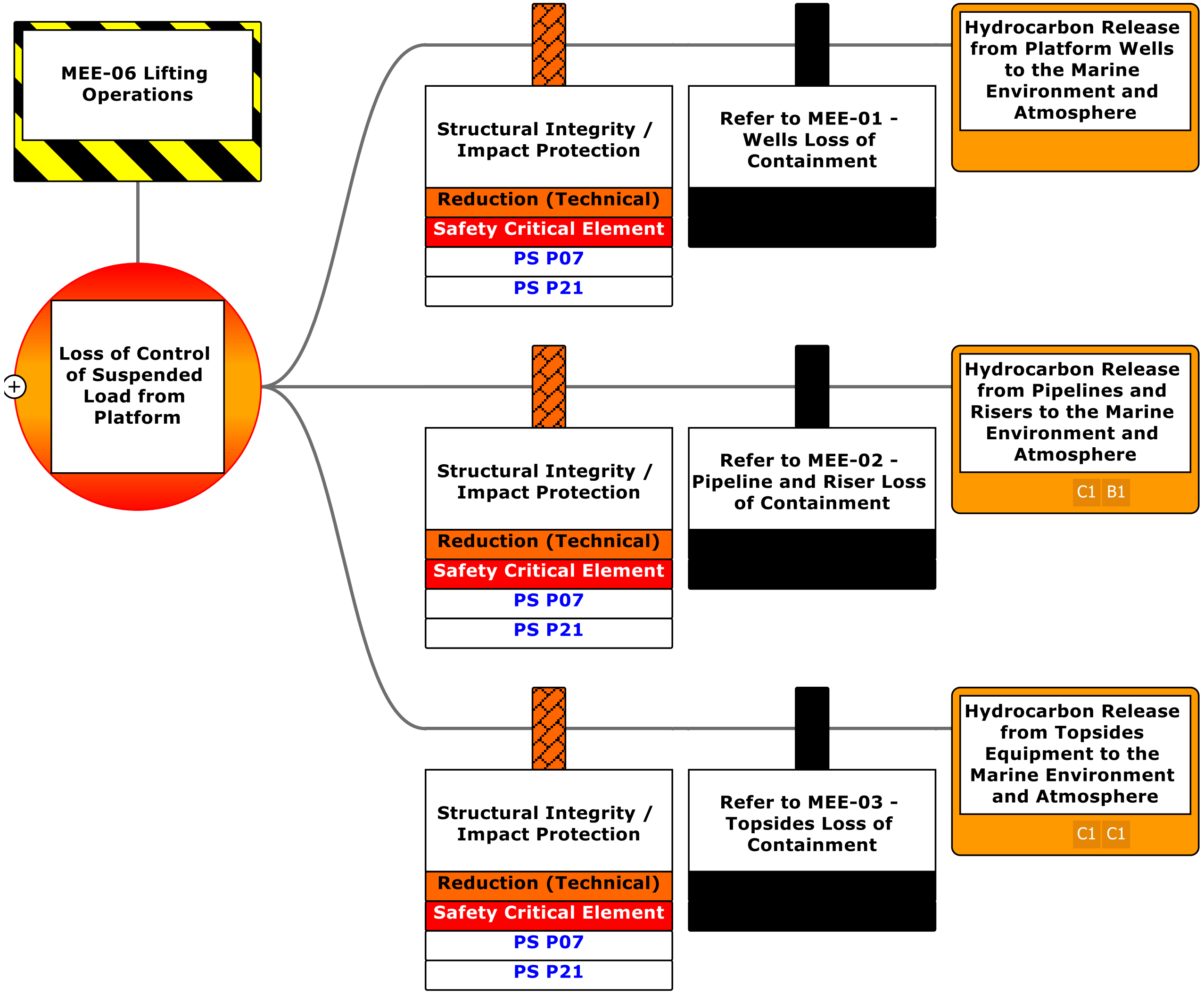

Figure 6-28: MEE-06 Loss of control of suspended load from facility lifting operations (outcomes)

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MEE-06 Well Loss of Control of a Suspended Load from Platform – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
Preventative Barriers – Safety and Environmental Critical Elements				
Elimination	N/A	No elimination or substitution controls were identified beyond those incorporated in design.		
Substitution				
Engineering Controls	Maintain platform lifting equipment to prevent platform lifting equipment failure or dropped/swinging loads that could result in a MEE	P20 – Lifting Equipment	Prevention (Technical)	Yes **C 18.1**
Mitigating Barrier – Safety and Environmental Critical Elements				
Impact Protection	Maintain structural integrity (impact protection) to ensure availability of critical systems during a major accident or environment event and prevent structural failures from contributing to escalation of a MEE.	P07 – Topsides / Surface Structures P21 – Substructures	Reduction (Technical)	Yes **C 16.1**
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: Accepted Safety Case for the GWA facility to; • identify hazards that have the potential to cause a MAE; • detail assessment of MAE risks; and • describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated with a MAE to ALARP; thus contributing to management of associated potential environmental consequences of MAEs.	GWA Safety Case	Prevention (Administration) Control based on legislative requirements – must be adopted	Yes **C 13.7**

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MEE-06 Well Loss of Control of a Suspended Load from Platform – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
Procedures and Administration	Incident reports are raised for unplanned releases within event reporting system.	Woodside Health, Safety and Environment Event Reporting and Investigation Procedure	Prevention / Mitigation (Administration) Control based on Woodside standard and regulatory requirements	Yes **C 9.5**
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • Engineering Standard Lifting Equipment • MSPS 03 Maintenance and Inspection • MSPS 04 Safe Work Control • Lifting Operations Procedures	Engineering Standard Lifting Equipment MSPS-03 Maintenance and Inspection MSPS-04 Lifting Operations Procedure	Prevention (Administration)	Yes – See **Section 7.9** Implementation Strategy.
Risk Based Analysis				
For risks identified as MEEs, a more detailed risk based Bowtie Analysis (as outlined in **Section 2.7**), has been used to identify, analyse and demonstrate ALARP controls for each MEE. ALARP controls have been selected following hierarchy of control principles and considers independence of each barrier and their type of effect in controlling the hazardous event. Application of Woodside Risk Management Procedures, and implementation of the WOMP, NWS Pipelines and GWA Safety Cases ensures the continuous identification of hazards, systematic assessment of risks and ongoing assessment of alternative control measures to reduce risk to ALARP, which includes: • Ongoing hazard identification, risk assessment and the identification of control measures • Ongoing integrity management of hardware control measures in accordance with the technical performance standards which define requirements to be suitably maintained, such that they retain effectiveness, functionality, availability and survivability. For each SCE, detailed requirements for equipment functionality, availability, reliability and survivability are incorporated into SCE technical Performance Standards which also include the relevant assurance tasks (e.g. inspection, maintenance, testing and monitoring requirements) to ensure technical integrity. Bowtie analysis was undertaken to assess MEE-02; refer to **Figure 6-27** and **Figure 6-28** for bowtie diagrams. A quantitative spill risk assessment was undertaken (refer **Section 6.8.1**).				
Company Values				
Refer to Company Values in demonstration of ALARP for MEE-01 (**Section 6.8.3**).				
Societal Values				
Refer to Societal Values in demonstration of ALARP for MEE-01 (**Section 5.8.3**).				

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MEE-06 Well Loss of Control of a Suspended Load from Platform – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***

ALARP Statement:

On the basis of the environmental risk assessment outcomes and use of the relevant tools appropriate to the decision type, Woodside considers the adopted controls appropriate to manage the impacts and risks of a highly unlikely likelihood unplanned hydrocarbon release as a result of a loss of control of suspended load.

The principle of inherent safety and environmental protection is based on the prevention of the MEE through design of structural integrity and impact protection, and lifting equipment and standards ensuring the systems are operated within their design envelope through operating practices and assurance through maintenance and inspection. If hydrocarbon loss of containment occurs, mitigation measures are in place to minimise the consequence by limiting the inventory which can be released and implementing remediation.

The controls in place for prevention and mitigation of MEEs are specified and assured through implementing the GWA Safety Case(s), SCE management procedures including technical performance standards for Safety Critical Elements (SCEs) and MSPS for Safety Critical Procedures.

Given the controls in place to prevent and control loss of containment events and mitigate their consequences, it is considered that MEE risk associated with Loss of Control of Suspended Load at GWA is managed to ALARP.

Demonstration of Acceptability

Loss of suspended load has been evaluated as having a ‘moderate’ level of risk rating. As per **Section 2**, Woodside considers ‘moderate’ risk ratings as broadly acceptable if the adopted controls are implemented. Due to the consequence associated with MEE-02, Decision Type B has been applied, and ALARP is demonstrated using good industry practice, consideration of company and societal values and risk based analysis, if legislative requirements are met and societal concerns are accounted for and the alternative control measures are grossly disproportionate to the benefit gained.

Acceptability is demonstrated with regard to the considerations described in **Section 6.8.3** (MEE-01) (the considerations include principles of ecological sustainable development, internal context, external context and other requirements (includes laws, policies, standards and conventions)).

EPOs, EPSs and MC

Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
EPO 18 Loss of suspended load from platform risks to the environment limited to High during the Petroleum Activities Program.	**C 18.1** Maintain platform lifting equipment to prevent platform lifting equipment failure or dropped/swinging loads that could result in a MEE.	**PS 18.1** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P20 – Lifting Equipment to; – prevent platform lifting equipment failure or dropped/swinging loads that could result in a MEE by maintaining lifting equipment integrity.	Refer to **MC 1.6.1**

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EPOs, EPSs and MC			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
	C 16.1 Maintain structural integrity (impact protection) to ensure availability of critical systems during a major accident or environment event, and prevent structural failures from contributing to escalation of a MEE.	Refer to **PS 16.1**	Refer to **MC 1.6.1**
	Refer to **C 13.7**	Refer to **PS 13.7**	Refer to **MC 13.7.1**
	Refer to **C 9.5**	Refer to **PS 9.5**	Refer to **MC 9.5**

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6.8.9 MEE Common Cause Event failure mechanisms: SCE Failure CCE-01 and Human Error CCE-02

This section presents common mode failure causes and controls applicable across MEEs, which are also observed within the bowties of the MEE's discussed within sections above. Controls, EPSs and MC presented within this section are also considered relevant to MEE-01 to MEE-06.

GWA: Major Environmental Datasheet	
MEE Number	All
Hazard Description	Generic Safety Critical Equipment failure (CCE-01)
Hazard Ref ID	N/A
Hazard Description	
Hazard Overview and Scope	
There are a number of causes which contribute to failures of SCEs and other systems which might protect against a MEE. These include: • maintenance errors • defects • electrical supply failure • hydraulic supply failure • adverse environmental conditions. The Generic SCE failure bowtie illustrates the causes, outcomes and the controls in place to manage these failure mechanisms.	

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Hazard Management (Bowtie Diagrams)

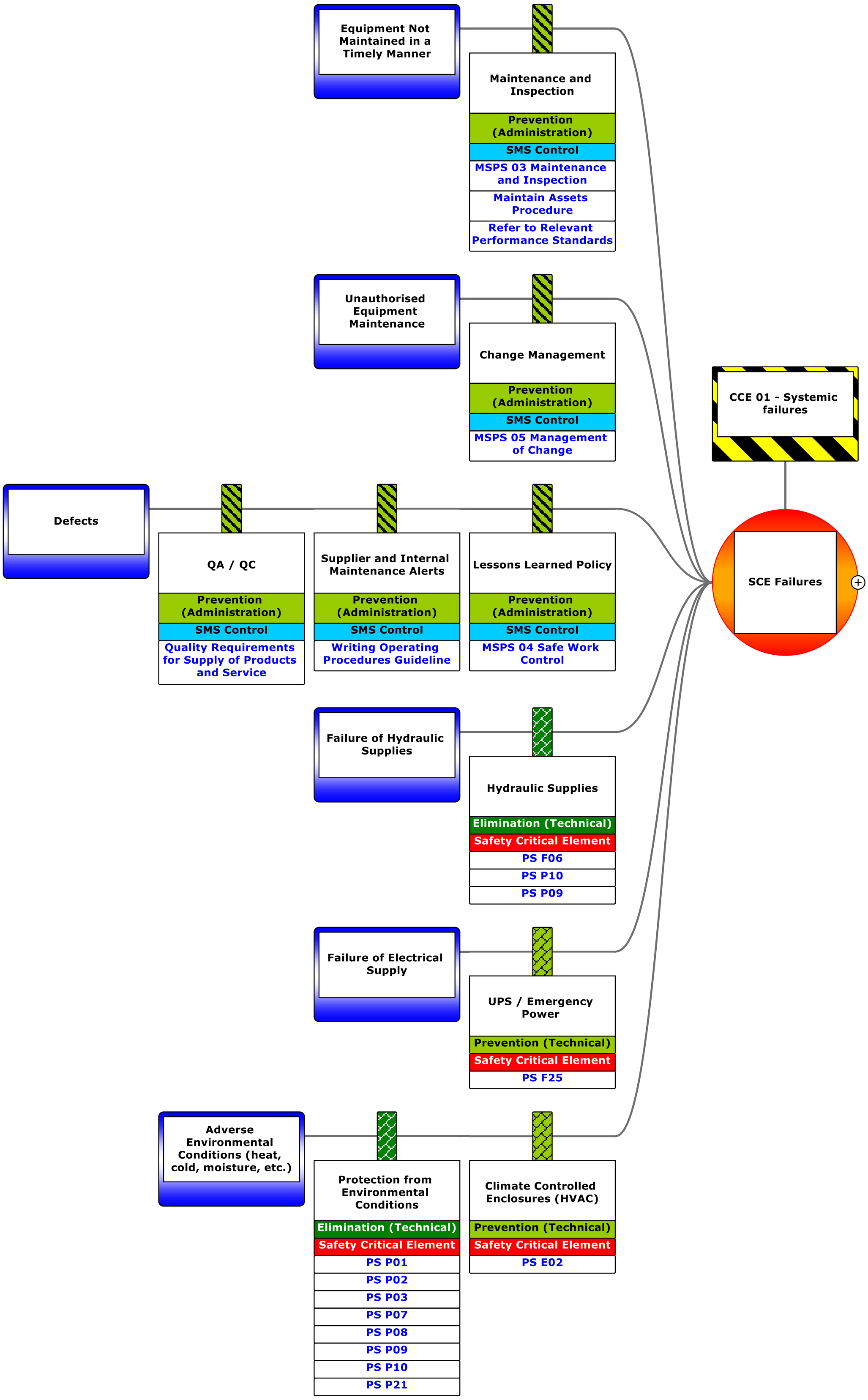

Figure 6-29: Generic Bowtie – SCE Failures (causes)

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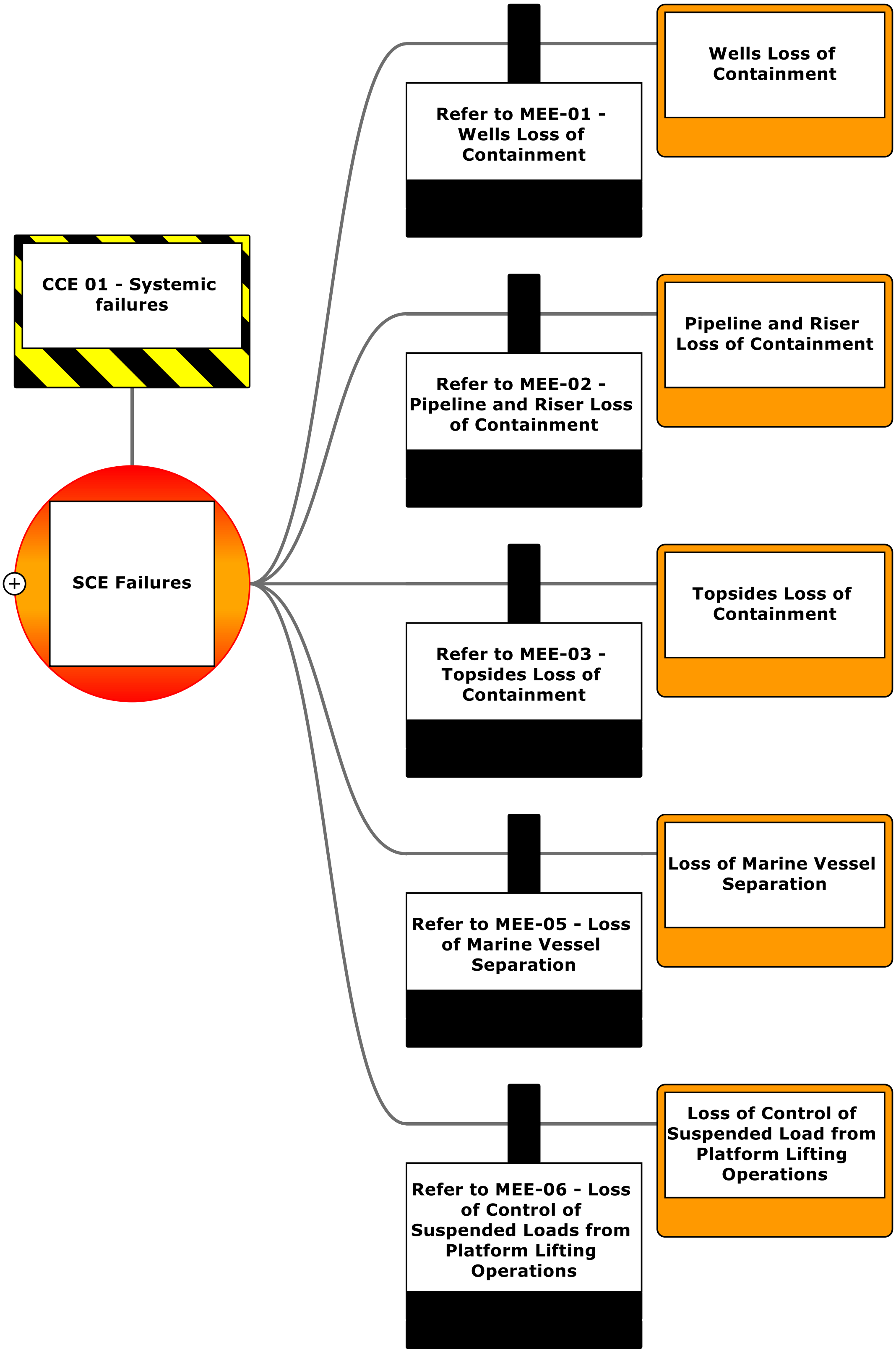

Figure 6-30:Generic Bowtie – SCE Failures (Outcomes)

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MEE Common Cause Event – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
Preventative Barriers – Safety and Environmental Critical Elements				
Elimination	Maintain hydraulic supplies (e.g to support Safety Instrumented Systems and actuation of SCE valves/isolations)	F06 – Safety Instrumented System	Elimination (Technical)	Yes **C 19.1**
	Maintain protection from environmental conditions	P01 – Pressure Vessels P02 – Heat Exchanger P03 – Rotating Equipment P07 – Topsides / Surface Structures P08 – Piping Systems P09 – Pipeline Systems P10 – Wells P21 – Substructures	Elimination (Technical)	Yes **C 19.2**
Substitution	N/A	No elimination or substitution controls were identified beyond those incorporated in design.		
Engineering Controls	Maintain UPS / emergency power system to supply Essential safety systems	F25 – UPS / Emergency Power	Prevention (Technical)	Yes **C 19.3**
	Maintain climate controlled enclosures to protect essential equipment from adverse environmental conditions	E02 – Safety Critical Buildings	Prevention (Technical)	Yes **C 19.4**
Mitigating Barrier – Safety and Environmental Critical Elements				
Mitigation	N/A	No mitigation controls were identified beyond those incorporated in design.		
Legislation Codes and Standards				
Procedures and Administration	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009: Accepted Safety Case for the GWA facility to; • identify hazards that have the potential to cause a MAE; • detail assessment of MAE risks; and • describe the physical barriers SCEs and the safety management systems identified as being required to reduce the risk to personnel associated	GWA Safety Case	Prevention (Administration) Control based on legislative requirements – must be adopted	Yes **C 13.7**

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MEE Common Cause Event – Demonstration of ALARP ALARP Control Measures				
Hierarchy	***Control / Barrier***	***SCE / Management System Reference***	***Type of Effect (Refer to Table 6-13)***	***Control Adopted***
	with a MAE to ALARP; thus contributing to management of associated potential environmental consequences of MAEs.			
Management System Specific Measures: Key Standards or Procedures				
Procedures and Administration	Implement management systems to maintain: • MSPS 03 Maintenance and Inspection • MSPS 04 Safe Work Control • MSPS 05 Management of Change • Quality Requirements for Supply of Products and Service • Provide Assurance Procedure	MSPS-03 MSPS-04 MSPS-05 Provide Assurance Procedure	Prevention (Administration)	Yes – See **Section 7.9** Implementation Strategy.
Risk Evaluation				
Refer to MEEs.				

CCE-01 Safety Critical Element Failure Performance Outcomes, Standards and Measurement Criteria			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
Refer to relevant MEE EPOS: EPO 13 EPO 14 EPO 15 EPO 16 EPO 17 EPO 18	**C 19.1** Maintain hydraulic supplies (e.g to support Safety Instrumented Systems and actuation of SCE valves/isolations).	**PS 19.1** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: F06 – Safety Instrumented System to; • maintain hydraulic supplies (e.g. to support Safety Instrumented Systems and actuation of SCE valves/isolations).	Refer to **MC 1.6.1**

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CCE-01 Safety Critical Element Failure Performance Outcomes, Standards and Measurement Criteria			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
	C 19.2 Maintain protection from environmental conditions.	**PS 19.2** Integrity will be managed in accordance with SCE Management Procedure (Section 6.1.5.2) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • P01 – Pressure Vessels • P02 – Heat Exchanger • P03 – Rotating Equipment • P07 – Topsides / Surface Structures • P08 – Piping Systems • P09 – Pipeline Systems • P10 – Wells • P21 – Substructures; for each SCE to; – protect equipment from adverse environmental conditions (e.g. heat, cold, moisture, chemical reaction/ incompatibility).	Refer to **MC 1.6.1**
	C 19.3 Maintain UPS / emergency power system to supply Essential safety systems.	**PS 19.3** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5**) and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for: • F25 – UPS / Emergency Power to; – provide continuous supply of power (emergency generation and uninterruptable power supply (UPS) to Essential loads following a total (mains) power failure.	Refer to **MC 1.6.1**
	C 19.4 Maintain climate controlled enclosures to protect essential equipment from adverse environmental conditions	**PS 19.4** Integrity will be managed in accordance with SCE Management Procedure (**Section 7.1.5)** and SCE technical Performance Standard(s) to prevent environment risk related Damage to SCEs for:	Refer to **MC 1.6.1**

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CCE-01 Safety Critical Element Failure Performance Outcomes, Standards and Measurement Criteria			
Environmental Performance Outcomes	***Controls***	***Environmental Performance Standards***	***Measurement Criteria***
		E02 – Safety Critical Buildings to; protect essential equipment from adverse environmental conditions by; • providing ventilation to ensure that the zonal classification is maintained within an enclosure or building via adequate or dilution ventilation, and; • preventing ingress of hazardous products from external sources into buildings / enclosures located within a hazardous/non-hazardous area.	
	Refer to **C 13.7**	Refer to **PS 13.7**	Refer to **MC 13.7.1**

GWA: Major Environmental Event Datasheet	
MEE Number	All
Hazard Description	Generic Human Errors – Degradation Factors
Hazard Ref ID	N/A

Hazard Description

Hazard Overview and Scope

There are a number of causes of human errors which contribute to MEEs, or which can result in failure or degradation of the barriers in place to protect against MEEs. These are presented in the following bowtie pages and include;

- task issues, e.g. poor task design; time pressures, task complexity
- poor physical interfaces / working environment
- provision of inappropriate tools for the task
- communication errors, i.e. poor quality information, lack of clarity in instructions
- operator failings, e.g. competence, fitness, impairment or fatigue
- organisational issues, e.g. peer pressure, poor safety culture, inadequate supervision, lack of clarity on roles and expectations.

The Generic Human Errors bowtie illustrates the causes, outcomes and the barriers in place for these failure mechanisms.

Human Errors are managed solely via the WMS (no SCEs) and the bowtie is included in this section for completeness.

Refer to **Section 7** Implementation Strategy for applicable Management System Procedures.

Hazard Management (Bowtie Diagrams)

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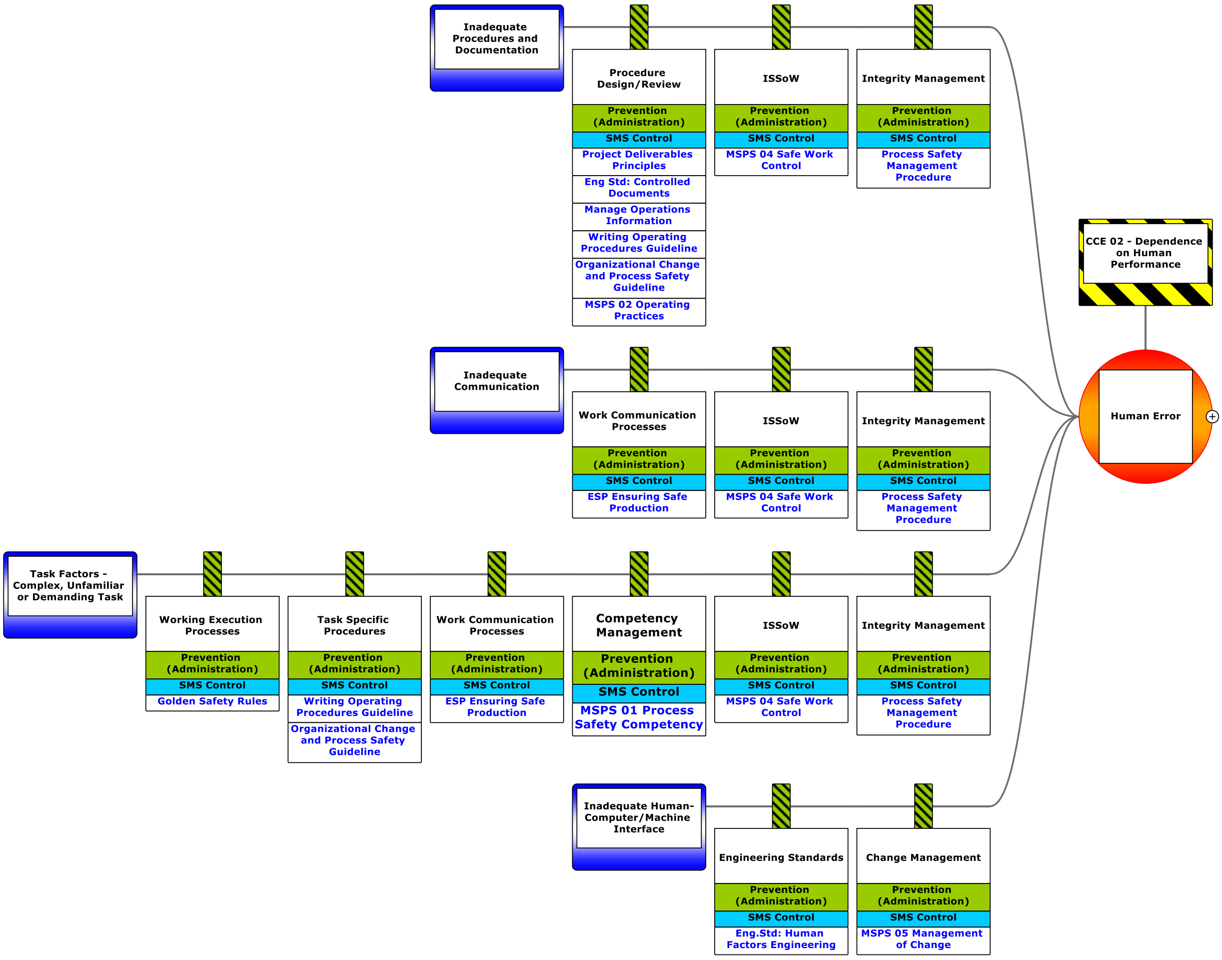

Figure 6-31: Generic Bowtie – Human Error (Causes 1 – 4)

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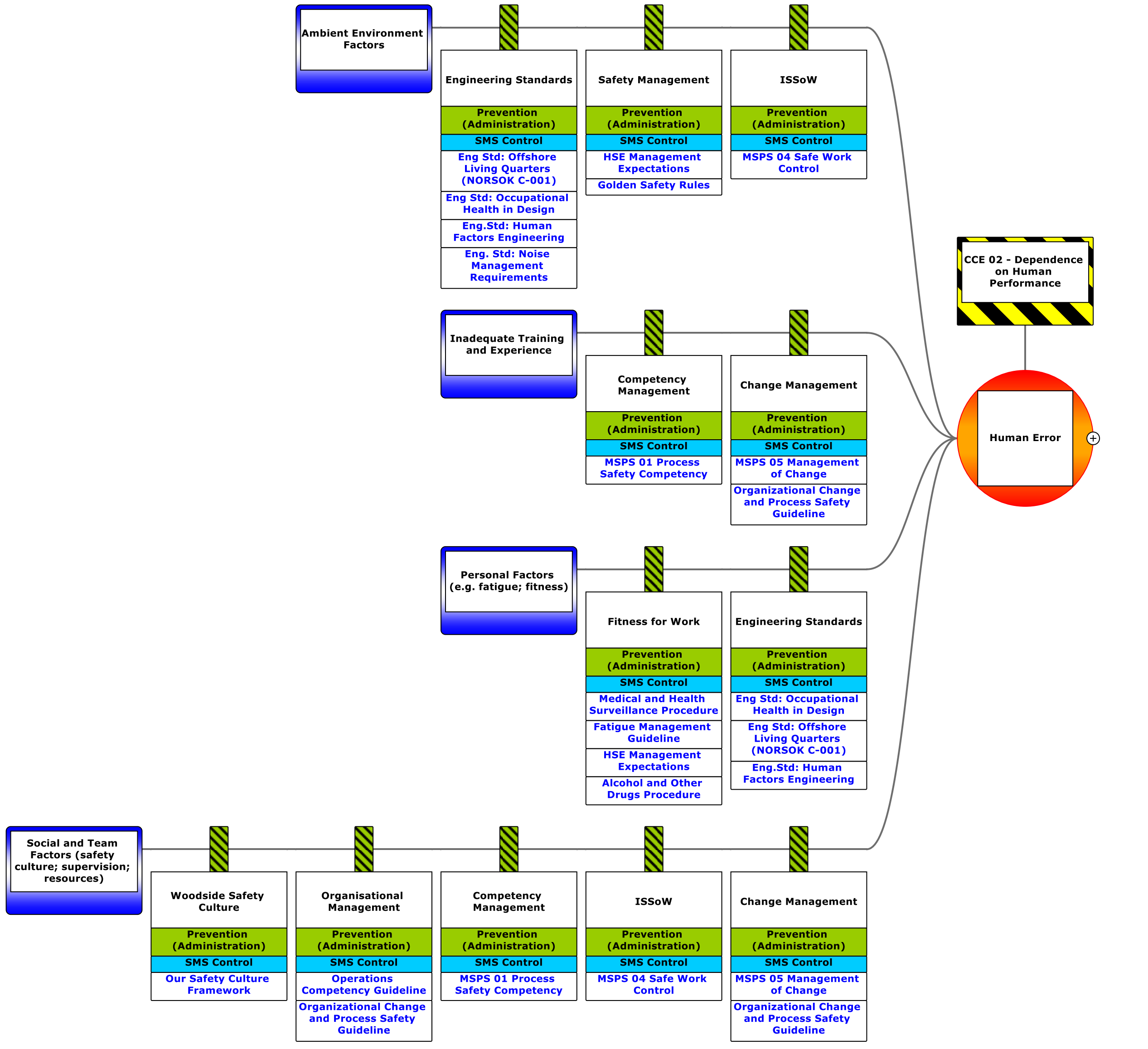

Figure 6-32: Generic Bowtie – Human Error (Causes 5 – 8)

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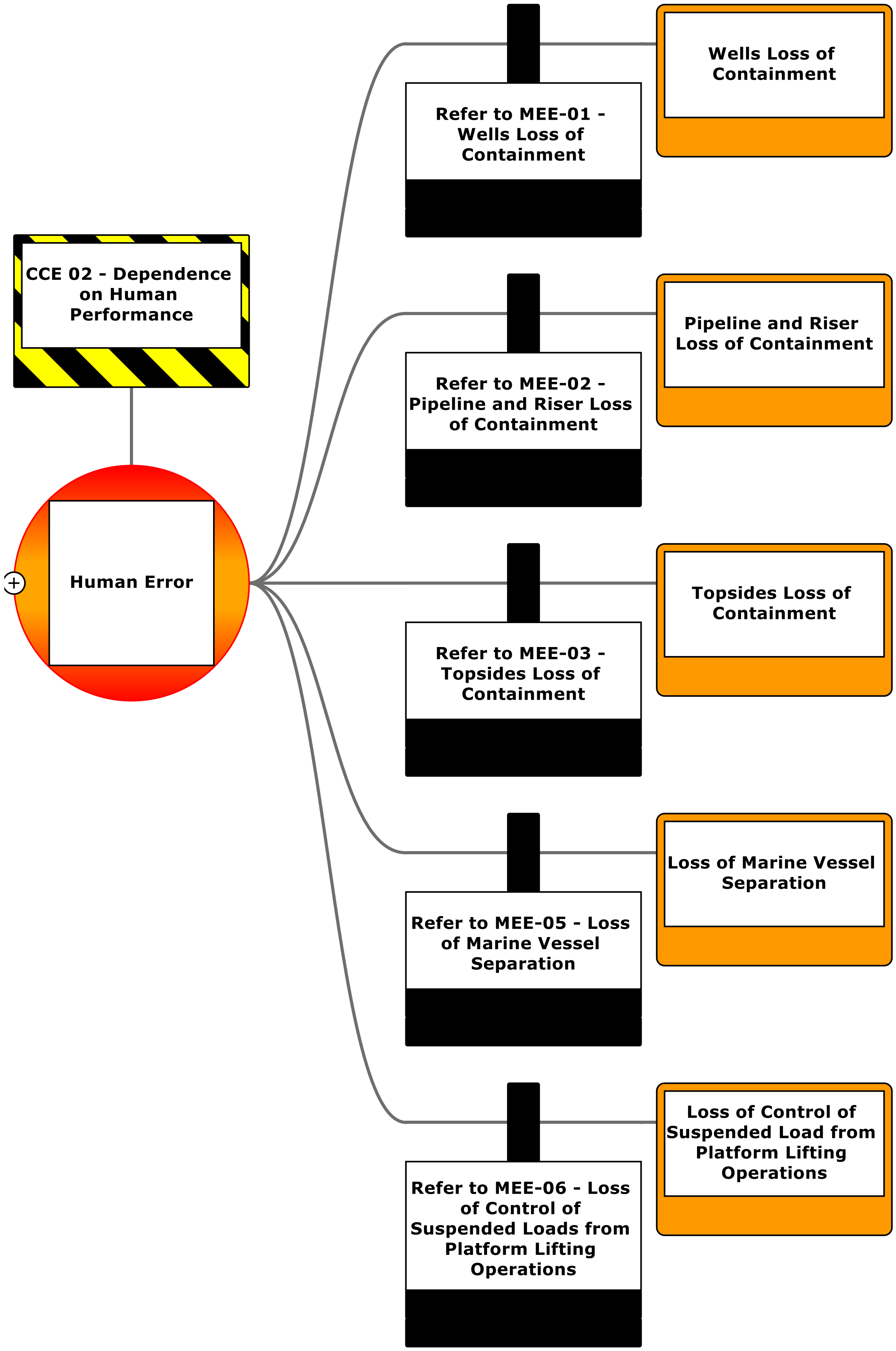

Figure 6-33: Generic Bowtie – Human Error (Outcomes)

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6.9 Recovery Plan and Threat Abatement Plan Assessment

This section describes the assessment that Woodside has undertaken to demonstrate that the Petroleum Activities Program is not inconsistent with any relevant recovery plans or threat abatement plans. For the purposes of this assessment, the relevant Part 13 statutory instruments (recovery plans and threat abatement plans) are:

- Recovery Plan for Marine Turtles in Australia 2017–2027 (Commonwealth of Australia, 2017).
- Conservation Management Plan for the Blue Whale 2015–2025 (Commonwealth of Australia, 2015a).
- Recovery Plan for the Grey Nurse Shark (Carcharias taurus) 2014 (Commonwealth of Australia, 2014b).
- Sawfishes and River Sharks Multispecies Recovery Plan (Commonwealth of Australia, 2015b).
- Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans 2018 (Commonwealth of Australia, 2018).

Table 6-23 lists the objectives and (where relevant) the action areas of these plans, and also describes whether these objectives/action areas are applicable to government, the Titleholder, and/or the Petroleum Activities Program. For those objectives/action areas applicable to the Petroleum Activities Program, the relevant actions of each plan have been identified, and an evaluation has been conducted as to whether impacts and risks resulting from the activity are not inconsistent with that action. The results of this assessment against relevant actions are presented in **Table 6-24** to **Table 6-27**.

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Table 6-23: Identification of Applicability of Recovery Plan and Threat Abatement Plan Objectives and Action Areas

EPBC Act Part 13 Statutory Instrument	Applicable to:		
	Government	***Titleholder***	***Petroleum Activities Program***
Marine Turtle Recovery Plan			
Long-term Recovery Objective: Minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so they can be removed from the EPBC Act threatened species list	Y	Y	Y
Interim Recovery Objectives			
1. Current levels of legal and management protection for marine turtle species are maintained or improved, both domestically and throughout the migratory range of Australia's marine turtles	Y		
2. The management of marine turtles is supported	Y		
3. Anthropogenic threats are demonstrably minimised	Y	Y	Y
4. Trends in nesting numbers at index beaches and population demographics at important foraging grounds are described	Y	Y	
Action Areas			
A. Assessing and addressing threats			
A1. Maintain and improve efficacy of legal and management protection	Y		
A2. Adaptatively manage turtle stocks to reduce risk and build resilience to climate change and variability	Y		
A3. Reduce the impacts of marine debris	Y	Y	Y
A4. Minimise chemical and terrestrial discharge	Y	Y	Y
A5. Address international take within and outside Australia's jurisdiction	Y		
A6. Reduce impacts from terrestrial predation	Y		
A7. Reduce international and domestic fisheries bycatch	Y		
A8. Minimise light pollution	Y	Y	Y
A9. Address the impacts of coastal development/infrastructure and dredging and trawling	Y	Y	
A10. Maintain and improve sustainable Indigenous management of marine turtles	Y		
B. Enabling and measuring recovery			

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EPBC Act Part 13 Statutory Instrument	Applicable to:		
	Government	*Titleholder*	*Petroleum Activities Program*
B1. Determine trends in index beaches	Y	Y	
B2. Understand population demographics at key foraging grounds	Y		
B3. Address information gaps to better facilitate the recovery of marine turtle stocks	Y	Y	Y
Blue Whale Conservation Management Plan			
Long-term recovery objective: Minimise anthropogenic threats to allow for their conservation status to improve so that they can be removed from the EPBC Act threatened species list	Y	Y	Y
Interim Recovery Objectives			
1. The conservation status of blue whale populations is assessed using efficient and robust methodology	Y		
2. The spatial and temporal distribution, identification of BIAs, and population structure of blue whales in Australian waters is described	Y	Y	Y
3. Current levels of legal and management protection for blue whales are maintained or improved and an appropriate adaptive management regime is in place	Y		
4. Anthropogenic threats are demonstrably minimised	Y	Y	Y
Action Areas			
A. Assessing and addressing threats			
A.1: Maintain and improve existing legal and management protection	Y		
A.2: Assessing and addressing anthropogenic noise	Y	Y	Y
A.3: Understanding impacts of climate variability and change	Y		
A.4: Minimising vessel collisions	Y	Y	Y
B. Enabling and Measuring Recovery			
B.1: Measuring and monitoring population recovery	Y		
B.2: Investigating population structure	Y		
B.3: Describing spatial and temporal distribution and defining biologically important habitat	Y	Y	Y

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EPBC Act Part 13 Statutory Instrument	Applicable to:		
	Government	***Titleholder***	***Petroleum Activities Program***
Grey Nurse Shark Recovery Plan			
Overarching Objective			
To assist the recovery of the grey nurse shark in the wild, throughout its range in Australian waters, with a view to: improving the population status, leading to future removal of the grey nurse shark from the threatened species list of the EPBC Act ensuring that anthropogenic activities do not hinder the recovery of the grey nurse shark in the near future, or impact on the conservation status of the species in the future	Y	Y	Y
Specific Objectives			
1. Develop and apply quantitative monitoring of the population status (distribution and abundance) and potential recovery of the grey nurse shark in Australian waters	Y		
2. Quantify and reduce the impact of commercial fishing on the grey nurse shark through incidental (accidental and/or illegal) take, throughout its range	Y		
3. Quantify and reduce the impact of recreational fishing on the grey nurse shark through incidental (accidental and/or illegal) take, throughout its range	Y		
4. Where practicable, minimise the impact of shark control activities on the grey nurse shark	Y		
5. Investigate and manage the impact of ecotourism on the grey nurse shark	Y		
6. Manage the impact of aquarium collection on the grey nurse shark	Y		
7. Improve understanding of the threat of pollution and disease to the grey nurse shark	Y	Y	Y
8. Continue to identify and protect habitat critical to the survival of the grey nurse shark and reduce the impact of threatening processes within these areas	Y	Y	
9. Continue to develop and implement research programs to support the conservation of the grey nurse shark	Y	Y	
10. Promote community education and awareness in relation to grey nurse shark conservation and management	Y		
Sawfish and River Sharks Recovery Plan			
Primary Objective			

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EPBC Act Part 13 Statutory Instrument	Applicable to:		
	Government	***Titleholder***	***Petroleum Activities Program***
To assist the recovery of sawfish and river sharks in Australian waters with a view to: improving the population status leading to the removal of the sawfish and river shark species from the threatened species list of the EPBC Act ensuring that anthropogenic activities do not hinder recovery in the near future, or impact on the conservation status of the species in the future	Y	Y	Y
Specific Objectives			
1. Reduce and, where possible, eliminate adverse impacts of commercial fishing on sawfish and river shark species	Y		
2. Reduce and, where possible, eliminate adverse impacts of recreational fishing on sawfish and river shark species	Y		
3. Reduce and, where possible, eliminate adverse impacts of Indigenous fishing on sawfish and river shark species	Y		
4. Reduce and, where possible, eliminate the impact of illegal, unregulated and unreported fishing on sawfish and river shark species	Y		
5. Reduce and, where possible, eliminate adverse impacts of habitat degradation and modification on sawfish and river shark species	Y	Y	Y
6. Reduce and, where possible, eliminate any adverse impacts of marine debris on sawfish and river shark species noting the linkages with the Threat Abatement Plan for the Impact of Marine Debris on Vertebrate Marine Life	Y	Y	Y
7. Reduce and, where possible, eliminate any adverse impacts of collection for public aquaria on sawfish and river shark species	Y		
8. Improve the information base to allow the development of a quantitative framework to assess the recovery of, and inform management options for, sawfish and river shark species	Y		
9. Develop research programs to assist conservation of sawfish and river shark species	Y	Y	
10. Improve community understanding and awareness in relation to sawfish and river shark conservation and management	Y		

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EPBC Act Part 13 Statutory Instrument	Applicable to:		
	Government	***Titleholder***	***Petroleum Activities Program***
Marine Debris Threat Abatement Plan			
Objectives			
1. Contribute to long-term prevention of the incidence of marine debris	Y	Y	
2. Understand the scale of impacts from marine plastic and microplastic on key species, ecological communities and locations	Y	Y	Y
3. Remove existing marine debris	Y		
4. Monitor the quantities, origins, types and hazardous chemical contaminants of marine debris, and assess the effectiveness of management arrangements for reducing marine debris	Y		
5. Increase public understanding of the causes and impacts of harmful marine debris, including microplastic and hazardous chemical contaminants, to bring about behaviour change	Y		

Table 6-24: Assessment against relevant actions of the Marine Turtle Recovery Plan

Part 13 Statutory Instrument	Relevant Action Areas/Objectives	Relevant Actions	Evaluation	EPO, Controls and PS
Marine Turtle Recovery Plan	**Action Area A3:** Reduce the impacts from marine debris	**Action:** Support the implementation of the Marine Debris Threat Abatement Plan (TAP) Priority actions at stock level: G-NWS – Understand the threat posed to this stock by marine debris LH-WA – Determine the extent to which marine debris is impacting loggerhead turtles F-Pil – no relevant actions	Refer **Section 6.7.2** **Not inconsistent assessment:** The assessment of the accidental release of solid hazardous and non-hazardous wastes has considered the potential risks to marine turtles. Controls have been implemented to reduce the likelihood of accidental release of solid wastes for the duration of the petroleum activities program.	**EPO 10** **C 10.1-10.4, C 9.5** **PS 10.1-10.3, PS 9.5**

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Part 13 Statutory Instrument	Relevant Action Areas/Objectives	Relevant Actions	Evaluation	EPO, Controls and PS
	Action Area A4: Minimise chemical and terrestrial discharge	**Action:** Ensure spill risk strategies and response programs adequately include management for marine turtles and their habitats, particularly in reference to 'slow to recover habitats', e.g. nesting habitat, seagrass meadows or coral reefs Priority actions at stock level: G-NWS – Ensure that spill risk strategies and response programs include management for turtles and their habitats LH-WA & F-Pil – Ensure that spill risk strategies and response programs include management for turtles and their habitats, particularly in reference to slow to recover habitats, e.g. seagrass meadows or corals	Refer **Sections 6.6.5, 6.7** and **6.8** **Not inconsistent assessment:** The assessment of accidental release of chemicals / hydrocarbons has considered the potential risks to marine turtles. Spill risk strategies and response program include management measures for turtles and their nesting habitats.	Refer Section 6.6.5, 6.7 and 6.8 Detailed oil spill preparedness and response EPOs, EPSs and MC for the Petroleum Activities Program are present in Appendix F
	Action Area A8: Minimise light pollution	**Action:** Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats Priority actions at stock level: G-NWS – as above LH-WA – no relevant actions F-Pil – Manage artificial light from onshore and offshore sources to ensure biologically important behaviours of nesting adults and emerging/dispersing hatchlings can continue	Refer Sections **6.6.8** **Not inconsistent assessment:** The assessment of light emissions has considered the potential impacts to marine turtles. Internesting, mating, foraging or migrating turtles are not impacted by light from offshore vessels. Based on the frequency and nature of IMR activities, the impacts to adult turtles moving through the Operational Area from vessel lighting are expected to be localised and temporary with no lasting effect.	**EPO 8** **C 8.1** **PS 8.1**

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Part 13 Statutory Instrument	Relevant Action Areas/Objectives	Relevant Actions	Evaluation	EPO, Controls and PS
	Action Area B1: Determine trends at index beaches	**Action:** Maintain or establish long-term monitoring programs at index beaches to collect standardised data critical for determining stock trends, including data on hatchling production Priority actions at stock level: G-NWS – Continue long-term monitoring of index beaches LH-WA – Continue long-term monitoring of nesting and foraging populations F-Pil – no relevant actions	**Not inconsistent assessment:** Woodside contributes to Action Area B1 via its support of the Ningaloo Turtle Program.	N/A
	Action Area B3: Address information gaps to better facilitate the recovery of marine turtle stocks	**Action:** Understand the impacts of anthropogenic noise on marine turtle behaviour and biology Priority actions at stock level: G-NWS – Given this is a relatively accessible stock that is likely to be exposed to anthropogenic noise – Investigate the impacts of anthropogenic noise on turtle behaviour and biology and extrapolate findings from the NWS stock to other stocks LH-WA – no relevant actions F-Pil – no relevant actions	Refer Sections 6.6.3 **Not inconsistent assessment:** The assessment of acoustic emissions has considered the potential impacts to marine turtles. IMR related noise is not expected to result in behavioural response, injury or mortality of individuals, or any other lasting effect.	**EPO 3** **C 3.1** **PS 3.1**

Assessment Summary

The Marine Turtle Recovery Plan has been considered during the assessment of impacts and risks, and the Petroleum Activities Program is not considered to be inconsistent with the relevant actions of this plan.

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Table 6-25: Assessment against relevant actions of the Blue Whale Conservation Management Plan

Part 13 Statutory Instrument	Relevant Action Areas/Objectives	Relevant Actions	Evaluation	EPO, Controls and PS
Blue Whale Conservation Management Plan	**Action Area A.2:** Assessing and addressing anthropogenic noise	**Action 2:** Assessing the effect of anthropogenic noise on blue whale behaviour **Action 3:** Anthropogenic noise in BIAs will be managed such that any blue whale continues to use the area without injury[2], and is not displaced from a foraging area	Refer **Sections 6.6.3** **Not inconsistent assessment:** The assessment of acoustic emissions has considered the potential impacts to pygmy blue whales. Acoustic emissions from project vessels will not cause injury to any pygmy blue whale. There are no known or possible foraging areas for pygmy blue whales within or adjacent to the Operational Area. If the Petroleum Activities Program within the Operational Area overlaps with an individual northbound or southbound migration, they may deviate slightly from the migratory route, but will continue on their migration.	**EPO 3** **C 3.1** **PS 3.1**
	Action Area A.4: Minimising vessel collisions	**Action 3:** 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	Refer **Section 6.7.3** **Not inconsistent assessment:** The assessment of vessel collision with marine fauna has considered the potential risks to pygmy blue whales. If the Petroleum Activities Program within the Operational Area overlaps with an individual northbound or southbound migration, they may deviate slightly from the migratory route, but will continue on their migration. Vessel collisions with pygmy blue whales are highly unlikely to occur, given the low operating speed of support vessels.	**EPO 11** **C 11.1** **PS 11.1**
	Action Area B.3: Describing spatial and temporal distribution and defining biologically important habitat	**Action 2:** Identify migratory pathways between breeding and feeding grounds **Action 3:** Assess timing and residency within BIAs	**Not inconsistent assessment:** Woodside contributes to Action Area B3 via its support of targeted research initiatives (e.g. satellite tracking of pygmy blue whale migratory movements[3]).	N/A
Assessment Summary The Blue Whale Conservation Management Plan has been considered during the assessment of impacts and risks, and the Petroleum Activities Program is not considered to be inconsistent with the relevant actions of this plan.				

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Table 6-26: Assessment against relevant actions of the Grey Nurse Shark Recovery Plan

Part 13 Statutory Instrument	Relevant Action Areas/Objectives	Relevant Actions	Evaluation	EPO, Controls and PS
Grey Nurse Shark Recovery Plan	**Objective 7:** Improve understanding of the threat of pollution and disease to the grey nurse shark	**Action 7.1:** Review and assess the potential threat of introduced species, pathogens and pollutants	Refer **Section 6.7.2** Not inconsistent assessment: This EP includes an assessment of the impacts from accidental release of solid wastes as well as planned discharges of drilling waste on marine species.	N/A
			Refer Sections 6.6.5, 6.7 and 6.8 **Not inconsistent assessment:** The assessment of accidental release of chemicals / hydrocarbons has considered the potential risks to grey nurse sharks. Spill risk strategies and response program include management measures, as identified and required.	Refer Sections 6.6.5, 6.7 and 6.8 Detailed oil spill preparedness and response EPOs, EPSs and MC for the Petroleum Activities Program are present in Appendix F
Assessment Summary The Grey Nurse Shark Recovery Plan has been considered during the assessment of impacts and risks, and the Petroleum Activities Program is not considered to be inconsistent with the relevant actions of this plan.				

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Table 6-27: Assessment against relevant actions of the Sawfish and River Shark Recovery Plan

Part 13 Statutory Instrument	Relevant Action Areas/Objectives	Relevant Actions	Evaluation	EPO, Controls and PS
Sawfish and River Shark Recovery Plan	**Objective 5:** Reduce and, where possible, eliminate adverse impacts of habitat degradation and modification on sawfish and river shark species	**Action 5c:** Identify risks to important sawfish and river shark habitat and measures needed to reduce those risks	Refer Sections 6.6.5, 6.7 and 6.8 **Not inconsistent assessment:** The assessment of accidental release of chemicals / hydrocarbons has considered the potential risks to sawfish and river shark. Spill risk strategies and response program include management measures, as identified and required.	Refer Sections 6.6.5, 6.7 and 6.8 Detailed oil spill preparedness and response EPOs, EPSs and MC for the Petroleum Activities Program are present in Appendix F
	Objective 6: Reduce and, where possible, eliminate any adverse impacts of marine debris on sawfish and river shark species noting the linkages with the Threat Abatement Plan for the Impact of Marine Debris on Vertebrate Marine Life	**Action 6a:** Assess the impacts of marine debris including ghost nets, fishing gear and plastics on sawfish and river shark species	Refer **Section 6.7.2** **Not inconsistent assessment:** The assessment of the accidental release of solid hazardous and non-hazardous wastes has considered the potential risks to sawfish. Controls have been implemented to reduce the likelihood of accidental release of solid wastes for the duration of the petroleum activities program.	N/A
Assessment Summary The Sawfish and River Shark Recovery Plan has been considered during the assessment of impacts and risks, and the Petroleum Activities Program is not considered to be inconsistent with the relevant actions of this plan.				

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Table 6-28 Assessment against relevant actions of the Marine Debris Threat Abatement Plan Part 13 Statutory Instrument	Relevant Action Areas/Objectives	Relevant Actions	Evaluation	EPO, Controls and PS
Marine Debris TAP	**Objective 2:** Understand the scale of marine plastic and microplastic impact on key species, ecological communities and locations	**Action 2.04:** Build understanding related to plastic and microplastic pollution	Refer **Section 6.6.7** **Not inconsistent assessment:** The assessment of the accidental release of solid hazardous and non-hazardous wastes has considered the potential risks to the marine environment. Controls have been implemented to reduce the likelihood of accidental release of solid wastes for the duration of the petroleum activities program.	N/A
Assessment Summary The Marine Debris TAP has been considered during the assessment of impacts and risks, and the Petroleum Activities Program is not considered to be inconsistent with the relevant actions of this plan.				

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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 1.8**).

7.1 Systems, Practice and Procedures

All operational activities are planned and carried out in accordance with relevant legislation and internal environment standards and procedures identified in this EP (**Section 6**).

Processes are implemented to verify controls to manage environmental impacts and risks to:

- a level that is ALARP and acceptable
- meet EPOs
- comply with EPSs defined in this EP.

The systems, practices and procedures that will 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; this is managed through a change register and management of change (MoC) process (**Section 7.1.4**). Further information regarding some of the key systems, practices and procedures relevant to implementation of this EP is provided below.

7.1.1 WMS Operate Processes

Under the WMS Operate Activity (see **Section 1.8** for an overview of the WMS), there are four overarching processes; those directly relevant to the implementation of this EP and environmental management during the Petroleum Activities Program are described below (Operate Plant Process and the Maintain Assets Process).

7.1.1.1 Operate Plant

The objective of the Operate Plant Process is to ensure production is carried out in a safe, efficient, reliable and economic manner, and that all required process variables are within allowable limits. This ensures the potential for unplanned (accident/incident) events that may impact the environment are minimised.

The Operate Plant Process develops key activities to support ongoing production activities in order to ensure the facility is operated within the Basis of Design. The process also identifies required production routines, routine execution, recording of data gathered and formulation of remedial activities. The Operate Plant Process includes the Integrated Safe System of Work (ISSoW) system (described below).

In addition, the Operating Practice MSPS (M02) is in place to assure operating practices are in place, such that:

- integrity critical operating procedures are available, accurate, up to date, understood and used
- safe operating and technical integrity limits are defined, understood and the process is managed within these limits.

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Integrated Safe System of Work

The ISSoW Procedure outlines the key activities required to achieve effective management of permit-controlled work on the facility. The ISSoW process is a management system for all work and is a key element in ensuring the safety of personnel, protection of the environment and technical integrity of the facility.

Work within the facility 500 m PSZ and operations within the vicinity of the connected flowlines is controlled in accordance with ISSoW.

The ISSoW system takes a risk-based approach to activities, thus tasks with higher levels of risk are subjected to greater scrutiny and control. The ISSoW system also allows for low risk routine tasks to be carried out with adequate but minimal administration. The prime objective of ISSoW is to ensure work other than normal operations is properly planned, risk assessed, controlled, coordinated and safely executed. It provides a methodical approach to identifying hazards, assessing risks, and creating and supporting permits to work and associated certificates.

In keeping with ALARP principles, this system is critical to ensuring the appropriate level of hazard identification and risk assessment is carried out for activities performed on the facility.

In addition, the Safe Work Control MSPS (M04) is in place to assure effective safe work control, permit to work and task risk management arrangements are in place and followed to control the risks arising from work activities.

7.1.1.2 Maintain Assets

The Maintain Assets Process aims to improve the reliability and availability of plant and equipment (which includes that required for safe operation) through well managed and planned execution of maintenance that promotes a proactive maintenance culture.

Maintenance, inspection and testing systems and procedures are in place to safeguard the integrity of the facility. The maintenance strategy for the facility is based on optimising safety, minimising environmental impact and maximising production. Maintenance practices used to establish well managed maintenances strategies, planned execution and improvement are described in the Maintenance of Assets Procedure.

A risk-based approach is used as the basis for establishing and prioritising inspection, maintenance and testing requirements at the facility. Equipment is assessed to establish equipment criticality with respect to the consequences and likelihood of equipment failure. This informs determination of appropriate maintenance and inspection activities. Maintenance activities are allocated risk rankings according to the criticality of equipment, to ensure high risk maintenance work orders are completed as a priority.

A computerised maintenance management system (CMMS) provides a database called SAP-PM that contains facility registers, equipment details, spare parts data and associated planned maintenance tasks. This system is used to plan, monitor and record maintenance activities. The system provides a variety of reports that enable monitoring and assessment of maintenance activities.

SCE Technical Performance Standards identify SCEs and associated assurance activities. These activities are identified in the CMMS and given the appropriate priority (Technical Integrity status). Refer to **Sections 2.7.5** and **7.1.5** for more detail on SCE Technical Performance Standards and how they differ from EPSs required by the Environment Regulations. SCE Technical Performance Standards form a key component in the processes and systems implemented by Woodside to maintain safety and environment critical plant and equipment.

In addition, the Maintenance and Inspection MSPS (M03) is in place to assure that the necessary inspection and maintenance requirements are identified and carried out to maintain the integrity of Safety and Environmental Critical Equipment (SCEs and SCQs).

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7.1.2 Process Safety Management

To ensure that Woodside protects the safety, security and health of its employees, contractors, the environment and assets, Woodside has adopted the Energy Institute's PSM framework within its PSM Procedure which sets out a disciplined framework for managing the integrity of systems and processes that handle hazardous substances over the production (and exploration) lifecycle. It deals with the prevention and control of events that have potential to release hazardous materials and energy.

PSM consists of four main focus areas. Each focus area contains a number of PSM requirements that define key aspects required to ensure that PSM is integrated through the organisation. There are twenty PSM requirements. The focus areas and requirements are shown in **Figure 7-1**.

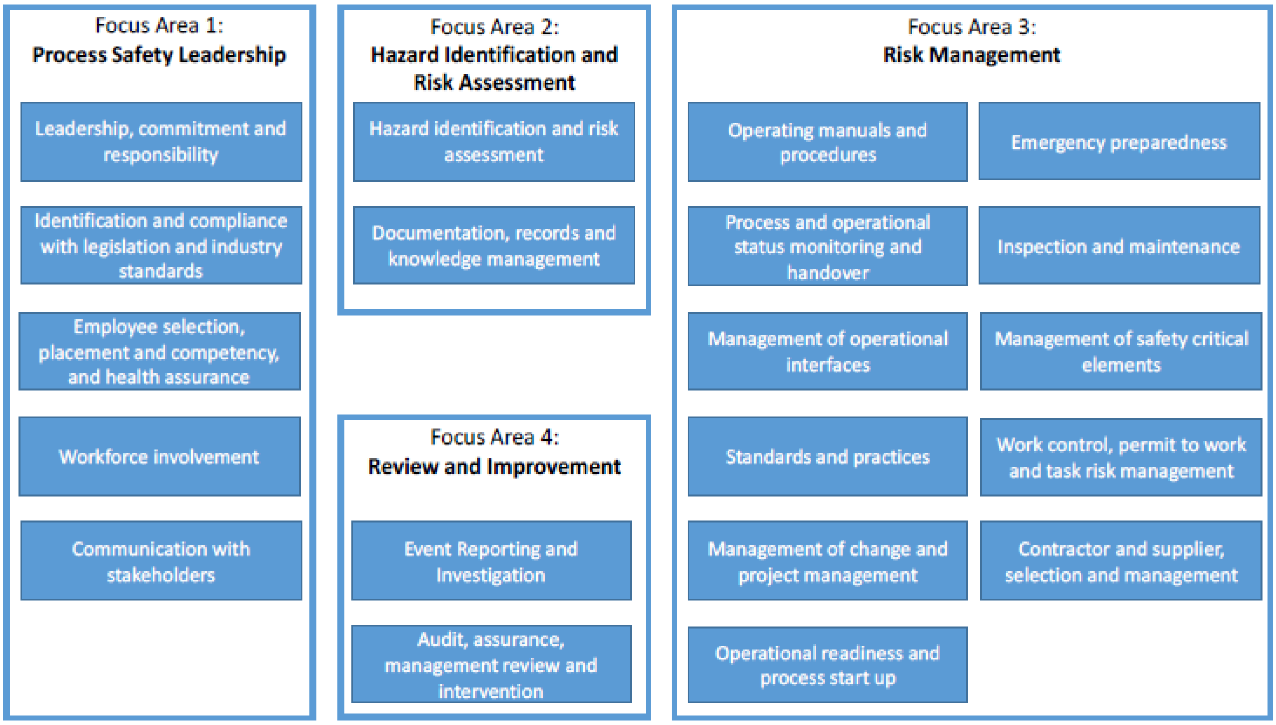

Figure 7-1: Process safety management focus area

7.1.2.1 Woodside Safety Culture Framework

Woodside's 'Our Safety Culture' framework (shown in **Figure 7-2**) promotes a strong HSE culture and is a key enabler for effective PSM. This framework outlines the expected behaviours for everyone including supervisors and managers/executives, and is openly discussed as part of inductions, training and development.

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Theme	Everyone	Supervisors	Managers/Executives
Standards	Follow rules	Ensure compliance	Set high standards
Communication	Speak up	Encourage the team	Communicate openly
Risk management	Be mindful	Promote risk awareness	Confront risk
Involvement	Get involved	Involve the team	Involve the workforce

Figure 7-2: Woodside 'Our Safety Culture' framework

7.1.3 Risk Management

Risk management processes and practices are applied on an ongoing basis to design, production and maintenance activities at the GWA facility to manage risks to personnel, assets and the environment.

Potential environmental consequences and impacts from the GWA facility are risk assessed and controlled in accordance with the Woodside risk management processes described in **Section 2.2** of this EP (Environmental Risk Management Methodology).

The results of the GWA facility ENVID are described in **Section 6** and in the facility Environmental Impacts and Risk Register. This register, in conjunction with the EP, provides a demonstration that environmental risks have been identified, and that appropriate controls are in place to manage those risks to a level that is acceptable and ALARP throughout the life of the facility.

A number of other risk management tools and techniques are used by the GWA facility to manage environmental and other risks on a routine basis during operational, maintenance and inspection tasks. Examples include:

- the processes outlined in **Section 2**
- risk management tools including: ISSoW tools, e.g. Hazard Identification and Risk Assessments and Level 2 Risk Assessments, Operational Risk Assessments, the technical MoC system (**Section 7.1.4**), and Step back 5 x 5
- integrity review studies, HAZIDs and Hazard Operability studies.

These tools, risk and integrity management practices are described further in the GWA Facility Safety Case, WOMP, and the Control of Operational Risk Procedure.

In addition, other risk sub-processes and practices are also applied within Woodside on an ongoing basis to manage different types of risk. A summary of those relevant to the Petroleum Activities Program is provided below. Woodside's risk management processes (refer to **Section 2.2.1**), along with the supporting risk sub-processes and practices discussed in this section, ensure the environmental impacts and risks of the activity continue to be identified and reduced to a level that is ALARP.

7.1.3.1 Management of Risks – Contracting and Procurement

Suppliers and contractors play a significant role in meeting the resource needs of Woodside's operations, including the facility operations. Effective management of environmental risks in

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contracts is achieved by setting clear expectations and managing environmental risks throughout the duration of the contract. Environmental risks in contracts are managed under the Contracting and Procurement Procedure supported by the Health, Safety and Environment in Contracting Guideline. The guideline provides a risk-based approach to contractor selection and management, and is aligned with 'HSE Management – Guidelines for Working Together in a Contract Environment' International Association of Oil and Gas Producers, Report No. 423.

The Engineering Standard Quality Requirements for Supply of Products and Services defines specific quality requirements for engineering contracts and purchase orders. The specified quality control requirements in the Standard are required to be complied with as applicable to the scope of supply.

7.1.3.2 Management of Risks – Subsea Activities

Subsea activities are managed in line with the Subsea and Pipelines Integrity Management Procedure which defines the practices and technical requirements that must be applied to deliver and safeguard integrity of the subsea equipment and pipelines during the facility lifecycle. It provides the relationship between the PSM Framework (including MoC) and Subsea and Pipelines Group services processes.

IMMR activities are managed under the Manage IMMR Work Procedure. Risk assessments are conducted as required under this procedure.

These requirements are supported by implementation of the Subsea Construction and Inspection, Maintenance and Repair Environment Screening Questionnaire tool. The screening questionnaire is used to understand the scope of the activity, potential environmental impact and if additional regulatory approvals are required. To achieve this, the questionnaire captures key project information such as seabed disturbance, chemical usage and waste. This information is used by an environment focal point to determine if further assessment is required. For projects that have the potential for environmental impact, an assessment is undertaken against this EP and other Woodside environmental requirements. If determined by the Subsea and Pipeline Environment Screening Questionnaire process, an EP MoC review (as per **Section 7.1.4.2**) is undertaken to confirm if the level of environmental risk warrants revision and resubmission of an EP. Environmental questionnaires are maintained in the Subsea and Pipeline (SSPL) Environment Project Register.

Key environmental requirements and regulatory commitments are communicated to project teams and incorporated into key project documentation where applicable and required (i.e. not addressed via existing Woodside practices).

7.1.3.3 Management of Risks – Major Projects

Major projects are required to follow the Appraise and Develop Management Procedure and the Opportunity Management Framework. This procedure defines the requirements to deliver a commercially valuable production facility or modify to an existing facility. The process workflow requires integration of work from various functions utilising their people and processes, including Environment, for example HSE philosophy and regulatory approval requirements.

These requirements are supported by implementation of the Brownfields Environment Screening Questionnaire tool. The screening tool is used to determine if a project has the potential for environmental impact or requires additional regulatory approvals. For projects that have the potential for environmental impact, an environmental focal point is assigned and the risks and impacts assessed against the facility EP and other Woodside environmental requirements.

Key environmental requirements and regulatory commitments are communicated to project teams and incorporated into key project documentation where applicable and required (i.e. not addressed via existing Woodside practices). Where it is identified that the project scope has the potential to result in significant modification or change to the facility description provided in the EP, or where potential significant new environmental risks or impacts or significant increases in an existing

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environmental risk or impact are identified, an EP MoC review (as per **Section 7.1.4.2**) is undertaken to confirm if the level of environmental risk warrants revision and resubmission of an EP.

7.1.3.4 Management of Risks – Well Integrity

Wells are managed throughout their lifecycle in line with the Well Lifecycle Management Procedure. This procedure provides the basis for ensuring well integrity in accordance with the PSM Procedure.

In addition, wells are required to have a regulator accepted WOMP to demonstrate that well integrity risks are managed to ALARP levels. Wells tied back to the facility, platform wells and ETA wells are managed under a WOMP.

Management of operating wells can be formally transferred from Operations to the D&C Function for activities such as well intervention and workover. Where activities are undertaken by the D&C Function, the risks are managed under the D&C Risk Management Procedure, which specifically addresses the risk of loss of containment from a well or well related equipment. This procedure supplements the Woodside Risk Management Procedure.

7.1.3.5 Management of Risks – Marine Services

Woodside's Marine Services Function provides a platform for the conduct of safe and efficient Marine Operations across Woodside through the Marine Services Management. A set of procedures that support vessel assurance and management (including HSE and quality management) are in place to ensure marine operations are conducted in a safe and efficient manner, and in accordance with regulatory requirements. Management of subsea activities on subsea support vessels is managed by the SSPL Function.

More details on vessel assurance and the communication of environment requirements to vessels are provided in **Section 7.6.2**.

Vessel masters are required to request clearance from the facility Offshore Installation Manager (OIM) or delegate prior to entering the 500 m PSZ.

7.1.3.6 Management of Risks – Emissions and Energy Management

Emissions generation and energy use is managed in line with the GHG Emissions and Energy Management Procedure which defines the minimum mandatory requirements to manage and deliver continuous improvement in energy efficiency and reduction in GHG emissions. The procedure supports the implementation of the Climate Change Policy and aligns with the requirements of the Environmental Performance Procedure, applicable to assets in Operate phase. It supports the "operate out" component of limiting net emissions, as shown in the Woodside Climate Change Strategy.

Implementation of the GHG Emissions and Energy Management Procedure assists in meeting external expectations, such as Woodside's aspiration to be net zero by 2050, and aligns with corporate initiatives, such as Zero Routine Flaring for oil assets (as captured in the Woodside Flare Framework) and the Methane Guiding Principles. The Methane Guiding Principles Management Guideline aims to continually reduce methane through leak detection and repair, accountability and governance, improving methane emissions data and increasing transparency through reporting.

The GHG Emissions and Energy Management Procedure links to the annual review of opportunities to improve energy performance through identification and evaluation as described in the Production Optimisation and Opportunity Management Procedure. It also requires measurement, analysis and communication of energy performance across the Operations Division and consideration of actual or potential impacts to energy efficiency in company decision making, such as management of change, operational decisions, issue resolution options analysis and facility optimisation plans.

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7.1.3.7 Management of Human Factor Related Risks

The term 'human factors' is used to describe the consideration of people as part of complex systems. Woodside defines 'human factors' as follows: 'human factors uses what we know about people, organisation and work design to influence performance.

As outlined in **Section 6.8.9**, human factors can contribute to MEEs, or result in failure or degradation of the controls in place to protect against MEEs. The WMS includes a number of procedures designed to manage human factors related risks and prevent incident causation.

7.1.4 Change Management

Woodside's Change Management Procedure describes Woodside's requirements for change management at Woodside owned or controlled operations/sites.

Change management is used where there is no existing approved business baseline, such as a process, procedure or accepted practice, or where conformance with an approved baseline is not possible or intended; for example, due to equipment fault or failure or a recently discovered issue which will take time to rectify. Change management is also used when the baseline is changed (e.g. the process is modified). It applies to management of temporary, permanent, planned or unplanned change encompassing one or more of the following:

- plant (equipment, plant, technology, facilities, operations or materials)
- projects (budget, schedule)
- people (organisation structure, performance, roles)
- process (WMS content, processes, procedures, standards, legislation, information).

Woodside's change management process hierarchy is depicted in **Figure 7-3**. The hierarchy has been developed with sub-processes to address the different types of change performed at Woodside.

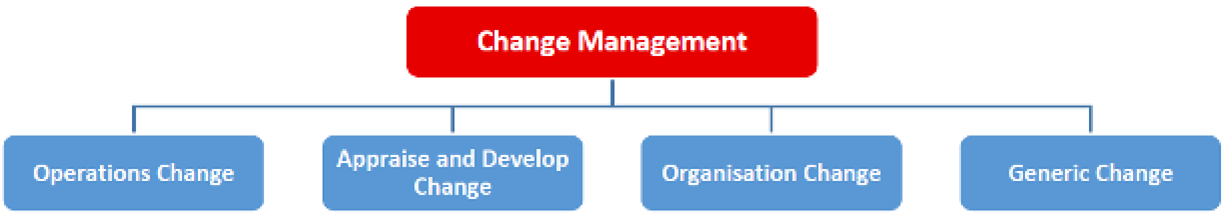

Figure 7-3: Change management hierarchy

To help manage the day-to-day operation of the facility, Woodside has developed a Golden Safety Rules Booklet, which provides a summary of mandatory requirements for safety in the workplace and includes guidance for managing changes that have a Health, Safety, Integrity and/or Environment impact.

7.1.4.1 Technical Change Management

Technical changes within the Operations Division are managed using the MoC – Assets Procedure. The objective of the MoC – Assets Procedure is to ensure HSE risks associated with both realised and potential changes, including any failure to meet the facility SCE Technical Performance Standards, are identified, assessed and reduced to ALARP (**Section 7.1.5** provides further information on management of SCE Technical Performance Standards).

Assessed changes must be recommended, agreed and decided upon based on the assessed current level of risk, as defined by Woodside's Technical Decision Authority matrices.

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The MoC requirements contained in the PSM Procedure and Management System Performance Standard M05 MoC are considered when conducting any changes with the potential to impact process safety.

The Engineering Management Procedure specifies key requirements of engineering-related changes, and requires that engineering Technical Decisions are agreed, recommended and decided at the appropriate engineering authority level according to the risk. Change management and risk assessment include consideration of applicable legislation/regulation.

Change is also managed under management system requirements set out as part of major projects (Brownfields), wells integrity, subsea and pipelines integrity management and marine management system. Change management includes consideration of regulatory requirements, managed in accordance with the Regulatory Compliance Management Procedure.

In addition, the MoC MSPS (M05) is in place to assure process safety risks arising from change (temporary and permanent) are systematically identified, assessed and managed.

7.1.4.2 EP Management of Change and Revision

Woodside's Environmental Approval Requirements Australia Commonwealth Guideline provides guidance on the Environment Regulations that may trigger a revision and resubmission of the EP to NOPSEMA. The document also provides guidance on what may constitute as new source-based or receptor-based impacts and risks, or a significant increase in an existing source of environmental risk (to provide context in determining if EP resubmission is required under Regulations 8 and 17 of the Environment Regulations).

Minor EP changes, where a review of the activity and the environmental risks and impacts of the activity shows the changes do not trigger regulatory requirements to resubmit the EP, will be considered a 'minor revision'.

Changes with potential to influence minor or technical changes to the EP text are tracked in MoC records, project records, or the Production EP Updates Register, and incorporated during internal updates of the EP or the five-yearly revision.

In accordance with the requirements of Regulation 19 of the Environment Regulations, Woodside will also submit to NOPSEMA a proposed revision to this EP at least 14-days before the end of each period of five years, commencing on the day on which the original and subsequent revisions of the EP are accepted under Regulation 11 of the Environment Regulations.

7.1.4.3 OPEP Management of Change

Relevant documents from the OPEP (**Section 7.9; Table 7-5**) will be reviewed in the following circumstances:

- implementation of improved preparedness measures
- a change in the availability of equipment stockpiles
- a change in the availability of personnel that reduces or improves preparedness and the capacity to respond
- introduction of a new or improved technology that may be considered in a response for this activity
- to incorporate, where relevant, lessons learned from exercises or events
- if national or state response frameworks and Woodside's integration with these frameworks changes.

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Where changes are required to the OPEP, based on the outcomes of the reviews described above, they will be assessed against Regulation 17 to determine if EP, including OPEP, resubmission is required (See **Section 7.1.4.2**).

7.1.5 Management of SCE Technical Performance Standards and Management System Performance Standards

7.1.5.1 Management System Performance Standards (MSPS)

Woodside ensures safety critical management processes function as required through the application of MSPS. MSPS are developed and owned at non-facility specific level (i.e. pan Woodside) and include assurance checks for the key requirements of the applicable management system.

Individual facilities demonstrate conformance against the MSPS through the conduct of reviews. Non-conformances against an MSPS are internally managed in accordance with the WMS.

7.1.5.2 SCE Technical Performance Standards

An SCE is defined by Woodside as a hardware barrier, the failure of which could cause or contribute substantially to, or the purpose of which is to prevent or limit the effect of a MAE/MEE, or Process Safety Event.

Woodside identifies/develops, implements, monitors/assures and verifies/optimises SCEs by applying SCE technical Performance Standards as described in the Safety and Environment Critical Element (SCE) Management Procedure. Key elements of the procedure are summarised in **Table 7-1**.

Table 7-1: Safety and Environment Critical Element Management Procedure Summary

Identify/Develop	**Identify SCE** – SCEs must be identified from the facilities PSRAs (e.g. Formal Safety Assessments) (**Section 2.2**). The identification of SCEs for which Performance Standards are required are part of the formal safety and environmental risk assessment processes. Woodside's Global Performance Standards (based on industry and Woodside Standards) should be used for preliminary selection of SCEs. **Complete Engineering Design Studies** – Engineering design studies must be completed to demonstrate that SCE Performance Criteria specified in the global Performance Standard and/or determined by PSRA will be met by the facility design, allowing for normal SCE degradation in operation. The studies must establish the testing and inspection tasks required to assess performance against the criteria. The scope and frequency of SCE Assurance Tasks are guided by the Global Performance Standard and may require designated Engineering Design Studies. Studies should include Reliability Centred Maintenance, Risk Based Inspection and Safety Instrumented Function studies to determine the Assurance Task scope and frequencies, RBI plans, and classification and implementation requirements for instrumented safeguarding. **Develop Performance Standards** – Facilities must develop Performance Standards for all SCEs by: • selecting the applicable Global Performance Standard (including Assurance Tasks) • considering facility specific requirements and applicable regulatory requirements • adding the specific data from the facility Engineering Design Studies and PSRA to compile scope and frequency of SCE assurance activities.
Implement	**Identify SCE in Asset Register** – SCEs must be uniquely identified on the asset register and assigned Performance Standard flags. **Develop Testing, Inspection and Maintenance Programs** – SCE assurance tasks are developed into maintenance procedures. **Implement Testing, Inspection and Maintenance Programs** – SCE testing, inspection and maintenance requirements must be implemented in the CMMS (**Section 7.1.1.2**).

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Maintain/Assure	**Execute Testing, Inspection and Maintenance Programs** – On completion of SCE assurance tasks, results must be recorded with all relevant detail, assessed for conformance with the Performance Criteria and any follow on correction work identified. **Conduct Fitness for Service (FFS) Assessment** – In some instances, an engineering FFS assessment may be required to determine whether equipment has failed its performance standard requirements, e.g. assessment of corrosion defects following inspection of piping. Detailed results of FFS assessment may be recorded out of CMMS. **Response to SCE Failure** – SCE failure (technical Performance Standard non-conformance) is a failure to achieve the given Performance Criteria. SCE failures must be managed in accordance with a structured review process. This process may require the application of the facility Manual of Permitted Operation (MOPO) which provides prescriptive guidelines to be followed in the event of a reduction in the performance of an SCE, or managed in accordance with the MoC – Assets Procedure (**Section 7.1.4**). **Internal Reporting** – SCE failure/damage and SCE demands must be reported in accordance with the Health Safety and Environment Event Reporting and Investigation Procedure (**Section 7.8.4**). **External Reporting** – External notification obligations for SCE failure/damage must be understood (i.e. based on local regulatory requirements). External communications must be in accordance with the health safety and environment event reporting and investigation procedure (**Section 7.8.5**). **Manage and Analyse Results** – The results from assurance tasks must be accurately recorded to support data analysis. Analysis will enable appropriate action to be taken to minimise future failure recurrences, and enable assessment of overall system performance and reliability to verify SCE effectiveness in revealing failures and to allow predictive maintenance.
Verify/Optimise	**Review SCE Performance** – SCE performance reviews must be conducted to ensure requirements for maintaining SCE performance are being met. **Manage Change** – Any change to the Performance Standards must be conducted in accordance with the Change Management Procedure (**Section 7.1.4**).

SCE Facility Performance Standards are a statement of the performance required of an SCE (e.g. functionality, availability, reliability, survivability), which is used as the basis for establishing agreed assurance tasks and managing the hazard. An assurance task is an activity to confirm that the SCE meets, or will meet, its SCE Performance Standard. Examples of assurance tasks include inspection routines, maintenance activities, test routines, instrumentation calibration and reliability monitoring.

These assurance tasks are identified in the CMMS, flagged against their associated Performance Standard, and given the appropriate priority (defined as Technical Integrity). Management systems are in place to manage the completion of maintenance including that required for Technical Integrity assurance.

Events where the SCC/SCE have not met their specified performance criteria must be managed in accordance with a structured review process. This process may require the application of the facility MOPO which provides prescriptive guidelines to be followed in the event of a reduction in the performance of an SCE in specific defined circumstances; or, if the MOPO does not cover the event, according to procedures for the assessment and management of operational risk.

Internal notification of SCC failures must be made in accordance with maintenance management workflows. Failures to meet a Facility Performance Standard occur where SCC events lead to the functional objectives (goal and/or key requirement statements) of the facility Performance Standard for the SCE not being met (i.e. lost or unavailable), taking into account any redundancy inherent within the SCE. These events are reported in the Event Reporting Database as potential SCE Failure to Meet Facility Performance Standard Events.

These are internally reported as Hazard Events. Where 'Failure to meet a Facility Performance Standard' leads to a loss of hydrocarbon containment, or a release of energy, it is internally reported

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(and externally where relevant) as a Loss of Primary Containment or Environmental Spill event, depending on the nature of the release.

Additionally, confirmed 'Failure to meet a Facility Performance Standard'' events for the SCEs identified in the MEE bowties may equate to a breach of EPOs and/or EPSs. The review to identify such events for external reporting considers whether the hazard event is relevant to environmental SCE functional objectives (goal and/or key requirements) of the SCE Facility Performance Standard and whether the event poses a risk to achieving EPOs and EPSs. The WMS Regulator Event Reporting Guideline provides additional information regarding external SCE related reporting obligations.

There may also be planned changes/deviations from SCE Technical Performance Standards, these are managed via procedures for the assessment and management of operational risk, and endorsed in accordance with the engineering management procedures (described further within **Section 7.1.4**). This management process ensures risks (including environment) are managed so that the planned change/deviation does not result in unacceptable impact or risk, remains ALARP and regulatory requirements are met.

7.2 Woodside Decommissioning Framework

Decommissioning is a planned activity for the offshore oil and gas industry. Current best practice is for decommissioning to include:

- designing for decommissioning during the development phase of projects / facilities
- maintaining and removing property, equipment and infrastructure, such as a facility or a pipeline, and plugging wells associated with a petroleum activity
- assessing decommissioning options and opportunities during the operational life of the facility leading up to cessation of production
- selecting, developing and planning the selected decommissioning option
- executing decommissioning plans; and
- restoring the marine environment.

This assists with compliance with Section 572 (3) of the OPGGS Act, which requires titleholders to remove property when it is neither used, nor to be used, in connection with the operations. As required under the OPGGS Act the base case for decommissioning is removal though the Act does provide a provision under Section 270(3) for other arrangements that are satisfactory to NOPSEMA. Titleholders may deviate via an accepted EP where it can be demonstrated that the risks and impacts are ALARP and acceptable. If a permanent deviation is being sought, NOPSEMA policy is that the proposed alternative presented in an EP must comply with all other Acts and legislation and deliver equal or better environmental outcomes compared to complete removal (DISER, 2020; NOPSEMA, 2020).

7.2.1 Decommissioning in Operations

Asset specific decommissioning plans are generally developed prior to cessation of production. Planning includes redundant infrastructure as well as structures coming to the end of production and the identification of decommissioning critical systems to enable removal. Appropriate maintenance plans are developed and implemented to ensure decommissioning critical systems meet the requirements to facilitate removal.

7.2.2 Facility Decommissioning Planning

Decommissioning planning generally commences 2-10 years prior to Cessation of Production (CoP) (**Figure 7-4**). The timeframe selected for decommissioning planning depends on the complexity of the facility and infrastructure requiring decommissioning.

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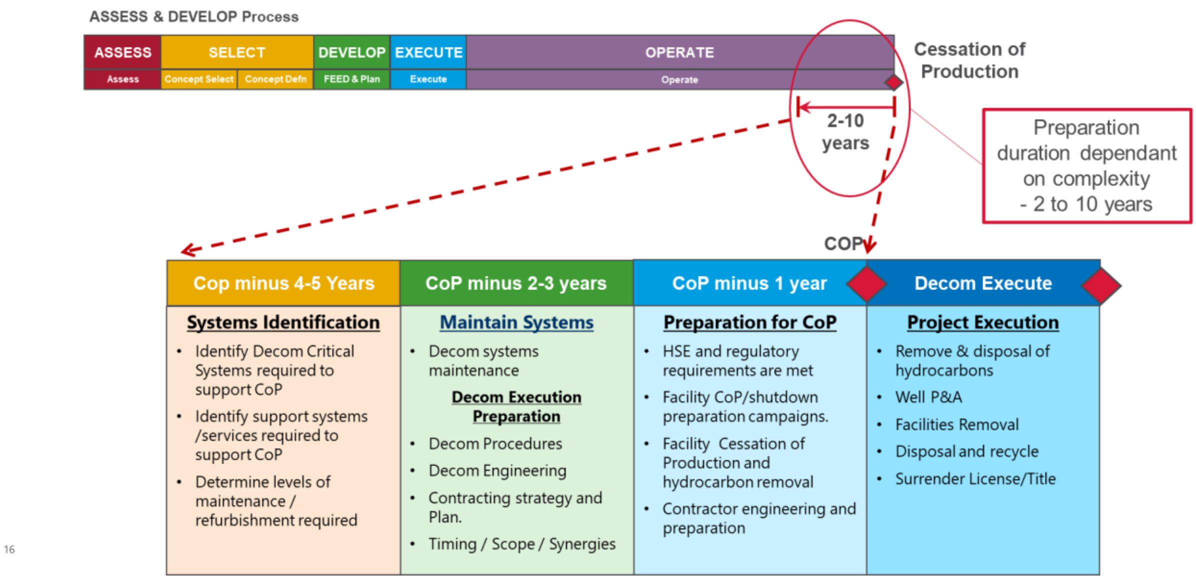

Figure 7-4: Woodside's process for decommissioning planning

7.2.3 GWA Decommissioning Infrastructure Status

GWA production is currently estimated to continue until approximately 2036-2040, based on the fields that are currently tied back to the facility. This estimate does not account for extensions of life through future development or repurposing of the structure.

An inventory and status of GWA subsea infrastructure is detailed in **Table 3-3**. An overview of key infrastructure decommissioning scopes is provided below.

7.2.3.1 Echo Yodel Subsea Infrastructure Decommissioning Planning

EY wells (Yodel 03 and Yodel 04) have been permanently plugged and abandoned and will be decommissioned in accordance with the accepted EY and Capella Permanent Plugging for Abandonment EP (NOPSEMA Doc ID A772288). The wells infrastructure is being maintained under this EP until it is removed.

Decommissioning of the EY subsea infrastructure is the subject of the EY Decommissioning EP (NOPSEMA Doc ID A728912), scheduled for resubmission in the second half of 2021. The EY subsea infrastructure is being maintained under this EP until decommissioning.

7.2.3.2 Perseus over Goodwyn Wells Plug and Abandonment Planning

Studies on the permanent plug and abandonment of the PER-02 and PER-04 wells have been undertaken: including the subsurface studies in support of the abandonment design and the technical well engineering for well re-entry and abandonment. The plug and abandonment project is currently in the Concept Select phase.

Execution of the PER-02 and PER-04 plug and abandonment campaign is currently intended to start no later than 1 December 2025, with options being assessed to accelerate this schedule. This timing is aligned with Industry Good Practise (OGA, 2018; OGUK, 2018; 2019), is supported by on-going well integrity monitoring and consistent with previous decommissioning commitments. Plug and abandonment of the PER wells is expected to be part of a larger, 5-7 well campaign of plug and abandonment activity. The EP for this activity is expected to be submitted in 2023 to support a start in either 2024 or 2025. Exact timing of this activity will be determined by commercial negotiations and rig availability.

The wells and associated subsea infrastructure are monitored and maintained in accordance with the Woodside Well Integrity Management Process for production wells and Woodside Asset

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Maintenance and Inspection regime for producing infrastructure, described in **Section 3.10**. Monitoring of the two PER wells continues as per the approved WOMP and well integrity management procedure (**Section 3.10**). The PoG flowline is currently being used for production from the adjacent PER-01 and PER-03 wells.

7.2.3.3 GWA Facility Decommissioning Planning

Decommissioning planning is estimated to commence between 2026-2035, which will be 5-10 years prior to GWA facility predicted EOFL.

7.3 Organisation Structure

The following Woodside organisational structure provides leadership and direction for operation of the GWA facility and environmental performance:

- the Executive Vice President Operations (EVP Operations) reports to the Chief Executive Officer
- Business Unit Senior Vice Presidents (SVPs) or Vice Presidents (VPs) report to the EVP
- the General Manager Environment reports to the VP HSE, who reports to EVP Operations
- the Production Environment Manager reports to the General Manager Environment
- the Asset Manager reports to the Business Unit SVPs or VPs
- the functional support teams report to the corresponding Business Unit SVP or VP
- Production facilities are supported by a team of environmental professionals who report to the Production Environment Manager
- facilities are supported by other Woodside functional teams including:
  - **Engineering** – supports operating assets in terms of engineering standards/guidelines and governance processes, systems, applications and specialist personnel to support these standards/guidelines
  - **HSE** – provides specific guidance and access to specialist HSE resources including assistance for governance and training, as well as guidance on Woodside HSE standards
  - **Subsea –** responsible for the installation and IMMR process for subsea infrastructure including facility structures, flowlines, manifolds and subsea isolation valves to ensure integrity
  - **Drilling and Completions –** ensures the safe planning and execution of drilling (note drilling is excluded from the scope of this EP), completion and work over operations
  - **Brownfields** – responsible for the engineering, construction and execution of small projects on operational facilities to ensure ongoing integrity and safe operation
  - **Marine Group –** responsible for chartering vessels to support Woodside's offshore production facilities including vessels to aid emergency response
  - **Aviation Group –** provides personnel transport, material transport, emergency evacuation and search and rescue capabilities.

A simplified chart of the structural organisation of the GWA facility is shown in **Figure 7-5**.

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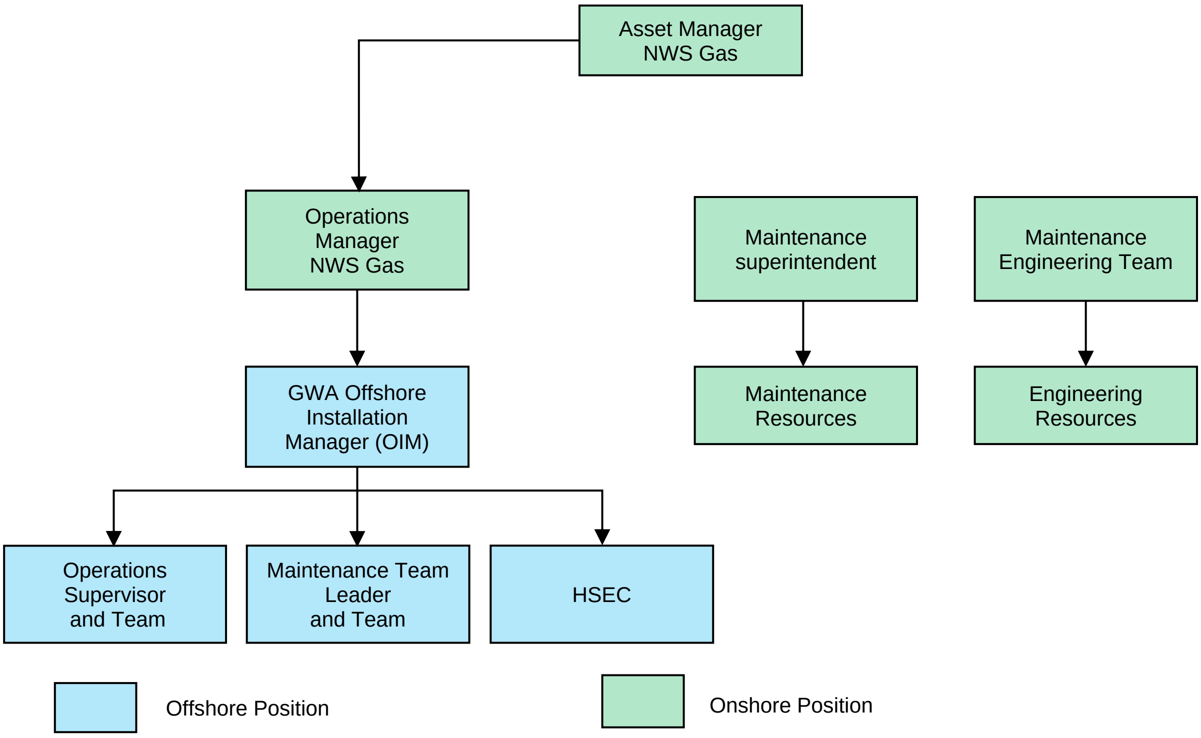

Figure 7-5: Operations Division organisational structure (simplified to show key relevant roles)

7.4 Roles and Responsibilities

As required by Regulation 14(4), this section of the implementation strategy establishes a clear chain of command that sets out the roles and responsibilities of personnel in relation to the implementation, management and review of the EP, ranging from senior management to operational personnel on the GWA facility and support vessels.

Key roles and responsibilities for Woodside and Contractor personnel in relation to the implementation, management and review of this EP are described below in **Table 7-2**. Roles and responsibilities for hydrocarbon spill preparation and response are outlined in **Table 7-2** and the Woodside Oil Pollution Emergency Arrangements (Australia). Roles and responsibilities for facility emergency response are outlined in the GWA Facility Safety Case and are consistent with the GWA Emergency Response Plan (ERP).

It is the responsibility of all Woodside employees and contractors to apply the Woodside Corporate Health, Safety and Environment Policy (**Appendix A**) in their areas of responsibility.

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Table 7-2: Roles and responsibilities

Title (role)	Environmental Responsibilities
All Personnel	
All facility based personnel and onshore support personnel	• understand the Woodside standards and procedures that apply to their area of work • understand the environmental risks and control measures that apply to their area of work • carry out assigned activities in accordance with approved procedures and the EP • follow instructions from relevant supervisor with respect to environmental protection • cease operations which are deemed to present an unacceptable risk to the environment • participate in environmental assurance activities and inspections as required • prompt reporting of environmental hazards/incidents to their supervisor and assist in event investigation.
Office-based Personnel	
NWS Gas Asset Manager	<u>Systems, Practices and Procedures</u> • accountable for ensuring all necessary regulatory approvals are in place to operate • approves (decides on) the content to be contained in the EP • accountable for managing the asset throughout its operations in accordance with legislative/regulatory requirements (including this EP) and WMS requirements. • approves written notification to regulatory authorities (for example notifications to NOPSEMA under this EP) • agrees facility key performance indicators (KPIs), including environment KPIs and is accountable for their achievement • responsible for continuous improvement of operations of the facility, including environmental performance <u>Monitoring, Auditing, Non-conformance and Emergency Response</u> • decides on technical decisions where required based on assessed current level of risk • accountable for incident notification, reporting and investigation in line with regulatory requirements, the WMS and EP requirements
NWS Gas Operations Manager	<u>Systems, Practices and Procedures</u> • responsible for the operation of the facility in accordance with legislative/regulatory requirements (including this EP) and the WMS • decides on technical decisions where required based on assessed current level of risk • accountable for aspects of integrity management <u>Monitoring, Auditing, Non-conformance and Emergency Response</u> • communicates changes relevant to the EP to the Production Environment team • accountable for conformance to production Operations processes including ISSoW

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Title (role)	Environmental Responsibilities
Maintenance Engineering Team Leader (METL)	Systems, Practices and Procedures • responsible for safeguarding process safety with respect to the asset • ensure technical integrity risks are identified, managed and reduced to ALARP • recommends technical decisions where required based on assessed current level of risk
Integrity Authorities (Technical Integrity Custodians, Technical Authorities and Engineering Authorities)	Systems, Practices and Procedures • agree technical integrity decision based on assessed current level of risk when discipline owner • undertake process safety responsibilities as defined under the Woodside process safety framework.
Production Environment Manager	Systems, Practices and Procedures • facilitate operations environmental approval documentation and timely submission in accordance with regulatory requirements • ensure operations understands and adheres to legislative and regulatory environment requirements, EP requirements and the environmental requirements of the WMS • guide and drive environmental management across operations • develop and maintain appropriate Production environmental processes and procedures • develop (in conjunction with divisional management) environment improvement plans and KPIs Resourcing, Training and Competencies • implement effective Production environmental training. Monitoring, Auditing, Non-conformance and Emergency Response • Monitor and communicate to internal stakeholders all relevant changes to legislation, policies, regulator organisation that may impact the EP or business • facilitate review of the EP, including five-yearly revision and in relation to any technical decisions or proposed changes to operations • monitor and review progress against environmental improvement plans and KPIs with divisional management to drive continuous improvement
Production Environment Adviser	Systems, Practices and Procedures • ensure operations understands legislative and regulatory requirements, EP requirements and WMS environmental requirements • manage change relevant to the EP in accordance with the Regulations and the EP • implement environment improvement plans and monitor progress • liaise with applicable regulatory authorities as required • communicate findings to management • assist with review, investigation and reporting of environmental incidents.

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Title (role)	Environmental Responsibilities
	• assurance that all IMMR activities are provided by the EP. Resourcing, Training and Competencies • ensure personnel have access to the EP and understand their environmental responsibilities under the EP • develop, maintain and roll-out environmental training inductions, refreshers and material to promote environmental awareness • liaise with Woodside contractors and Subsea Support Bessel crew to communicate and ensure their understanding of IMR related requirements under this EP • conduct IMR related environment training, messaging/communications, event reporting and investigation as required Monitoring, Auditing, Non-conformance and Emergency Response • ensure environmental monitoring, offshore inspections, and reporting is undertaken as per the requirements of this EP • coordinate and monitor closeout of corrective actions • ensure environmental inspections/audits are undertaken as per the requirements of the EP • ensure environmental incident reporting meets regulatory requirements (as described within the EP) and WMS requirements
Subsea and Pipelines (IMMR) Activity Manager	Systems, Practices and Procedures • ensure IMMR process undertaken in line with EP commitments • manage IMMR change requests for the activity and notify the Production Environment Adviser of any scope changes in a timely manner • responsible for governance of IMR related activities for Subsea Support Vessels. Resourcing, Training and Competencies • provide sufficient resources to implement the EP requirements Monitoring, Auditing, Non-conformance and Emergency Response • monitor and close out corrective actions raised from IMMR environmental inspections/audits or incidents
Corporate Affairs Adviser	Systems, Practices and Procedures • stakeholder identification and consultation • reporting on stakeholder consultation • ongoing stakeholder liaison as required.
Woodside Marine Services Function	• responsible for pre-charter assurance for all contracted vessels • conduct of ongoing operational assurance of vessels contracted through Woodside Marine, to confirm vessels operate in compliance with relevant legislation, rules and Woodside Marine Charterers Instructions in order to be able to meet safety, navigation, operational and emergency response requirements.
Contractor Sponsors	Systems, Practices and Procedures • ensure implementation of EP for the contractor's scope of work

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Title (role)	Environmental Responsibilities
	Resourcing, Training and Competencies • ensure contractors have adequate environmental capability in order to execute their respective scopes of work • review contractor environmental performance as required.
Offshore-based Personnel	
GWA Offshore Installation Manager (OIM)	Systems, Practices and Procedures • in charge of the GWA facility and the field • accountable for implementation of the EP at the facility • ensures offshore personnel comply with regulatory/legislative requirements (including the EP) and the WMS • responsible for Area Operations compliance with Technical Integrity requirements including MoC process, Permit to Work process and MOPO and process safety requirements • single point responsible person for the coordination of simultaneous activities • implement relevant offshore environment initiatives and review environmental performance to drive continuous improvement. • ensure effective communication with workforce on environmental performance • ensure incidents are reported and investigated in line with WMS and EP requirements, with appropriate actions initiated and closed out • decides on technical decisions where required based on assessed current level of risk • communicates changes relevant to the EP to the Production Environment team. Resourcing, Training and Competencies • accountable for the performance and development of direct reports, ensuring operator capability and competency across all shifts and ensuring the skill requirements of the Production division are being met. Monitoring, Auditing, Non-conformance and Emergency Response • lead response efforts (as Incident Controller) in managing emergency or crisis scenarios • ensure exercises and drills are conducted in a manner to assure the facility's ability to respond effectively to an emergency
Operations Supervisor/Operations Team Leader/Maintenance Team Leader/ Shift Supervisor	Systems, Practices and Procedures • accountable for the day-to-day operations of the facility including effective shift handover; completion and logging of operator routine • responsible for operations shift compliance to all legislative and regulatory requirements as defined in the EP • responsible for permitting and isolation for all frontline work activities • responsible for leading and coordinating a multi-disciplined team performing specific duties required to support the facility, including helicopter operations, vessel movements and consumable controls. Monitoring, Auditing, Non-conformance and Emergency Response

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Title (role)	Environmental Responsibilities
	• responsible for following emergency response protocols in accordance with the emergency response procedure and fulfilling allocated emergency response roles
Operations and Maintenance Technicians	Systems, Practices and Procedures • responsible for all daily operations on the facility within their operational control. • undertake daily operational and maintenance tasks in accordance with approved standards and procedures to ensure compliance with the EP. • manage day-to-day environmental risks through use of ISSoW and other risk management tools. • identify opportunities for continuous improvement and communicate these to their Supervisor. • complete training requirements to maintain competence and knowledge in operating and maintaining equipment, and manage environmental risks and impacts. • participate in environmental assurance activities and inspections as required. • report all environmental hazards and incidents and assist in investigations.
Health, Safety and Environment Coordinator (HSEC)	Systems, Practices and Procedures • liaise with managers/supervisors on day to day management of environmental risks and issues • assist in the ongoing promotion of environmental performance at the facilities and day-to-day management HSE risks and issues • identify opportunities for continuous improvement and communicate these to the OIM and Environment Team • implement environmental improvement plans Resourcing, Training and Competencies • support operational personnel to understand the EP requirements applicable to their role • communicate environmental performance information and training material to offshore personnel and maintain associated records. • communicates changes relevant to the EP to the Production Environment team
Vessel-based Personnel	
Vessel Master of Support Vessel (Platform and Subsea Support Vessels)	Systems, Practices and Procedures • understand and manage HSE aspects of the vessel, including environmental requirements • communicate with OIM as required regarding potential environmental risks applicable to vessel activities • ensure vessel meets quarantine requirements Monitoring, Auditing, Non-conformance and Emergency Response • notify AMSA and other authorities of any incidents as per maritime requirements

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Title (role)	Environmental Responsibilities
	• provide, as requested by Woodside, copies of documents, records, reports and certifications (i.e. fuel use, ballast exchanges, waste logs, etc.) in a timely manner to assist in compliance reporting • ensure the vessel's Emergency Response Team have sufficient training to implement the vessel's SOPEP • ensure all emergency and SOPEP drills are conducted • ensure that vessel procedures are followed in the event of an emergency or spill • immediately notify the Woodside Representative of any environmental incidents.
Subsea and Pipelines Site Woodside Representative	Systems, Practices and Procedures • ensure relevant management measures in this EP are implemented on the Subsea Support Vessel Resourcing, Training and Competencies • ensure Subsea Support Vessel induction attendance is recorded. Monitoring, Auditing, Non-conformance and Emergency Response • ensure periodic environmental inspections are completed • ensure environmental incidents or breaches of EPOs, EPSs or MCs are reported in accordance with Woodside and regulatory requirements

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7.5 Training and Competency

As required by Regulation 14(5), this section of the implementation strategy includes measures that ensure all personnel associated with operating the GWA facility are aware of their EP related responsibilities, and that all relevant personnel have appropriate competencies and training.

Environmental training is undertaken to ensure employees and contractors whose work may impact on the environment have the necessary awareness, knowledge and competence appropriate for their role.

Different levels of training are undertaken in relation to managing environmental risks and impacts for the production offshore facilities and associated Subsea Support Vessel based IMR activities, as follows:

- inductions for offshore facility workers and visitors
- operations competency framework training
- permit to work training (ISSoW)
- production environmental leadership training and environment awareness training
- emergency and hydrocarbon spill response training
- inductions for subsea IMR (vessel based) personnel.

Records for Woodside production personnel, in relation to the above listed training, are maintained in Woodside's learning management system. Contractor training records are also maintained.

Competence of operations personnel can be reviewed via online dashboards.

7.5.1 Inductions for Offshore Facility Workers and Visitors

A comprehensive induction process is in place for personnel working on or visiting Woodside's offshore production facilities. The induction process is designed to equip personnel with the HSE awareness and skills necessary for them to manage their own safety and environmental performance and contribute to others working around them. The induction process includes:

- **Common Production Induction** – All employees and contractors who have not accessed a production facility within twelve months are required to undertake this induction prior to mobilisation. It includes Woodside's values, HSE and Process Safety, continuous improvement, risk management and ISSoW.
- **Facility Specific Induction** – All employees and contractors that have not accessed the production facility within six months are required to undertake this induction on arrival at the facility. This induction covers the HSE and emergency response issues specific to each facility. For environment, this induction covers the Facility EP, prevention of spills, waste management, fauna interactions, hazard identification and risk assessment, and incident reporting.
- **Production Offshore Environmental Leadership Training –** Key operations leadership roles (as specified within the Operations Competency Framework) are required to complete this competency on commencement of the new role and three yearly thereafter. The training covers Woodside's policies and standards, environmental legislative requirements, the EP, key environmental risk and impacts, environmental reporting, environmental management tools (e.g. improvement planning, compliance reviews and audits), hydrocarbon spill response and environmental accountabilities.
- **Production Offshore Environmental Awareness Training –** All new offshore operational personnel are required to undertake this online training on commencement of the new role and two yearly thereafter. This training covers environmental legislative requirements, the facility EP, key environmental hazards and control measures (including waste management, spill

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prevention, chemical storage, wildlife interactions), environmental management tools, hazard and incident reporting, spill response, and environmental responsibilities.

7.5.2 Operations Competency Framework Training

The Operations Competency Guideline defines a framework to make sure all personnel on operating facilities are competent to perform their work and that competency is managed. By doing this, the potential for unplanned (accident/incident) type events that could result in environmental impact is minimised.

Operational Area Licence to Operate (LTO) roles are those roles related to oil and gas processing, equipment maintenance, marine regulations, emergency response and any other roles involved with safeguarding the facility integrity, including all roles where high-risk work licences are required. Additionally, roles mandated by Woodside such as HSEC and helicopter landing officer are included in the LTO roles process.

The requisite competency and training for each LTO role has been defined. Competencies for these LTO roles are stipulated by the governance group for each respective position and are based on the relevant Australian or International standards which apply. In cases where no Australian or International standards are available or applicable, training is based on the relevant Woodside Standard as determined by the respective governance group.

Contractors working on Woodside facilities are required to verify the competency of their personnel through the contractor's own verification systems. Additionally, contractor personnel working on Woodside facilities are required to be registered in Woodside's Contractor Verification Service (CVS) beforehand. Personnel registered in CVS have had their skills and qualifications independently verified on behalf of Woodside thereby confirming that contractor personnel hold the required competencies before mobilisation to the facility.

The LTO Roles Report (available online on the Woodside Competency Reporting Dashboard on the Production Academy Intranet page) provides the conformance status of the facility against the LTO roles requirements.

7.5.3 Permit to Work System Training

The ISSoW permit to work system (see **Section 7.1.1**) is a key element in ensuring that all necessary steps are taken to ensure the safety of personnel, protection of the environment and technical integrity of the facility. The ISSoW system takes a risk-based approach to all activities, thus tasks with higher levels of risk are subjected to greater scrutiny and control.

All members of the workforce that are required to work with ISSoW (**Section 7.1.1**) receive training commensurate with the level of authority and responsibility they hold in ISSoW.

7.5.4 Emergency and Hydrocarbon Spill Response Training

All operations personnel involved in crisis and emergency management are required to commit to ongoing training, process improvement and participation in emergency and crisis response (both real and simulated), including emergency drills specific to potential incidents at the GWA facility. Training includes task specific training and role based training and 'on the job' experience (i.e. participation in crisis or emergency management exercises). Roles based training is further described in **Section 7.9**.

An overview of Woodside's hydrocarbon spill response training and competency requirements are provided in dashboards for key responder roles. The roles are consistent with Woodside's crisis and emergency management incident control structure.

Woodside Hydrocarbon Spill Preparedness Advisor(s) are responsible for maintaining hydrocarbon spill preparedness competency. This includes the identification and development of approved competency and non-competency based courses, identification of relevant personnel required to

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undertake training an ensuring training records are maintained. Minimum Woodside capabilities will continue to be identified and documented.

7.5.5 Subsea IMR Activity Environmental Awareness

At the beginning of, and during a new Subsea IMR activity, the Subsea Support Vessel crew including contractor crew, Woodside representatives and other relevant personnel are required to undertake a vessel induction before commencing work. This induction covers HSE requirements for the vessel and IMR activities, and as required environmental information specific to the activity location. The induction may cover the following environmental information:

- adherence to standards and procedures, and the use of Job Safety Analysis and permit to work hazard identification and management process
- spill management including prevention, response and clean-up, location of spill kits and reporting requirements
- waste management requirements and location of bins
- reporting of marine fauna, location of forms and charts
- chemical management requirements.

All personnel who undertake the project induction are required to sign an attendance sheet which is retained.

Regular HSE meetings are held on Subsea Support Vessels with crew. During these meetings, any environmental incidents are reviewed, and environmental awareness material presented.

7.6 Monitoring, Auditing, Management of Non-conformance and Review

Regulation 14(6) states that the implementation strategy is to provide for the monitoring, audit, management of non-conformance and review of operator's environmental performance and the implementation strategy itself.

This Section of the EP outlines the measures undertaken by Woodside to regularly monitor the management of environmental risks and impacts of the GWA facility against the EPOs, EPSs and MCs, with a view to continuous improvement of environmental performance. The effectiveness of the implementation strategy is also reviewed periodically as part of the monitoring and assurance process.

7.6.1 Monitoring

Woodside and its Contractors undertake a program of periodic monitoring during the Petroleum Activities Program. This information will be collected using the tools and systems outlined below based on the EPOs, controls, EPSs and MCs in this EP. Environmental aspects are integrated into Woodside-wide functional and asset review and assurance processes, which deliver effective governance. This integration of environmental controls into appropriate parent systems and processes includes PSM (**Section 7.1.2**), contractor management (**Section 7.1.3**) and marine assurance (**Section 7.6.2.4**), and provides multi-faceted assurance of routine implementation.

The tools and systems collect, as a minimum, the data (evidence) referred to in the MCs in Sections **6.6, 6.7** and **6.8**. The collection of this data will form part of the record of compliance maintained by Woodside and form the basis for demonstrating that the EPOs and EPSs are met. Compliance is summarised in a series of routine reporting documents (refer to **Section 7.8.3.1**).

The following tools and systems to monitor environmental performance, (including collection of evidence of compliance with controls), where relevant, include:

- environmental emissions/discharge reporting systems that record volumes of planned discharges to ocean and atmosphere, e.g. via the Production Allocation System and process

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historian database – a summary of emissions and discharges monitoring that is undertaken during the Petroleum Activities Program is provided within **Table 7-3**

- monitoring of progress against the Production Function scorecard for KPIs (**Section 7.6.4.2**)
- routine internal reporting (as described in **Section 7.8.2**) and routine external annual compliance reporting (as described in **Section 7.8.3**)
- internal auditing and assurance program (as described in **Section 7.6.2**).

Collectively, these systems/tools involve collection of evidence of compliance with controls. Throughout the Petroleum Activities Program, Woodside continues to identify new source-based risks and impacts through the Monitoring and Auditing systems and tools described above and within **Section 7.6**.

Other examples of assurance tasks implemented through the EP include (as an example);

- start of shift operator walk arounds
- permit to work hazard, risk management check list, area sign-on, and permit audits (ISSoW – **Section 7.1.1**)
- technical integrity SCE performance reviews (daily, weekly, monthly) (**Section 2.7.5**)
- ongoing maintenance performance assurance (e.g. conformance dashboard)
- management system performance audits reviews (e.g. MSPSs) (**Section 7.6.2**)
- data gathering and governance dashboard presentations (e.g. Woodside Integrated Risk and Compliance System).

7.6.1.1 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 MoC are documented in the WMS EP 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.

7.6.1.2 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 7.1.4**).

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Table 7-3: Summary of emissions and discharges monitoring for the Petroleum Activities Program

Category	Parameter to be Monitored/Reported	Monitoring Frequency	Monitoring Equipment/Methodology	EP Reference
Planned Emissions				
Atmospheric Emissions from fuel combustion	Greenhouse, energy and criteria pollutants	Normally continuous process metering/annual reporting	NGERS and NPI reporting estimation methods (e.g. fuel/flare flow meters, throughput meters, process estimation)	**Section 6.6.7**
	Fuel gas and flare intensity	Normally continuous process metering/monthly reviews	Fuel and flare flowmeters inform intensity profiles – tracked against optimisation targets	**Section 6.6.7**
Planned Discharges				
Discharge of subsea control fluids during well actuations	Subsea control fluid consumption	Normally continuous process indication/monthly review	Subsea control fluid consumption surveillance. Process indication for gross leaks/ruptures	**Section 6.6.4**
Discharge of hydrocarbons and chemicals during subsea IMR activities	Volumes of hydrocarbons and chemicals released subsea	As required, during IMR activities (activity specific)	Estimates based on known volumes pumped and ROV observation	**Section 6.6.4**
Discharge of PW	OIW concentration of discharged PW	Normally continuous process metering / monthly review	Normally continuous process metering / monthly review	**Section 6.6.5**
		Up to 6-hourly during non-routine operations	Manual sampling	
	PW chemical character	Annually	PW chemical characterisation	
	PW ecotoxicity	3 yearly	PW ecotoxicity testing	
Discharge of cooling water	Total Residual Chlorine	Periodically	Total Residual Chlorine testing	**Section 6.6.6**
Waste recycling and disposal	Quantities of solid and liquid wastes disposed of onshore	Ongoing	Facility waste manifest	**Section 6.7.2**
Unplanned Emissions and Discharges				
Unplanned emissions and discharges	Nature of release	As required	HSE Event Reporting System (First Priority)	**Sections 6.7 and 6.8**

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7.6.2 Auditing

7.6.2.1 Operations Assurance

To provide confidence, based on evidence commensurate with risk, that business objectives are met, business activities are performed and risks are managed, assurance is performed as described in the Provide Assurance Procedure and the Provide Assurance Guideline. The Guideline aims to explain how the Operations Division Assurance Team implement WMS Assurance requirements, while concurrently satisfying the Operations Division's specific objectives.

Operations Assurance Assignments are contained within the Operations Division Integrated Assurance Assignment Plan.

Environmental assurance activities are conducted on a regular basis to help:

- verify environmental risks and potential impacts are being managed in accordance with the EPOs and EPSs detailed in this EP
- monitor, review and evaluate the effectiveness of the performance outcomes and standards detailed in this EP
- verify effectiveness of the EP implementation strategy
- identify potential non-conformances.

The outputs of the assurance process are corrective actions that feed the improvement process. Therefore, assurance is a key driver of continuous improvement.

7.6.2.2 Annual Offshore Inspection/Desktop Review

An inspection/review of the facility is undertaken every calendar year by the Production Environment Team, via either an offshore inspection or desktop review. Selected risk areas/activities are inspected to review environmental performance against the EPOs and EPSs, and verify that control measures are effective in reducing the environmental risks and impacts of the activity to an ALARP and acceptable level.

The inspection/review also includes review of conformance with selected aspects of the EP implementation strategy. All risk sources/activities applicable to the offshore facility will be reviewed over a three-year rolling period. Records of findings and records of close-out of any corrective or improvement actions are maintained (close-out is tracked in Woodside's action tracking system).

7.6.2.3 Subsea Support Vessel Environment Inspection

Environmental inspections of subsea support vessels are undertaken. This involves annual and ongoing inspections of subsea support vessels to ensure that any subsea support vessel is compliant with both the EP and the approved Contractor Management system. Inspections are conducted in line with the SSPL contractor implementation package, however, may include additional requirements for project specific inspection items.

Vessel inspection findings are captured within a closeout report. Actions arising from subsea support vessel environmental audits are added to the relevant Environmental Commitments and Actions Register (eCAR) within the Subsea Construction, IMR Environment Project Register. This eCAR is used to track support vessel compliance with EP commitments, including any findings and corrective actions.

7.6.2.4 Marine Assurance

Woodside's marine assurance is managed by the Marine Assurance Team of the Logistics Function Marine Services Group in accordance with Woodside's Marine Offshore Vessel Assurance Procedure. The Woodside process is based on industry standards and consideration of guidelines

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and recommendations from recognised industry organisations such as Oil Companies International Marine Forum and International Maritime Contractors Association.

Woodside's Marine Offshore Assurance process is mandatory for all vessels (other than Tankers and Floating Production Storage and Offloading vessels) that are chartered directly by or on behalf of Woodside, 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:

- Safety Management System Assessment
- Dynamic Positioning (DP) System Verification
- Vessel Inspections
- Project support for tender review, evaluation and pre/post contract award.

Vessel inspections are used to verify actual levels of compliance with the company's Safety Management System, the overall condition of the vessel and the status of the planned maintenance system onboard. Woodside Marine Assurance Specialist will conduct a risk assessment on the vessel to determine the level of assurance applied and the type of vessel inspection required.

Methods of vessel inspection may include, and are not limited to:

- Woodside Marine Vessel Inspection
- OCIMF OVID Inspection
- IMCA CMID Inspection
- Marine Warranty Survey

Upon completion of the marine assurance process, to confirm that identified concerns are addressed appropriately and conditions imposed are managed, the Woodside Marine Assurance Team will issue the vessel a statement of approval. Should a vessel not meet the requirements of the Woodside Marine Offshore Vessel Assurance Process and be rejected, there does exist an opportunity to further scrutinise the proposed vessel.

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 vessel inspection and/or OVMSA Verification Review is not available and all reasonable efforts based on time and resource availability to complete a vessel 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.

Risk Assessment

Woodside conducts a risk assessment of vessels where either an OVMSA Verification Review and/or an OVID vessel 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 Marine Vessel Risk Assessment will be conducted by the Marine Assurance Specialist Superintendent, or the nominated deputy, where the vessel meets the short term hire prerequisites.

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.

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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.

7.6.3 Management of Non-conformance (Internal)

Woodside employees and Contractors are required to internally report all environmental incidents and hazards, including potential non-conformances with EPOs and EPSs in this EP.

The Health, Safety and Environment Event Reporting and Investigation Procedure defines how incidents and hazards are internally reported. Key requirements are set out through the use of an Event Report Form, which includes details of the event, immediate action taken to control the situation, and corrective actions to prevent reoccurrence. An internal online database called First Priority is used for the recording and reporting of these events. Corrective actions are monitored using First Priority and closed out in a timely manner.

Detailed investigations are completed for incidents with an actual impact of A, B or C, and high potential environmental incidents and hazards. The classification, reporting, investigation and actioning of environmental incidents and hazards is undertaken in accordance with the Health, Safety and Environment Event Reporting and Investigation Procedure supported by the HSE Event Reporting Guideline. Event bulletins may be used for communication of learnings from significant events.

Non-conformances with EPOs and EPSs are also internally reported and investigated in accordance with Regulatory Compliance Management Procedure, supported by the Regulatory Compliance Management Guideline.

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External regulatory reporting requirements for this activity are outlined in **Section 7.8** of this EP.

7.6.4 Review

7.6.4.1 Environmental Risk Review

Woodside risk management processes include risk review, are described in **Sections 2.2.1** and **7.1.3** and are applied on a day-to-day basis. The Facility Environmental Impacts and Risk Register must be reviewed and updated every five years.

Monitoring (**Section 7.6.1**), assurance (**Section 7.6.2**) and review (**Section 7.6.4**) are also used to identify potential new information that may arise during the activity and ensure that performance outcomes and standards are being met and EP environmental control measures are effective. Whilst conducting these activities, qualified, experienced environment advisors, in consultation with experienced Operational and/or Engineering personnel use their professional judgement, to identify potential new control measures that have potential to improve environmental outcomes or reduce risk. As various monitoring/assurance/review processes are used there is not an overarching procedure/checklist that is suitable to contain a prompt for consideration of new environmental controls.

In addition, Woodside's risk management practices and processes are systematically applied on an ongoing basis to activities provided for within the EP (as summarised within **Section 7.1.3**). Via these processes and practices, new risk controls for individual planned and unplanned events may be selected and implemented (proportional to risk levels). When such risk controls are identified by environmental advisors as being relevant to the overarching EP sources of risk, these may also be added as new EP control measures. Any new or improved EP environmental controls or specific measures (that have the potential to improve environmental outcomes or reduce risk), can be tracked within the production EP updates register for incorporation into the EP at its next revision. The EP may be internally revised to reflect these changes without resubmission.

Where review processes identify new or improved controls relevant to environmental risks identified in this EP (that have the potential to improve environmental outcomes or reduce risk), the EP may be internally revised to reflect these changes without resubmission.

7.6.4.2 Key Performance Indicator Review

Key performance indicators (KPIs) are developed annually and agreed with senior management (i.e. GWA Asset Manager). Progress against the environment KPIs is tracked within Asset Scorecards.

Reviews of hydrocarbon spill arrangements and testing are carried out in accordance with **Appendix D**.

7.6.4.3 Learning and Knowledge Sharing

Learning and knowledge sharing occurs via a number of different methods, including for example:

- operations learnings meetings
- event investigations
- event bulletins
- engineering and technical authorities discipline communications and sharing.

7.6.4.4 Continuous Improvement

Continuous improvement (CI) projects to improve production or environmental performance that involve refurbishment, modification or major maintenance on the facility are typically managed by Brownfields Engineering and required to follow appraise and develop management procedures. The Procedure requires that all projects be managed in accordance with the Opportunity Management

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Framework, which supports the progressive maturation of an opportunity through value creation in the Assess and Select Phases and the maintenance of value in the Develop and Execute phases.

To support the accountable executive to make a decision on whether a CI Project should proceed to the next phase in the Opportunity Management Framework, it is sometimes necessary to conduct a trial of the modification to determine the outcomes that can be expected if the modification is implemented. Due to prioritisation of resources, the phased progress of opportunities, competition between different solutions and long-term strategic and financial considerations, it is not possible to set quantitative success criteria to determine whether a modification will be implemented based on the results of trials. Instead, the results of a trial are used to inform a decision on whether to progress the CI Project to the next phase in the Opportunity Management Framework. Decisions are typically made with two key considerations; whether the business is ready to proceed which has a technical/functional focus and whether there is a business case for progressing to the next phase. The business case may consider the ALARP position for the CI Project, if relevant.

7.7 Record Keeping

Compliance records (outlined in MCs in **Section 6**) are maintained. Record keeping is in accordance with Regulation 14(7) that addresses maintaining records of emissions and discharges such that the records can be used to assess whether EPOs and EPSs are being met (refer to **Section 7.6.1** and **Table 7-3** for a summary of records that are retained).

7.8 Reporting

7.8.1 Overview

In order to meet the EPOs and EPSs outlined in this EP, Woodside undertakes reporting at a number of levels. These reporting arrangements are outlined below.

7.8.2 Routine Reporting (Internal)

7.8.2.1 Daily Reports

The following daily reports, containing environmental performance information are issued:

- Pan-Woodside Daily Production Report – The report includes facility performance information on production and a log of any HSE events.
- Subsea support vessel Daily Progress Report(s) – During subsea IMR activities, daily reports are issued by the Woodside Site Representative. The reports provide performance information on HSE events, diesel use, together with equipment information, current and planned work activities.

7.8.2.2 Performance Reporting

A number of routine performance reports are developed in support of the facility operational activities. These reports cover HSE, production and process safety performance. Information included in these reports, relevant to the EP, includes:

- summary of environment incidents
- current and planned work activities, significant events (e.g. shutdowns, failures)
- integrity status and process safety metrics
- status of subsea IMR activities.

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7.8.3 Routine Reporting (External)

7.8.3.1 Environmental Performance Review and Reporting

In accordance with applicable environmental legislation for the activity, Woodside is required to report information on environmental performance to the appropriate regulator.

Routine regulatory reporting requirements are summarised in **Table 7-4**. The requirements include that Woodside will develop and submit an annual Environmental Performance Report to NOPSEMA, with the first report submitted within 12 months of the commencement of activities covered by this EP (as per the requirements of Regulation 14(2)(b)) (i.e. by 30 April the following year).

Table 7-4: Routine external reporting requirements

Report	Recipient	Frequency	Content
Monthly Recordable Incident Report	NOPSEMA	Monthly, by 15 of each month	As required by Regulation 26B, details of recordable incidents that have occurred under the EP for the previous month. Refer to **Section 7.8.5** for more detail.
Annual EP Performance Report	NOPSEMA	Annual, by 30 April of the year following reporting period	As required by Regulation 14 (2) and 26C the report will report compliance with the EPOs and EPSs outlined in **Section 6** of this EP. The reporting period is 1 January to 31 December each year.
NPI Report	DAWE	Annual, by 30 September each year	Summary of the emissions to land, air and water including those from the facility. Reporting period 1 July to 30 June each year.
National Greenhouse and Energy Reporting (NGERS)	Clean Energy Regulator	Annual, by 31 October each year	Summary of energy use and greenhouse gas emissions including those from the facility. Reporting period is 1 July to 30 June each year.

7.8.3.2 End of the Petroleum Activities Program Notification

In accordance with Regulation 29, Woodside will notify NOPSEMA within ten days of the completion of the Petroleum Activities Program. The Petroleum Activities Program is not expected to end within the five-year life of this EP.

7.8.3.3 End of the Environment Plan

The EP will end when Woodside notifies NOPSEMA that the Petroleum Activities Program has ended, 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. As noted above, the Petroleum Activities Program is not expected to end within the five-year life of this EP.

7.8.4 Incident Reporting (Internal)

All Woodside employees and contractors are required to report environmental incidents and non conformances with this EP. Incidents are reported using an Event Report Form which includes details of the event, immediate action taken to control the situation, and corrective actions to prevent reoccurrence (for further details refer to **Section 7.6.3**).

7.8.5 Incident Reporting (External) – Reportable and Recordable

Woodside's regulatory reporting requirements are outlined within the Regulator Event Reporting Procedure supported by the Regulator Event Reporting Guideline.

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7.8.5.1 Reportable Incidents

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 **Section 2.6**).
- 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 **Section 2.6**).

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 ocean resulting from either:

- loss of well containment (MEE-01)
- pipeline and riser loss of containment (MEE-02)
- topsides loss of containment (MEE-03)
- loss of structural integrity (MEE-04)
- loss of marine vessel separation (MEE-05)
- loss of control of suspended load from Platform (MEE-06).

Any such incidents represent potential events which would be reportable incidents. Reporting of incidents 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:

- orally notify NOPSEMA of all reportable incidents to the regulator 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 (NOPTA) and the Department of the responsible State Minister (Department of Mines, Industry Regulation and Safety [DMIRS]) as soon as practicable after the oral notification of the incident
- complete a written report for all reportable incidents using a format consistent with the NOPSEMA Form FM0929 – Reportable Environment Incident 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 NOPTA and DMIRS, within seven days of the written report being provided to NOPSEMA.

7.8.5.2 Recordable Incidents

A recordable incident is defined under Regulation 4 of the Environment Regulations as a 'breach of an EPO or EPS, in the EP that applies to the activity, that is not a reportable incident'.

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Any breach of the EPOs or EPSs (as presented within **Section 6**) will be raised as a recordable incident and managed as per the notification and reporting requirements outlined below and internal requirements outlined in **Section 7.8**.

Notification

NOPSEMA will be notified of all recordable incidents, according to the requirements of Regulation 26B (4). Woodside will:

- provide a written record not later than 15 days after the end of the calendar month using a format consistent with the NOPSEMA Form – Recordable Environmental Incident Monthly Summary Report (**Appendix G**).

7.8.5.3 Other External Reporting Requirements and Notifications

In addition to the notification and reporting of environmental incidents defined under the Environment Regulations and Woodside requirements, the following incident reporting requirements also apply in the Operational Area if the spill originates from a vessel:

- Any oil pollution incidents in Commonwealth Waters will be reported (by the vessel master) to 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. (This requirement is included in the GWA Oil Pollution First Strike Plan; **Appendix F**).

  If the ship is at sea, reports are to be made to:

  Free call: 1800 641 792

  Phone: 08 9430 2100 (Fremantle).

- Any spills greater than ten tonnes in Commonwealth Waters must be reported (by the vessel master) to AMSA within one hour. (This requirement is detailed in the GWA Oil Pollution First Strike Plan; **Appendix I**). Reports are to be made via the national 24-hour emergency notification contacts (AusSAR: RCC):

  Rescue Coordination Centre Australia (RCC Australia)

  Phone: 02 6230 6811

  Facsimile: 02 6230 6868

  Telex: 62349

  Free call: 1800 641 792

  AFTN: YSARYCYX.

- A hydrocarbon spill incident with potential to significantly impact MNES must be reported to DAWE.

- If the activity described within this EP results in the unintentional death of or injury to a fauna that constitute MNES (i.e. species listed as Threatened or Migratory under the EPBC Act), and the activity was not authorised by a permit, the Secretary of the DAWE should be notified within seven days of becoming aware of the results of the activity:

  The Secretary

  DAWE

  Hotline: 1800 803 772

  Email: protected.species@environment.gov.au.

For hydrocarbon 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

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Emergency Arrangements (Australia) and the GWA Oil Pollution First Strike Plan (**Appendix I**), including but not limited to:

- A hydrocarbon spill incident with the potential to significantly impact MNES must be reported to DAWE.

7.9 Emergency Preparedness and Response

7.9.1 Overview

Under Regulation 14(8), the implementation strategy must contain an OPEP and provide for the updating of the OPEP. Regulation 14(8AA) outlines the requirements for the OPEP which must include adequate arrangements for responding to and monitoring of oil pollution.

A summary of how this EP and supporting documents address the various requirements of Environment Regulations relating to oil pollution response arrangements is shown in **Table 7-5.**

Table 7-5: Oil Pollution Preparedness and Response Overview

Content	Environment Regulations Reference	Document/Section Reference
Details (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 (**Appendix D**).
Describes the OPEP	Regulation 14 (8)	EP: **Section 7.9**. Woodside's OPEP has the following components: Oil Pollution Emergency Arrangements (Australia) GWA Oil Pollution First Strike Plan (**Appendix I**). Oil Spill Preparedness and Response Mitigation Assessment (**Appendix D**). In accordance with Regulation 31 of the Environmental Regulations the Woodside Oil Pollution Emergency Arrangements (Australia) was provided with the Julimar Phase 2 Drilling and Subsea Installation EP, accepted by NOPSEMA on 8 November 2019
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 (**Appendix D**). GWA Oil Pollution First Strike Plan (**Appendix I**).
Details the arrangements for updating and testing the oil pollution response arrangements	Regulation 14 (8), (8A), (8B), (8C)	EP: **Section 7.9.8** Oil Spill Preparedness and Response Mitigation Assessment (**Appendix D**).
Details provisions for monitoring impacts to the environment from oil pollution and response activities	Regulation 14 (8D)	Oil Spill Preparedness and Response Mitigation Assessment (**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).

7.9.2 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.

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Following the mapping of training to Woodside identified competencies, training was then mapped to positions based on their required competencies (**Table 7-6**).

Table 7-6: Emergency Response Training Requirements

IMT Position	Minimum Competency
Corporate Incident Coordinate Centre (CICC) Leader	Incident and Crisis Leadership Development Program (ICLDP) Oil Spill Response Skills Enhancement Course (OSREC – internal course) Participation in L2 oil spill exercise (initial) Participation in L2 oil spill exercise (refresher)
Security & Emergency Manager Duty Manager	ICLDP OSREC IMO2 or equivalent spill response specialist level with an oil spill response organisation (OSRO) Participation in L2 oil spill exercise (initial) Participation in L2 oil spill exercise (refresher)
Operations, Planning, Logistics, Safety	OSREC ICC Fundamentals Course (internal course) Participation in L2 oil spill exercise (initial) Participation in L2 oil spill exercise (refresher)
Environment Coordinator	ICC Fundamentals OSREC IMO2 or equivalent spill response specialist level with an OSRO Participation in L2 oil spill exercise (initial) Participation in L2 oil spill exercise (refresh
Note on competency/equivalency	
In 2018 Woodside undertook a review of incident and crisis systems, processes and tools to assess whether these were fit-for purpose and has rolled out a change to the Incident and Crisis Management training and the oil spill response training requirements for both ICC and field-based roles. The revised ICC Fundamentals training Program and Incident and Crisis Leaders Development Program (ICLDP) align with the performance requirements of the *PMAOMIR320 – Manage Incident Response Information* and *PMAOM0R418 - Coordinate Incident Response.* Regarding training specific equivalency; ICLDP is mapped to *PMAOM0R418* (and which is equivalent to IMOIII when combined with Woodside's OSREC course) and ensures broader incident management principles aligned with Australasian Inter-service Incident Management System (AIIMS). The revised ICC Fundamentals Course is mapped to *PMAOMIR320* (and which is equivalent to IMOII). The blended learning program offers modules aligned to IMOIII, IMOII, IMOI and AMOSC Core Group Training Oil Spill Response Organisation Specialist Level training. OSREC involves the completion of two (2) online AMSA Modules (Introduction to National Plan and Incident management; and Introduction to oil spills) as well as elements of IMOI and IMOII tailored to Woodside specific OSR capabilities. Woodside Learning Services (WLS) are responsible for collating and maintaining personnel training records. The HSP Dashboard reflects the competencies required for each oil spill role (IMT/operational).	

7.9.3 Emergency Response Preparation

The CICC based in Woodside's head office in Perth, is the onshore coordination point for an offshore emergency. The CICC is staffed by an appropriately skilled team 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 Oil Pollution Emergency Arrangements (OPEA)(Australia). Roles and responsibilities for facility

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emergency response are outlined in the GWA Safety Case and the Pipelines Safety Case are consistent with the GWA ERP and the Pipelines ERP.

Woodside has a number of ERP in place, which detail the actions and resources available in the event of various emergency scenarios. Electronic copies of the ERPs are available on the facility Virtual Bookshelves and the intranet. Hard controlled copies are available on the facilities.

In addition, the Emergency Preparedness MSPS (M06) is in place to assure that in the event of an incident, the organisation is appropriately prepared for all necessary actions which may be required for the protection of People, Environment, Asset, Reputation and Livelihood.

7.9.3.1 Initial Response to Facility Incident

The facility is equipped with emergency shutdown systems designed to protect personnel, the facility and the environment from unsafe operating conditions and catastrophic situations.

Emergency shutdown systems are provided as a means of isolation in response to process upsets and facility conditions (including associated flowlines and risers) that could result in loss of hydrocarbon inventories, or to reduce the potential impact from a hydrocarbon loss of containment event on the facility. Provision has been made for process and facility alarm systems to provide early indication of any process upset conditions and potential hazardous events, including fire and gas alarms.

The key ERP relevant to the facility and subsea infrastructure (excluding the export pipeline) is the GWA ERP. This plan covers health, safety, asset and environmental risks (including fire, structural integrity, sabotage, etc.) to ensure the range of occupational, asset and environmental risk exposures from incidents have been considered and plans are in place for their management. The plan provides specific details on the initial response required during events with potential significant environmental consequences such as a hydrocarbon spill, subsea hydrocarbon leak or potential collision.

The Pipelines ERP covers key ERP relevant to the export pipeline, as well as other major pipelines on Woodside's NWS facilities. The GWA Oil Pollution First Strike Plan provides immediate actions required to commence a response (**Appendix I**). Vessels 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 GWA 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**.

7.9.4 Oil and Other Hazardous Materials Spill

A significant hydrocarbon spill during the 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 OPEA (Australia) document, supported by the GWA Oil Pollution First Strike Plan which provides tactical response guidance to the activity/area (**Appendix I**), and **Appendix D** of this EP, cover spill response for this Petroleum Activities Program.

The Security and 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. The interface and responsibilities, as defined under the National Plan, are described in the OPEA (Australia). AMSA and Woodside have a MoU in place to support Woodside in the event of a hydrocarbon spill.

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7.9.5 Emergency and Spill Response

Woodside categorises incidents in relation to response requirements as follows:

- **Level 1 Incident** – A Level 1 incident can be resolved through the use of 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.
- **Level 2 Incident** – A Level 2 incident is characterised by a response that requires external operational support to manage the incident. It is triggered in the event the capabilities of the tactical level response are exceeded. This support is provided to the activity via the activation of all, or part of, the responsible CICC.
- **Level 3 Incident** – A Level 3 incident or crisis is identified as a critical event that seriously threatens the organisation's People, the Environment, company Assets, Reputation, or Livelihood. At Woodside, the Crisis Management Team (CMT) manages the strategic impacts in order to respond to and recover from the threat to the company (material impacts, litigation, legal and commercial, reputation etc.). The CICC may also be activated as required to manage the operational incident response requirements.

7.9.6 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 7-7**. 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 the reference point for emergency management and crisis management exercise schedule development. 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 MAEs and MEEs. After each exercise, the team holds a debrief session, during which the exercise is reviewed. Any lessons learnt or areas for improvement are identified and incorporated into revised procedures where appropriate.

Table 7-7: Testing of response capability

Response Category	Scope	Response Testing Frequency	Response Testing Objective
Level 1 Response	Drills are asset specific	Two comprehensive Level 1 'First Strike' drills conducted per year, per asset. Additional Level 1 emergency drills routinely conducted (approximately one per fortnight).	• Comprehensive drill test elements of the GWA Oil Pollution First Strike Plan for a Level 1 incident (**Appendix I**). • Emergency drills are scheduled by each asset to test other aspects of their ERP.

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Response Category	Scope	Response Testing Frequency	Response Testing Objective
Level 2 Response	Exercises are relevant to all Woodside assets	A minimum of one Emergency Management exercise is conducted biennially.	• Testing both the facility IMT response and/or that of the CICC following handover of incident control.
Level 3 Response		The number of CMT exercises conducted each year is determined by the Chief Executive Officer, in consultation with the VP of Security and Emergency Management.	• Test the ability of the company to respond to and manage a crisis level incident.

7.9.7 Hydrocarbon Spill Response testing of 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 understand and 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 is undertaken accordingly. Additional activities or activity locations are not anticipated to occur; however, in the event that they do, testing of relevant response arrangements will be undertaken as soon as practicable.

In addition to the testing of response capability described in **Table 7-7**, up to eight formal exercises are planned annually, pan-Woodside, to specifically test arrangements for responding to a hydrocarbon spill to the marine environment.

7.9.8 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 International Petroleum Industry Environmental Conservation Association (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 7-6** provides a condensed snapshot of Woodside's five-year rolling Testing of Arrangements Schedule.

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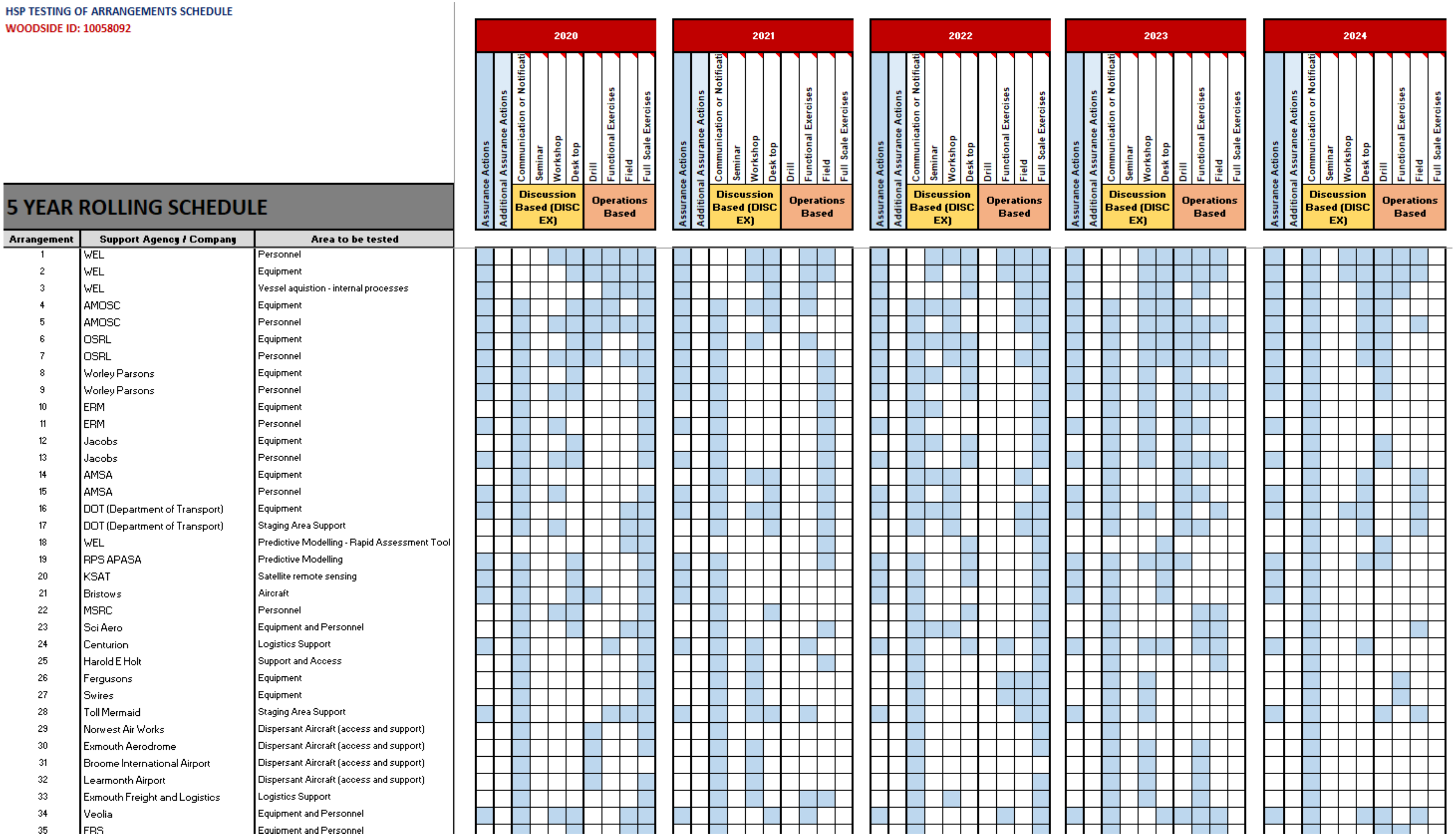

Arrangement	Support Agency / Company	Area to be tested
1	WEL	Personnel
2	WEL	Equipment
3	WEL	Vessel aquistion - internal processes
4	AMOSC	Equipment
5	AMOSC	Personnel
6	OSRL	Equipment
7	OSRL	Personnel
8	Worley Parsons	Equipment
9	Worley Parsons	Personnel
10	ERM	Equipment
11	ERM	Personnel
12	Jacobs	Equipment
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 7-6: Indicative Five-yearly Testing of Arrangements Schedule (*Snapshot of a selection of OSR arrangements tested annually)*

Note: schedule is subject to change, additional detail is included in the live document.

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Numbered hydrocarbon spill arrangements listed in the rows of the schedule are taken from Support Plans and Operational Plans described in Section 1.4 of **Appendix D**. Each arrangement has a support agency/company and an area to be tested (e.g. capability, equipment and personnel). For example, an arrangement could be to test Woodside's personnel capability for conducting scientific monitoring, or the ability of AMOSC to provide response personnel and equipment. In total there are approximately 75 hydrocarbon spill preparedness arrangements tested annually across the eight planned exercises, as described in **Section 7.9.7**.

The vertical columns under each year heading in **Figure 7-6** relate to an individual exercise or additional assurance actions that are conducted over the five-year rolling schedule. The sub-heading for the column describes the standard method of testing (e.g. discussion exercise, desktop exercise, etc.), and the blue filled cells indicate the arrangements that could be tested for each method.

Arrangements in the schedule are tested at least once per year; however, some arrangements may be tested across multiple exercises (e.g. critical arrangements) or via other 'additional assurance' methods outside of the formal Testing of Arrangements Schedule that also constitute sufficient evidence of testing of arrangements (e.g. audits, no-notice drills, internal exercises, assurance drills etc) (refer first and second vertical columns for each year in **Figure 7-6**).

7.9.8.1 Exercises, Objectives & KPIs

Exercises are designed to cumulatively provide assurance for all arrangements within Woodside's testing of arrangements schedule annually across all facilities. Exercise initiating scenarios are derived from the worst-case Credible Scenarios as described in the relevant facility First Strike Plans.

Objectives and KPIs for each exercise are determined from review of:

- the testing of arrangements schedule which identifies which arrangements can be tested for each testing method (**Section 7.9.7**)
- the objectives and KPIs master generic plan which provides a summary of generic objectives and KPIs that could be tested for specific response strategies, based on industry good practice guidance (i.e. IPIECA) for testing oil spill arrangements
- the oil spill ALARP commitments register which summarises all spill response commitments from accepted EPs (e.g. timings, numbers, etc.) for different response strategies, with consideration of priority commitments and worst-cast spill scenarios
- actions undertaken from recommendations out of previous exercises, where relevant.

The required capabilities, number of personnel, equipment, and timeframes (i.e. arrangements) form specific KPIs during an exercise. Where this is the case, the ALARP commitments register indicates the specific response strategy performance standards to use/test the arrangements against. Where relevant the most stringent Performance Standard across all in-force EPs is used as the KPI. Following each exercise, a report is produced that includes recommendations for improvements which are then converted to actions and tracked in the Testing of Arrangements Register.

Additional assurance actions are also routinely undertaken outside of the formal exercises (e.g. response audits, no-notice drills) which support testing of these arrangements. Evidence and outcomes from additional assurance actions are used, where relevant, to support testing individual arrangements, including from external sources (e.g. evidence of suppliers conducting testing of their own arrangements).

7.9.9 Cyclone and Dangerous Weather Preparation

Tropical cyclones and other severe weather events are a potential risk to the safety and health of personnel and can potentially cause spills of hazardous materials into the environment from infrastructure and/or damaged vessels.

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Subsea support vessels receive regular forecasts from the Bureau of Meteorology (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 asset Cyclone Contingency Plan and the vessel's Cyclone Contingency Plan will be actioned. If required, vessels can transit from the proposed track of the cyclone (severe weather event).

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8. REFERENCES

Aichinger Dias, L., Litz, J., Garrison, L., Martinez, A., Barry, K., Speakman, T., 2017. Exposure of cetaceans to petroleum products following the Deepwater Horizon oil spill in the Gulf of Mexico. Endangered Species Research 33: 119–125. doi:10.3354/esr00770

ANZG, 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.

Australian Institute of Marine Science, 2014a. Extended benthic models and habitat maps of Rankin Bank (Report prepared by the Australian Institute of Marine Science for Woodside Energy Ltd.). Australian Institute of Marine Science, Townsville.

Australian Institute of Marine Science, 2014b. AIMS 2013 biodiversity survey of Glomar Shoal and Rankin Bank (Report prepared by the Australian Institute of Marine Science for Woodside Energy Ltd.). Australian Institute of Marine Science, Townsville.

Baker, C., Potter, A., Tran, M., Heap, A.D., 2008. Sedimentology and geomorphology of the northwest marine region: a spatial analysis (Geoscience Australia Record No. 2008/07). Geoscience Australia, Canberra.

Berry WO, 1980, A comparative study of the uptake of toulene by bluegill sunfish Lepomis macrochirus and crayfish Orconectes rusticus. Environmental Pollution 21:109-119.

BMT Oceanica, 2015. Offshore water quality monitoring verification and sediment quality study - Goodwyn A survey report (No. 1178_003/1 Rev 0). BMT Oceanica Pty Ltd, Perth.

BMT Oceanica, 2016. Offshore canyons of Western Australia: Cape Range Canyon literature review and Enfield Canyon 2015 environment survey (Report No. 1247_003/2 Rev 1). BMT Oceanica Pty Ltd, Perth.

BMT 2021, Goodwyn Alpha Produced Water Ecotoxicity and Chemical Characterisation Assessment 2020. BMT Commercial Australia Pty Ltd, Perth

Bonn Agreement, 2015. Bonn Agreement Counter Pollution Manual, December 2015. ed. Bonn Agreement Secretariat, London.

Cai, W., Cowan, T., 2006. SAM and regional rainfall in IPCC AR4 models: Can anthropogenic forcing account for southwest Western Australian winter rainfall reduction? Geophysical Research Letters 33. https://doi.org/10.1029/2006GL028037

Catry, T., Ramos, J., Le Corre, M., Phillips, R., 2009. Movements, at-sea distribution and behaviour of a tropical pelagic seabird: the wedge-tailed shearwater in the western Indian Ocean. Marine Ecology Progress Series 391: 231–242. doi:10.3354/meps07717

Chapman, C.C., Lea, M.A., Meyer, A., Sallée, J.B. and Hindell, M., 2020. Defining Southern Ocean fronts and their influence on biological and physical processes in a changing climate. Nature Climate Change, 10(3), pp.209-219.

Church, John.A., Hunter, John.R., Mcinnes, K., White, Neil.J., 2006. Sea-level rise around the Australian coastline and the changing frequency of extreme events. Australian Meteorological Magazine 55, 253–260. https://doi.org/10.1016/j.gloplachs.2006.04.001

Cohen, A., Gagnon, M.M., Nugegoda, D., 2005. Alterations of metabolic enzymes in Australian bass, Macquaria novemaculeata, after exposure to petroleum hydrocarbons. Archives of Environmental Contamination and Toxicology 49: 200–205. doi:10.1007/s00244-004-0174-1.

Commonwealth of Australia, 2006. A guide to the integrated marine and coastal regionalisation of Australia Version 4.0. Department of the Environment and Heritage, Canberra, Australia.

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Commonwealth of Australia, 2012. Conservation Management Plan for the Southern Right Whale A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 2011–2021. Department of Sustainability, Environment, Water, Population and Communities.

Commonwealth of Australia, 2014a. Streamlining offshore petroleum environmental approvals Program Report. Australian Government.

Commonwealth of Australia, 2014b. Recovery Plan for the Grey Nurse Shark (Carcharias taurus). Department of the Environment, Canberra.

Commonwealth of Australia, 2015a. Conservation management plan for the blue whale: A recovery plan under the Environment Protection and Biodiversity Conservation Act 1999 2015-2025. Department of the Environment, Canberra.

Commonwealth of Australia, 2015b. Sawfish and river shark multispecies recovery plan (Recovery Plan). Department of the Environment, Canberra.

Commonwealth of Australia, 2017. Recovery plan for marine turtles in Australia 2017-2027. Department of the Environment and Energy, Canberra.

Commonwealth of Australia, 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018). Department of the Environment and Energy.

Commonwealth of Australia, 2020. National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds AND Migratory Shorebirds. Department of the Environment and Energy, Canberra.

CSIRO, 2017. Climate Change in Australia [WWW Document]. URL https://www.climatechangeinaustralia.gov.au/en/

Dai, A., 2013. Increasing drought under global warming in observations and models. Nature climate change 3, 52.

Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan and final programmatic environmental impact statement. National Oceanic and Atmospheric Administration, Silver Spring.

Department of the Environment and Energy, 2019. Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases [WWW Document]. URL https://www.environment.gov.au/climate-change/climate-solutions-package (accessed 6.4.19).

Department of Conservation and Land Management, 2005b. Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005 - 2015 (Management Plan No. 52). Department of Conservation and Land Management, Perth.

Department of Environment and Conservation, 2007. Management plan for the Montebello/Barrow Islands Marine Conservation Reserves. Marine Parks and Reserves Authority, Perth.

Department of Fisheries, 2017. Statewide Array Survellance Program (SWASP) – Pilbara Port Authority Port of Dampier, Winter 2016 Report.

Department of the Environment, Water, Heritage and the Arts (DEWHA), 2008. The north-west marine bioregional plan: bioregional profile. Department of the Environment, Water, Heritage and the Arts,

[DISER] Department of Industry, Science, Energy and Resources, 2020. Offshore Petroleum Decommissioning Guideline. Australian Government, Canberra.

[DISER] Department of Industry, Science, Energy and Resources, 2020a. Australia's emissions projections 2020. Australian Government, Canberra.

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Dix, G.R., James, N.P., Kyser, T.K., Bone, Y., Collins, L.B., 2005. Genesis and dispersal of carbonate mud relative to late quaternary sea-level change along a distally-steepened carbonate ramp (Northwestern Shelf, Western Australia). Journal of Sedimentary Research 75: 665–678.

DNV, 2019. Integrity management of submarine pipeline systems, DNVGL-RP-F116. Oslo, Norway.

Double, M., Jenner, K., Jenner, M., Ball, I., Childerhouse, S., Loverick, S., Gales, N., 2012a. Satellite tracking of northbound humpback whales (Megaptera novaeangliae) off Western Australia. Australian Marine Mammal Centre, Hobart.

Double, M., Jenner, K., Jenner, M.-N., Ball, I., Laverick, S., Gales, N., 2012b. Satellite tracking of pygmy blue whales (Balaenoptera musculus brevicauda) off Western Australia. Australian Marine Mammal Centre, Hobart.

Double, M.C., Andrews-Goff, V., Jenner, K.C.S., Jenner, M.-N., Laverick, S.M., Branch, T.A., Gales, N.J., 2014. Migratory movements of pygmy blue whales (Balaenoptera musculus brevicauda) between Australia and Indonesia as revealed by satellite telemetry. PloS one 9: e93578.

Dunlop, M., Hilbert, D., Ferrier, S., House, A., Liedloff, A., Prober, S., Smyth, A., Martin, T., Harwood, T., Williams, K., Fletcher, C., Murphy, H., 2012. The Implications of Climate Change for Biodiversity, Conservation and the National Reserve System: Final Synthesis. CSIRO Climate Adaptation Flagship. https://doi.org/10.4225/08/5850384d796c6

Ecotox Services Australia, 2013. Toxicity Assessment of an Enfield and Marine Diesel Sample, . Report prepared for Woodside Energy Ltd.

Energy Institute, 2009. Guideline for Management of Integrity of Subsea Facilities. London, UK.

Environmental Protection Agency, 2016, State Waters Technical Guidance: Protecting the quality of Western Australia's marine environment.

Field, C.D., 1995. Impact of expected climate change on mangroves. Hydrobiologia 295, 75–81. https://doi.org/10.1007/BF00029113

Fletcher, W., Mumme, M., Webster, F. (Eds.), 2017. Status reports of the fisheries and aquatic resources of Western Australia 2015/2016: State of the fisheries. Department of Fisheries, Perth.

Fodrie, F.J., Heck, K.L., 2011. Response of coastal fishes to the Gulf of Mexico oil disaster. PLoS ONE 6: e21609. doi:10.1371/journal.pone.0021609

French, D.P., Schuttenberg, H.Z., Isaji, T., 1999. Probabilities of oil exceeding thresholds of concern: examples from an evaluation for Florida Power and Light. Presented at the Arctic and Marine Oilspill Program Technical Seminar, Ministry of Supply and Services, Ottawa, pp. 243–270.

Furnas, M., Mitchell, A., 1999. Wintertime carbon and nitrogen fluxes on Australia's Northwest Shelf. Estuarine, Coastal and Shelf Science 49: 165–175.

Gagnon, M.M., Rawson, C., 2010. Montara well release: Report on necropsies from a Timor Sea green turtle. Curtin University, Perth.

Gaston, K.J., Duffy, J.P., Gaston S., Bennie J., Davies, T.W. 2014. Human alteration of natural light cycles: causes and ecological consequences. Oecologia 176: 917-931.

Geraci, J., 1988. Physiologic and toxicologic effects of cetaceans, in: Geraci, J., St Aubin, D. (Eds.), Synthesis of Effects of Oil on Marine Mammals, OCS Study. Department of Interior, Ventura, pp. 168–202.

Gilmour, J., Speed, C.W., Babcock, R., 2016. Coral reproduction in Western Australia. PeerJ 4, e2010. https://doi.org/10.7717/peerj.2010

Hassan, A., Javed, H., 2011. Effects of Tasman Spirit oil spill on coastal birds at Clifton, Karachi coast, Pakistan. Journal of Animal and Plant Sciences 21: 333–339.

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Hazel, J., Lawler, I.R., Marsh, H., Robson, S., 2007. Vessel speed increases collision risk for the green turtle Chelonia mydas. Endangered Species Research 3: 105–113.

Heatwole, H., Cogger, H.G., 1993. Chapter 36: Family Hydrophiidae, in: Fauna of Australia. Australian Government Publishing Service, Canberra.

Helm, R.C., Costa, D.P., DeBruyn, T.D., O'Shea, T.J., Wells, R.S., Williams, T.M., 2015. Overview of effects of oil spills on marine mammals, in: Fingas, M. (Ed.), Handbook of Oil Spill Science and Technology. Wiley, pp. 455–475.

Henkel, J.R., Sigel, B.J., Taylor, C.M., 2012. Large-scale impacts of the Deepwater Horizon oil spill: can local disturbance affect distant ecosystems through migratory shorebirds? BioScience 62: 676–685. doi:10.1525/bio.2012.62.7.10

Hjermann, D.Ø., Melsom, A., Dingsør, G.E., Durant, J.M., Eikeset, A.M., Røed, L.P., Ottersen, G., Storvik, G., Stenseth, N.C., 2007. Fish and oil in the Lofoten–Barents Sea system: synoptic review of the effect of oil spills on fish populations. Marine Ecology Progress Series 339: 283–299.

Hoegh-Guldberg, O., 1999. Climate change, coral bleaching and the future of the world's coral reefs. Marine and freshwater research 50, 839–866.

Hoegh-Guldberg, O., Jacob, D., Taylor, M., Bindi, M., Brown, S., Camilloni, I., Diedhiou, A., Djalante, R., Ebi, K.L., Engelbrecht, F., Guiot, J., Hijioka, Y., Mehrotra, S., Payne, A., Seneviratne, S.I., Thomas, A., Warren, R., Zhou, G., 2018. Impacts of 1.5oC Global Warming on Natural and Human Systems, in: Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty.

Hughes, L., 2003. Climate change and Australia: Trends, projections and impacts. Austral Ecology 28, 423–443. https://doi.org/10.1111/j.1442-9993.2003.tb00266.x

International Energy Agency (IEA), 2021. Global Energy Review. URL https://www.iea.org/reports/global-energy-review-2021 (accessed 1.7.21).

International Petroleum Industry Environmental Conservation Association, 2004. A guide to oiled wildlife response planning (IPIECA Report Series No. 13). International Petroleum Industry Environmental Conservation Association, London.

International Tanker Owners Pollution Federation, 2011a. Effects of oil pollution on the marine environment (Technical Information Paper No. 13). International Tanker Owners Pollution Federation Limited, London.

International Tanker Owners Pollution Federation, 2011b. Effects of oil pollution on fisheries and mariculture (Technical Information Paper No. 11). International Tanker Owners Pollution Federation Limited, London.

[IPCC] International Panel on Climate Change, 2021. Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [MassonDelmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M.Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press.

Jacobs, 2016, Offshore Facilities Produced Water: Chemical Characterisation and Sedimentation Assessment 2016, Document number: IW118700-0000-NM-RPT-0004.

Jacobs, 2020, Offshore Facilities Produced Water: GWA High Water Cut Well Unloading 2019, Document number: IW217100_RPT_0000

James, N.P., Bone, Y., Kyser, T.K., Dix, G.R., Collins, L.B., 2004. The importance of changing oceanography in controlling late Quaternary carbonate sedimentation on a high-energy, tropical,

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oceanic ramp: north-western Australia. Sedimentology 51: 1179–1205. doi:10.1111/j.1365-3091.2004.00666.x

Jarman, S., Wilson, S., 2004. DNA-based species identification of krill consumed by whale sharks. Journal of Fish Biology 65: 586–591.

Jensen, A., Silber, G., 2004. Large whale ship strike database (NOAA Technical Memorandum No. NMFS-OPR). National Marine Fisheries Service, Silver Spring.

Johansen, J.L., Allan, B.J., Rummer, J.L., Esbaugh, A.J., 2017. Oil exposure disrupts early life-history stages of coral reef fishes via behavioural impairments. Nature Ecology and Evolution 1: 1146–1152. doi:10.1038/s41559-017-0232-5

King, D., Lyne, R., Girling, A., Peterson, D., Stephenson, R., Short, D., 1996. Environmental risk assessment of petroleum substances: The hydrocarbon block method (CONCAWE No. 96/52). CONCAWE, Brussels.

Koops, W., Jak, R., van der Veen, D., 2004. Use of dispersants in oil spill response to minimize environmental damage to birds and aquatic organisms. Interspill 2004.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S., Podesta, M., 2001. Collisions between ships and whales. Marine Mammal Science 17: 35–75.

Longcore, T., Rich, C. 2004. Ecological light pollution. Frontiers in Ecology and the Environment 2: 191-198

Lutcavage, M., Lutz, P., Bossart, G., Hudson, D., 1995. Physiologic and clinicopathologic effects of crude oil on loggerhead sea turtles. Archives of Environmental Contamination and Toxicology 28: 417–422.

Matkin, C.O., Saulitis, E.L., Ellis, G.M., Olesiuk, P., Rice, S.D., 2008. Ongoing population-level impacts on killer whales Orcinus orca following the ‘Exxon Valdez’oil spill in Prince William Sound, Alaska. Marine Ecology Progress Series 356: 269–281.

McInnes, K., 2015. Wet Tropics Cluster Report, in: Ekström, M., Whetton, P., Gerbing, C., Grose, M., Webb, L., Risbey, J. (Eds.), Climate Change in Australia Projections for Australia’s Natural Resource Management Regions: Cluster Reports. CSIRO and Bureau of Meteorology, Australia.

McLean, D.L., Partridge, J.C., Bond, T., Birt, M.J., Bornt, K.R., Langlois, T.J., 2017. Using industry ROV videos to assess fish associations with subsea pipelines. Continental Shelf Research 141: 76–97. doi:10.1016/j.csr.2017.05.006

Milton, S.L., Lutz, P.L., 2003. Physiological and genetic responses to environmental stress, in: Lutz, P.L., Musick, J.A., Wyneken, J. (Eds.), The Biology of Sea Turtles. CRC Press, Boca Raton, pp. 164–198.

National Oceanic and Atmospheric Administration, 2010. Oil and sea turtles: Biology, planning and response. National Oceanic and Atmospheric Administration, Washington.

[NOPSEMA] National Offshore Petroleum Safety and Environmental Management Authority 2019. Oil spill modelling bulletin, A652993, April 2019.

[NOPSEMA] National Offshore Petroleum Safety and Environmental Management Authority, 2020. Section 572 Maintenance and removal of property, Policy, N-00500-PL1903 A720369, 20/11/2020.

Neff, J., 2002. Bioaccumulation in Marine Organisms - Effect of Contaminants from Oil Well Produced Water. Elsevier, Amsterdam.

Neff, J., Lee, K. and DeBlois, E.M. 2011. Produced water: Overview of composition, fate and effects. In: Produced Water, Environmental Risks and Advances in Mitigation Technologies (Eds. Lee K and Neff J) pp 608. Springer New York.

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[OGA] Oil and Gas Authority, 2018. Guidance for applications for suspension of inactive wells, October 2018, London, UK.

[OGUK] Oil & Gas UK, 2018. Well Decommissioning Guidelines, Issue 6, June 2018.

[OGUK] Oil & Gas UK, 2019. Well Lifecycle Integrity Guidelines, Issue 4, March 2019.

Oxford Economics, 2010. Potential impact of the Gulf oil spill on tourism. Oxford Economics, Oxford.

PENV 2020b. Scarborough Desktop Lighting Impact Assessment. Unpublished report prepared by Pendoley Environmental Pty for Advisian, February 2020.

Rob Phillips Consulting (2016). Offshore Production Facilities Marine Discharges Modelling Study. Phase 3: GWA. Prepared for Jacobs Australia. Document number RPC-REP-13-001-006 Rev 0.docx.OSPAR (2014). Establishment of a Predicted No Effect Concentrations (PNECs) for naturally occurring substances in produced water. (OSPAR agreement 2014-05). Background Document Romero, I.C., Schwing, P.T., Brooks, G.R., Larson, R.A., Hastings, D.W., Ellis, G., Goddard, E.A., Hollander, D.J., 2015. Hydrocarbons in deep-sea sediments following the 2010 Deepwater Horizon blowout in the northeast Gulf of Mexico. PLOS ONE 10: e0128371. doi:10.1371/journal.pone.0128371

Rob Phillips Consulting, 2018, Offshore Production Facilities Marine Discharges Modelling Study Goodwyn ‘A’, Document number RPC-REP-18-010-001 REV 0 GWA.

Rob Phillips Consulting, 2021, Produced Water Discharge Modelling Goodwyn ‘A’, Document number: RPC-REP-19-009-001, REV 0.

RPS Environment and Planning, 2011. Field report July 2011: Apache Julimar Development Pipeline Corridor Biological Seabed Survey (No. N11126). RPS Environment and Planning Pty Ltd, Subiaco.

RPS Environment and Planning, 2012. Sediment quality surveys March-April 2011, Greater Western Flank Marine Environmental Baseline Studies. RPS Environment and Planning Pty Ltd, Perth.

RPS Group, 2017. Goodwyn Alpha (GWA) Operations EP Quantitative Spill Risk Assessment. Prepared for Woodside Energy Ltd. August 2017. RPS Group, Perth.

RPS Group, 2019c. Woodside GWF-3/Lambert Deep Quantitative Spill Risk Assessment - Preliminary Results - Scenario 3. Report prepared for Woodside Energy Ltd.

RPS Group, 2021. Woodside Goodwyn Alpha Operations – Quantitative Spill Risk Assessment Report. April 2021. RPS Group, Perth.

Schianetz, K., Jones, T., Kavanagh, L., Walker, P.A., Lockington, D., Wood, D., 2009. The practicalities of a Learning Tourism Destination: a case study of the Ningaloo Coast. International Journal of Tourism Research 11: 567–581. doi:10.1002/jtr.729

SGS Economics and Planning, 2012. Economic development opportunities for the Gascoyne region associated with resource sector investment and expansion. Gascoyne Development Commission, Fortitude Valley.

Simpson, S.L., Batley, G.E., Chariton, A.A., 2013. Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines. CSIRO Land and Water Science Report 08/07.

SKM, 2006, North West Shelf Cumulative Environmental Impact Study, Offshore Marine Environmental Survey, Drilling Impacts and Recovery.

SKM 2014, GWA Drill Cuttings Environmental Survey, Document number: 0066.

SKM 2013, Offshore Marine Discharges Study – Modelling and Sedimentation Analysis. Report prepared for Woodside Energy Ltd.

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SINTEF, 2017. SINTEF Offshore Blowout Database - SINTEF [WWW Document]. SINTEF Offshore Blowout Database. URL https://www.sintef.no/en/projects/sintef-offshore-blowout-database/ (accessed 8.17.17).

Smallwood, C.B., Beckley, L.E., Moore, S.A., Kobryn, H.T., 2011. Assessing patterns of recreational use in large marine parks: A case study from Ningaloo Marine Park, Australia. Ocean and Coastal Management 54: 330–340. doi:10.1016/j.ocecoaman.2010.11.007

Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., Miller, H.L., 2007. Contribution of working group I to the fourth assessment report of the intergovernmental panel on climate change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Spalding, M.D., Brown, B.E., 2015. Warm-water coral reefs and climate change. Science 350, 769–771.

Steffen, W., Burbidge, A.A., Hughes, L., Kitching, R., Lindenmayer, D., Musgrave, W., Staford Smith, M., Werner, P., 2009. Australia´s biodiversity and climate change: A strategic assessment of vulnerability of Australia´s biodiversity to climate change. A report to the Natural resource Management Ministerial Council commissioned by Australian Government. CSIRO Publishing.

Taylor, J.G., 2007. Ram filter-feeding and nocturnal feeding of whale sharks (Rhincodon typus) at Ningaloo Reef, Western Australia. Fisheries Research 84: 65–70.Vanderlaan, A.S.M., Taggart, C.T., 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. Marine Mammal Science 23: 144–156. doi:10.1111/j.1748-7692.2006.00098.x

Vik EA, Bakke DR and Verburgh J, 1996, The N-octanol/water partition coefficient: a critical parameter in environmental risk assessment of offshore EandP chemicals, in Ray, JP and Engelhardt FR., (eds), Produced Water: Technological/Environmental Issues and Solutions, Plenum Press, New York.

Warne MSTJ, Batley GE, van Dam RA, Chapman JC, Fox DR, Hickey CW and Stauber JL. (2015). Revised Method for Deriving Australian and New Zealand Water Quality Guideline Value for Toxicants. Updated January, 2017. Prepared for the Council of Australian Government's Standing Council on Environment and Water (SCEW). Department of Science, Information Technology and Innovation, Brisbane, Queensland. 48 pp.

Winton, T., Binet, M., Stauber, L. and Phillips, R. 2008. Prediction of PW toxicity risk to marine life in offshore oscillating current environments, Society for Environmental Toxicology and Chemistry World Congress, Sydney, August 2008.

Woodside, 2008. Torosa South-1 (TS-1) Pilot appraisal well, environmental monitoring program - development of methodologies Part 1 (Pg 51). Report produced by Environmental Resource Management (ERM) and Sinclair Knight Merz (SKM).

Yender, R., Michel, J., Lord, C., 2002. Managing seafood safety after and oil spill. National Oceanic and Atmospheric Administration, Seattle.

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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
2TL	Second Trunkline
3D	Three-dimensional
ACN	Australian Company Number
AHO	Australian Hydrographic Office
AIMS	Australian Institute of Marine Science
ALARP	As low as reasonably practicable
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
APPEA	Australian Petroleum Production and Exploration Association
AS/NZS	Australian Standard/New Zealand Standard
AW	Abandoned wells with Wellhead (AW)
BESS	Battery Energy Storage System
BDV	Blow-down Valve
BIA	Biologically Important Area
BoM	Bureau of Meteorology
BOP	Blowout Preventer
CCE	Common cause event
CCR	Central Control Room
CICC	Corporate Incident Communication Centre
cm	Centimetre
cm^3	Cubic centimetre
CMMS	Computerised Maintenance Management System
CMT	Crisis Management Team
CO	Carbon monoxide
CO_2	Carbon dioxide
COO	Chief Operations Officer
cP	Centipoise
CS	Cost Sacrifice
CV	Company Value
CVS	Contractor Verification Service

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Acronym	Description
D&C	Drilling and Completions
dB re 1 µPa	Decibels relative to one micropascal; the unit used to measure the intensity of an underwater sound
DMIRS	Western Australian Department of Mines, Industry Regulation and Safety
DNP	Director of National Parks
DOA	Dockrell
DoEE	Commonwealth Department of the Environment and Energy
DoT	Western Australian Department of Transport
DP	Dynamic positioning
eCAR	Environmental Commitments and Actions Register
EMBA	Environment that may be affected
ENVID	Environment Identification (study)
EP	Environment Plan
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPO	Environmental Performance Objective
EPS	Environment Performance Standard
ERP	Emergency Response Plan
ESD	Emergency Shutdown
ETA	Exploration wells Temporary Abandoned (ETA)
EY	Echo Yodel
FFS	Fitness for Services
FPSO	Floating production, storage, and offtake
g	Gram
GP	Good Practice
GWA	Goodwyn Alpha
HAZID	Hazard identification (study)
HP	High Pressure
HQ	Hazard Quotient
HSE	Health, Safety, and Environment
HSEC	Health, Safety and Environment Coordinator
HVAC	Heating, ventilation and air conditioning
IFL	Interfield Line
IMMR	Inspection, maintenance, monitoring, and repair
IMS	Invasive Marine Species
IMSMP	Invasive Marine Species Management Plan
IPIECA	International Petroleum Industry Environmental Conservation Association
ISO	International Organization for Standardization
ISSoW	Integrated Safe System of Work
IUCN	International Union for Conservation of Nature

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Acronym	Description
KEF	Key Ecological Feature
KDA	Keast Dockrell
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
LP	Low Pressure
LPA	Lady Nora Pemberton
LTO	Licence to Operate
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 Sonar
MC	Measurement Criteria
MEE	Major Environmental Event
MEG	Monoethylene glycol
mg	Milligram
ml	Millilitre
MNES	Matters of National Environmental Significance
MoC	Management of Change
MOPO	Manual of Permitted Operation
MoU	Memorandum of Understanding
MPA	Marine Protected Area
MSPS	Management System Performance Standards
MW	Megawatt
n.d.	No date
N/A	Not Applicable

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Acronym	Description
N_2O	Nitrous oxide
NGERS	National Greenhouse and Energy Reporting Scheme
NIMS	Non-indigenous Marine Species
nm	Nautical mile
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NORM	Naturally Occurring Radioactive Material
NO_X	Oxides of nitrogen
NPI	National Pollutant Inventory
NRA	North Rankin Alpha
NRC	North Rankin Complex
NWMR	North-west Marine Region
NWS	North West Shelf
OCIMF	Oil Companies International Marine Forum
OCNS	Offshore Chemical Notification Scheme
OIM	Offshore Installation Manager
OIW	Oil in water
OPEA	Oil Pollution Emergency Arrangements (Australia)
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
pH	Measure of acidity or basicity of a solution
PJ	Professional Judgement
PLONOR	Pose Little or no Risk to the Environment
PMST	Protected Matters Search Tool
PoB	Personnel Onboard
PoG	Perseus over Goodwyn
ppb	Parts per billion
ppm	Parts per million
PSM	Process Safety Management
PSRA	Process Safety Risk Assessment
PSZ	Petroleum safety zone
PW	Produced Water
RBA	Risk-based Analysis
RBI	Risk-based Inspection
RCC	Rescue Coordination Centre
RESDV	Riser Emergency Shutdown Valve

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Acronym	Description
RO	Reverse osmosis
ROV	Remotely operated vehicle
SCC	Safety and Environment Critical Component
SCE	Safety and Environmental Critical Element
SCM	Subsea Control Module
SCQ	Safety and Environmental Critical Equipment
SIMAP	Spill Impact Mapping and Analysis program
SKM	Sinclair Knight Mertz (company)
sm^3	Standard cubic metres
SOPEP	Ship Oil Pollution Emergency Plan
SO_X	Sulfur oxides
SSPL	Subsea and Pipelines
SSIV	Sub-sea Isolation Valve
SSSV	Sub-sea Safety Valve
SV	Societal Value
SVP	Senior Vice President
T100	Train 100
T200	Train 200
T	Tonne
TEG	Triethylene glycol
UK	United Kingdom
UPS	Uninterrupted Power Supply; battery power system
VOC	Volatile Organic Compound
VP	Vice President
WA	Western Australia
WGS84	Word Geodesic System 1984
WMS	Woodside Management System
Woodside	Woodside Energy Limited
WOMP	Well Operations Management Plan

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APPENDIX A WOODSIDE HEALTH, SAFETY AND ENVIRONMENT AND RISK MANAGEMENT POLICIES

WOODSIDE POLICY

Health, Safety and Environment Policy

OBJECTIVES

Strong health, safety and environment (HSE) performance is essential for the success and growth of our business. Our aim is to be recognised as an industry leader in HSE 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.

PRINCIPLES

Woodside will achieve this by:

- implementing a systematic approach to HSE 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 HSE performance
- embedding HSE considerations in our business planning and decision-making processes
- integrating HSE requirements when designing, purchasing, constructing and modifying equipment and facilities
- maintaining a culture in which everybody is aware of their HSE obligations and feels empowered to speak up and intervene on HSE issues
- undertaking and supporting research to improve our understanding of HSE 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 HSE expectations in a mutually beneficial manner
- publicly reporting on HSE 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.

Updated by the Board in April 2021

WOODSIDE POLICY

Woodside

Risk Management Policy

OBJECTIVES

Woodside recognises that risk is inherent in our business and the effective management of risk is vital to deliver our strategic objectives, continued growth and success. We are committed to managing risks in a proactive and effective manner as a source of competitive advantage.

Our approach protects us against potential negative impacts, enables us to take risk for reward and improves our resilience against emerging risks. The objective of our risk management framework is to provide a single consolidated view of risks across the company to understand our full risk exposure and prioritise risk management and governance.

The success of our approach lies in the responsibility placed on everyone at all levels to proactively identify, assess and treat risks relating to the objectives they are accountable for delivering.

PRINCIPLES

Woodside achieves these objectives by:

- Applying a structured and comprehensive framework for the identification, assessment and treatment of current risks and response to emerging risks;
- Ensuring line of sight of financial and non-financial risks at appropriate levels of the organisation;
- Demonstrating leadership and commitment to integrating risk management into our business activities and governance practices;
- Recognising the value of stakeholder engagement, best available information and proactive identification of potential changes in external and internal context;
- Embedding risk management into our critical business processes and control framework;
- Understanding our exposure to risk and tolerance for uncertainty to inform our decision making and assure that Woodside is operating with due regard to the risk appetite endorsed by the Board; and
- Evaluating and improving the effectiveness and efficiency our approach.

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 4 December 2020.

APPENDIX B RELEVANT REQUIREMENTS

The below table 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 – Offshore Industry units* • *Marine order 57 - Helicopter operations* • *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.
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.

Commonwealth Legislation	Legislation Summary
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—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 WOODSIDE MASTER EXISITING ENVIRONMENT DOCUMENT

Description of the Existing Environment

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TABLE OF TABLES

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1. INTRODUCTION

1.1 Purpose

This document applies, where indicated in the relevant Environment Plan, to Woodside Energy Ltd. (Woodside) activities and operations.

1.2 Scope

This document describes the existing environment within the Woodside areas of activity located in Commonwealth waters off north-western Western Australia (WA), with a focus on the North-west Marine Region (NWMR) (**Figure 1-1**). This document includes details of the particular and relevant values and sensitivities of the environment as required by the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 in order to inform the impact and risk evaluation of Woodside's activities within the NWMR. Furthermore, the key values of the South-west Marine Region (SWMR) and the North Marine Region (NMR) are summarised to encompass areas outside the NWMR. This is with reference to the environment that may be affected (EMBA), as defined and described in individual EPs, for unplanned hydrocarbon spill risks. Additional information appropriate to the nature and scale of the impacts and risks of activities that may interact with the environment will be used to further inform impact and risk assessments and included in the Description of the Existing Environment of individual EPs.

This document is informed by a variety of resources that includes: a search of the Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) for the marine bioregions (NWMR, SWMR and NMR) and the three PMST reports provided in **Appendix A**; State (WA)/Commonwealth Marine Park Management Plans, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Species Profile and Threats Database (SPRAT), Part 13 statutory instruments (recovery plans, conservation advices and wildlife conservation plans for listed threatened and migratory species); and peer reviewed scientific publications, as well as Woodside and Joint Venture (JV) funded studies and other titleholder funded study findings available in the public domain.

1.3 Review and Revision

The information presented in this document is reviewed and updated, where relevant, on at least an annual basis to address any relevant changes, which includes but is not limited to the status of EPBC Act listed species, Part 13 Instruments, policies and guidelines and recently published scientific literature.

1.4 Regional Context

Where relevant, the physical, biological and social environments within the areas of interest are discussed with reference to the three marine bioregions of Australia—NWMR, SWMR and NMR (**Table 1-1)**. The NWMR is the focal marine bioregion for the Description of the Existing Environment as this is currently the location of most of Woodside's activities.

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Table 1-1. Description of the Marine Bioregions

Marine Bioregion	Description
North-west	The NWMR includes all Commonwealth waters (from 3 nautical mile [nm] from the Territorial Sea Baseline [TSB] to the 200 nm Exclusive Economic Zone [EEZ] boundary) extending from the WA/Northern Territory (NT) border to Kalbarri, south of Shark Bay in WA, covering an area of approximately 1.07 million square kilometres and includes extensive areas of shallower waters on the continental shelf, as well as deep areas of abyssal plain where water depths are 5000 m or greater.
South-west	The SWMR comprises Commonwealth waters from the eastern end of Kangaroo Island in SA to Shark Bay in WA. The region spans approximately 1.3 million square kilometres of temperate and subtropical waters and abuts the coastal waters of SA and WA.
North	The NMR comprises Commonwealth waters from west Cape York Peninsula to the NT/WA border). The region covers approximately 625,689 square kilometres of tropical waters in the Gulf of Carpentaria and Arafura and Timor seas, and abuts the coastal waters of Queensland and the NT.

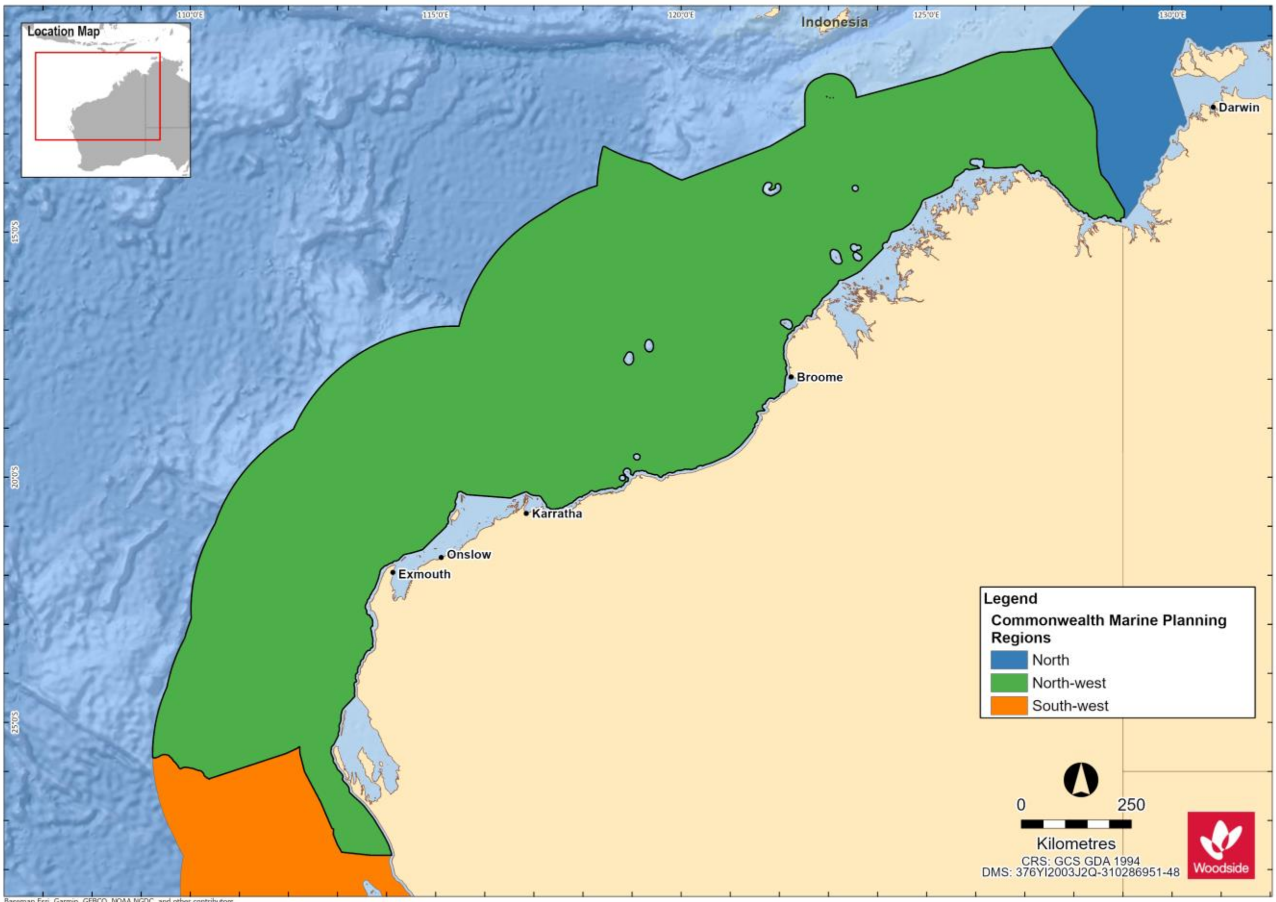

Figure 1-1. Marine Bioregions: North-west (NWMR), South-west (SWMR) and North (NMR)

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2. PHYSICAL ENVIRONMENT

2.1 Regional Context

The key physical characteristics of the NWMR, SWMR and NMR are presented in **Table 2-1**.

Table 2-1 Key physical characteristics of the NWMR, SWMR and NMR

Bioregion	Key Characteristics
North-west Marine Region	The NWMR experiences a tropical monsoonal climate towards the northern extent of the region, transitioning to tropical arid and subtropical arid within the central and southern areas of the region (DSEWPAC, 2012a).
	The NWMR is part of the Indo-Australian Basin, the ocean region between the north-west coast of Australia and the Indonesian islands of Java and Sumatra. Dominant currents in the Region include: the South Equatorial Current, the Indonesian Throughflow; the Eastern Gyral Current, and the Leeuwin Current (DEWHA, 2007a).
	The seafloor of the NWMR consists of four general feature types: continental shelf; continental slope; continental rise; and abyssal plain and is distinguished by a range of topographic features including canyons, plateaus, terraces, ridges, reefs, and banks and shoals.
South-west Marine Region	The SWMR contains both subtropical and temperate climates, with overall light climatic cycles.
	The SWMR experiences complex and unusual oceanographic patterns, driven largely by the Leeuwin Current and its associated currents that have a significant influence on biodiversity distribution and abundance.
	The major seafloor features of the SWMR include a narrow continental shelf on the west coast to the waters off south-west WA, and a wide continental shelf dominated by sandy carbonate sediments of marine origin in the Great Australian Bight, the region also contains a steep, muddy continental slope, many canyons and large tracts of abyssal plains (DSEWPAC, 2012b).
North Marine Region	The NMR experiences a tropical monsoonal climate with complex weather cycles, including high temperatures and heavy seasonal yet variable rainfall and cyclones, which can be both destructive (loss of seagrass and mangroves) and constructive (mobilisation of sediment into coastal habitats).
	The NMR comprises Commonwealth waters from west Cape York Peninsula to the NT–WA border, covering tropical waters in the Gulf of Carpentaria and Arafura and Timor seas. Currents in the NMR are driven largely by strong winds and tides, with only minor influences from oceanographic currents such as the Indonesian Throughflow and the South Equatorial Current (DSEWPAC, 2012c).
	The seafloor of the NMR consists mainly of a wide continental shelf, as well as other geomorphological features such as shoals, banks, terraces, valleys, shallow canyons and limestone pinnacles.

2.2 Marine Systems of the North-west Marine Region.

The NWMR can be divided into three large scale ecological marine systems on the basis of the influence of major ocean currents, seafloor features and eco-physical processes (e.g. climate, tides, freshwater inflow) upon the Region (DSEWPAC, 2012a). The three large scale marine systems approximate the Woodside activity areas within the NWMR (**Figure 2-1**). The key characteristics of each marine system are outlined below in **Table 2-2**.

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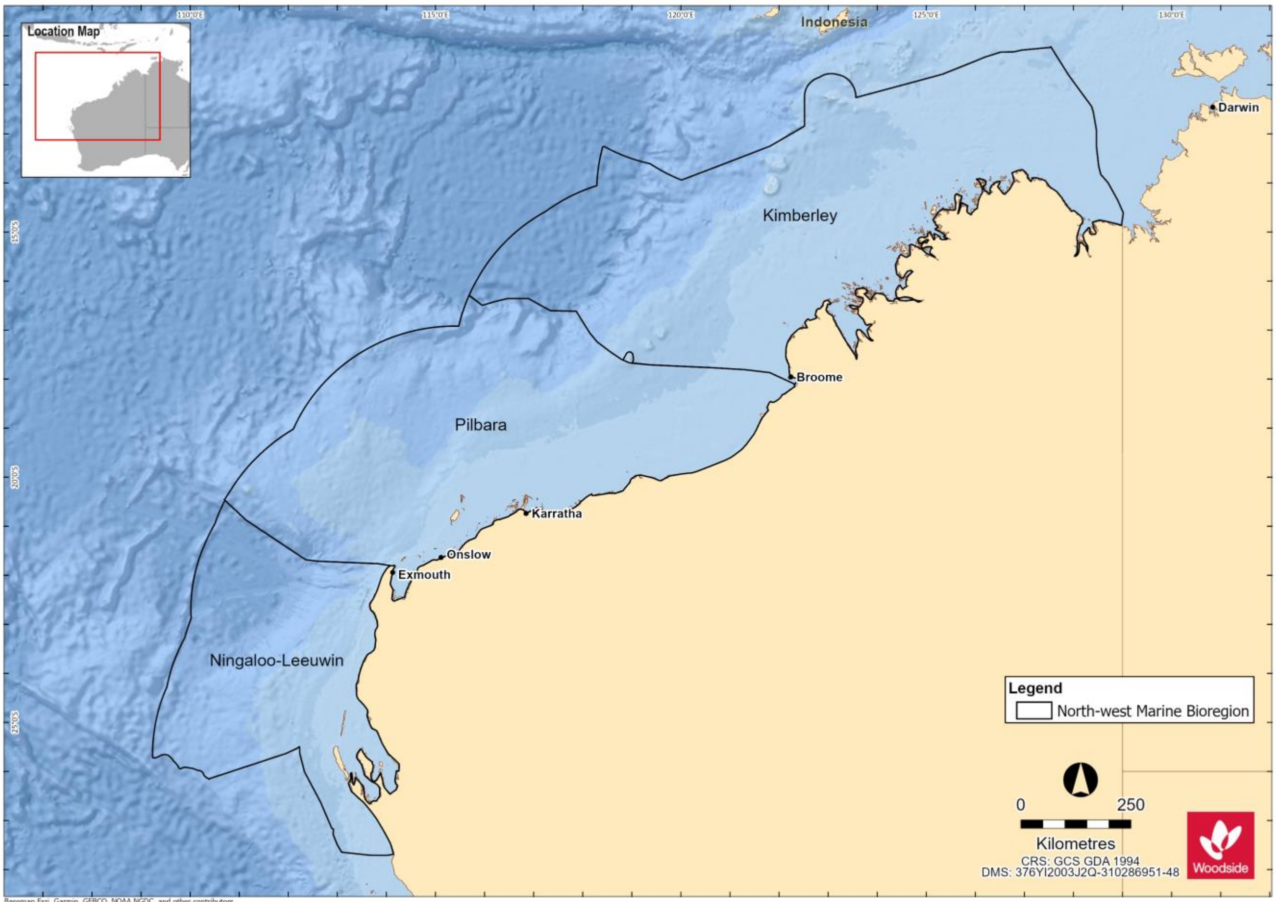

Figure 2-1. The marine systems of the North-west Marine Region (NWMR)

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Table 2-2. Key characteristics of the Marine Systems of the NWMR

Note: Woodside areas align with the marine systems as described in DEWHA (2007a)

Marine System	Woodside Activity Area	Key Characteristics
Kimberley	Browse	Tropical monsoonal climate Strong influence from Indonesian Throughflow Predominantly tropical Indo-Pacific species Subject to episodic offshore cyclonic activity, rarely crossing the coast Large tidal regimes Freshwater input from terrestrial monsoonal run-off Turbid coastal waters (i.e. light limited systems) Dominated by shelf environments Predominantly hard substrates in inner to mid-shelf environments Includes a number of shelf-edge atolls (i.e. Scott Reef, Rowley Shoals)
Pilbara	North-west Shelf (NWS) / Scarborough	Tropical arid climate Transition between Indonesian Throughflow and Leeuwin Current dominated areas Predominantly tropical species High cyclone activity with frequent crossing of the coast Transitional tidal zone Internal tide activity Large areas of shelf and slope Dry coast with ephemeral freshwater inputs
Ningaloo-Leeuwin	North-west Cape	Subtropical arid climate Leeuwin Current consolidates Transitional tropical/temperate faunal area Higher water clarity in near-shore and offshore environments Narrow shelf and slope Marginal tidal range Seasonal wind forcing more dominant influence on marine environment

2.3 Meteorology and Oceanography

This section describes the general meteorological conditions and oceanography for the NWMR and provides further detail for the three Woodside activity areas. The NWMR is influenced by a complex system of ocean currents that change between seasons and between years, which generally result in its surface waters being warm and nutrient-poor, and of low salinity (DEWHA, 2007a). The mix of bathymetric features, complex topography and oceanography across the whole north-west marine environment has created and supports a globally important marine biodiversity hotspot (Wilson, 2013).

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Table 2-3 NWMR climate and oceanography summary

Receptor	Description
Meteorology	
Seasonal patterns	The NWMR associated land mass of the Australian continent is characterised as a hot and humid summer climate zone. The broader NWMR experiences variations of a tropical or monsoon climate. In the far north-west (Kimberley), there is a hot summer season from December to March and a milder winter season between April and November. The Pilbara area is described as having a tropical arid climate with high cyclone activity (DEWHA, 2007a). The Pilbara and North-west Cape has a hot summer season from October to April and a milder winter season between May and September with transition periods between the summer and winter regimes.
Air temperature and rainfall	In summer (between September and March), maximum daily temperatures range from 31ºC to 33ºC. During winter (May to July), mean daily temperatures range from 18ºC to 31ºC (BOM[1]), refer to **Figure 2-2a** and **b**. Rainfall in the region typically occurs during the summer, with highest falls observed late in the season. This is often associated with the passage of tropical low-pressure systems and cyclones.
Wind	Wind patterns in north-west WA are dictated by the seasonal movement of atmospheric pressure systems. During summer, high-pressure cells produce prevailing winds from the north-west and south-west, which vary between 10 and 13 ms^{-1}. During winter, high-pressure cells over central Australia produce north-easterly to south-easterly winds with average speeds of between 6 and 8 ms^{-1}. Refer to **Figure 2-3a** and **b**.
Tropical cyclones	The NWS and Pilbara coast (within the NWMR) experiences more cyclonic activity than any other region of the Australian mainland coast (BOM, 2021a). Tropical cyclone activity typically occurs between November and April and is most frequent in the region during December to March (i.e. considered the peak period), with an average of about one cyclone per month (BOM, 2021a). Refer to **Figure 2-4**.
Oceanography	
Ocean temperature	Waters in NWMR are tropical year-round, with sea surface temperature in open shelf waters reaching ~26°C in summer and dropping to ~22°C in winter. Nearshore temperatures (as recorded for the NWS area) fluctuate more widely on an annual basis from ~17°C in winter to ~31°C in summer (Chevron Australia, 2010). Refer to **Figure 2-5a** and **b**.
Currents	The major surface currents influencing north-west WA flow towards the poles and include the Indonesian Throughflow, the Leeuwin Current, the South Equatorial Current, and the Eastern Gyral Current. The Ningaloo Current, the Holloway Current, the Shark Bay Outflow, and the Capes Current are seasonal surface currents in the region. Below these surface currents are several subsurface currents, the most important of which are the Leeuwin Undercurrent and the West Australian Current. These subsurface currents flow towards the equator in the opposite direction to surface currents (DEWHA, 2007a). Refer to **Figure 2-6**. The offshore waters of the NWMR are characterised by surface and subsurface boundary currents that flow along the continental shelf/slope and are enhanced through inflows from the ocean basins and are an important conduit for the poleward heat and mass transport along the west coast (Wijeratne *et al.*, 2018). Local physical oceanography is strongly influenced by the large-scale water movements of the Indonesian Throughflow (Liu *et al*. 2015; Sutton *et al*. 2019). Typically, a warm and well-mixed oligotrophic surface layer and a cooler and more nutrient rich, deeper water layer (Menezes *et al*. 2013).
Waves	Sea surface waves within the NWMR, generally reflect the direction of the synoptic winds and flow predominately from the south-west in the summer and east in winter (Pearce *et al.*, 2003). The NWS within the NWMR is a known area of internal wave generation. Both internal tides and internal waves are thought to be more prevalent during summer months due to the increased stratification of the water column (DEWHA, 2007a). Along the continental slope of the NWMR, strong internal waves and interaction between semi-diurnal tidal currents and seabed topographic features facilitates upwelling events and localised productivity events (Holloway, 2001).
Tides	Tides on the NWS (NWMR) increase as the water moves from deep towards the shallower coast. The highest offshore tides are experienced at the border of the Browse and Canning basins. The smallest tides are experienced at the Exmouth Plateau, near the coast. Tides of NWS (NWMR) are predominantly semi-diurnal (two highs and two lows each day), but with increasing importance of the diurnal (once per day) inequality at the southern and northern extremities of the NWS.

[1] http://www.bom.gov.au/jsp/ncc/climate_averages/temperature/index.jsp, accessed 21 January 2021.

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Receptor	Description
	The tide range—represented by the Mean Spring Range (MSR)—increases northwards along the coast from 1.4 m at North-west Cape (Point Murat) to 7.7 m at Broome, before decreasing again (apart from local amplification in King Sound and Collier Bay) to about 5 m off Cape Londonderry. The MSR then increases again through Joseph Bonaparte Gulf and on up 5.5 m at Darwin (RPS, 2016).

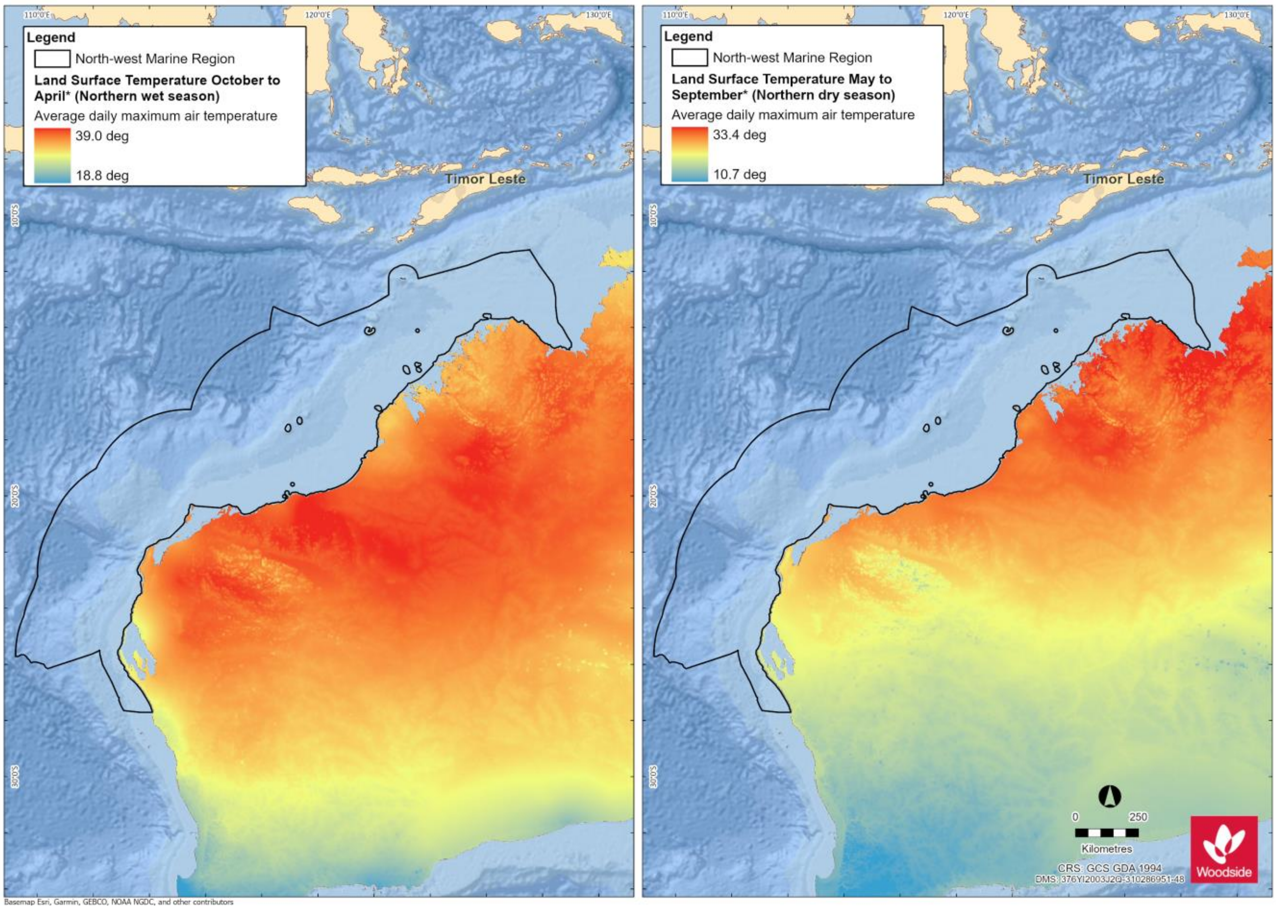

Figure 2-2. Average daily maximum air temperature for land surface adjacent to NWMR: (a) summer (northern wet season) and (b) winter (northern dry season)

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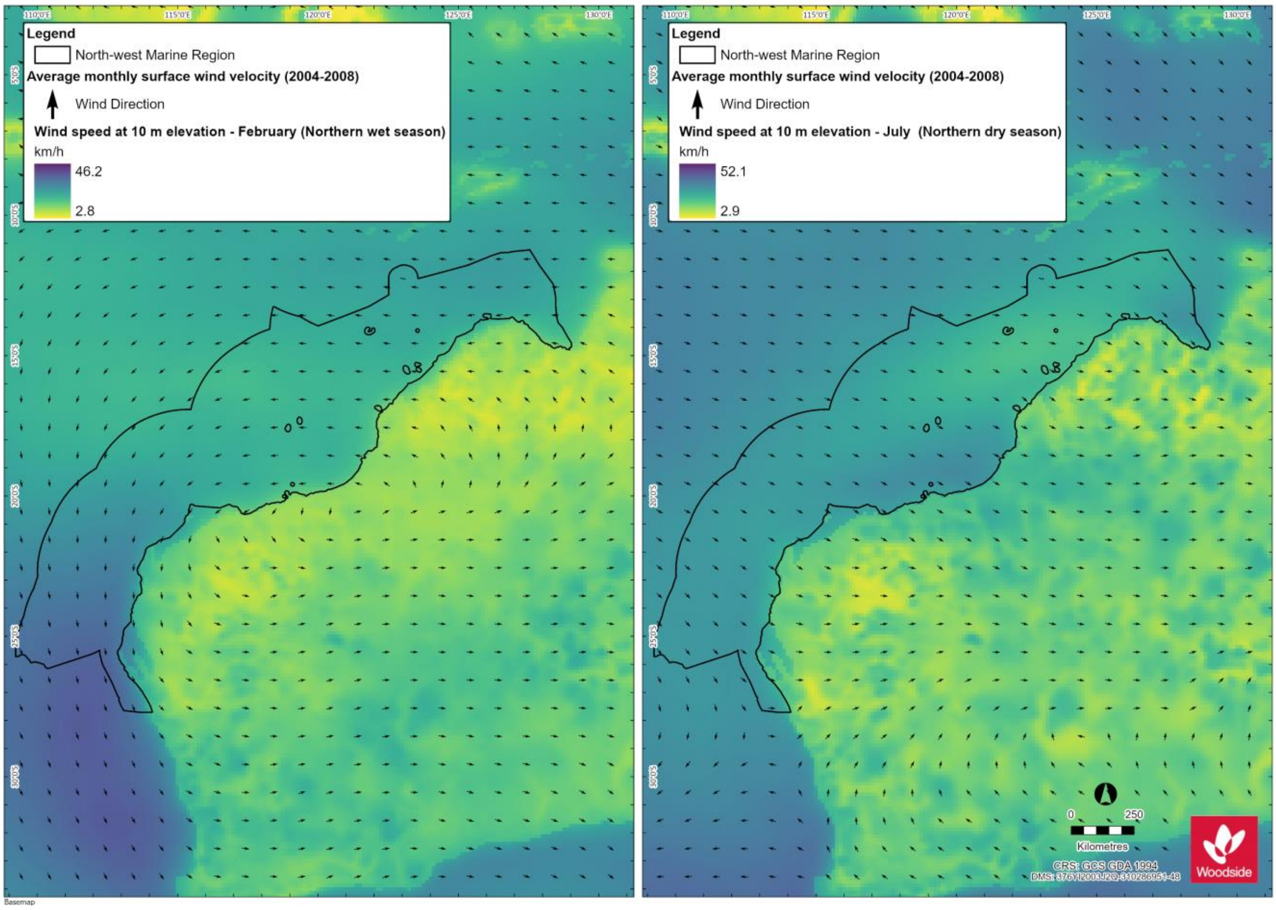

Figure 2-3. Average monthly surface wind direction and velocity for NWMR: (a) summer (February, northern wet season) and (b) winter (July, northern dry season)

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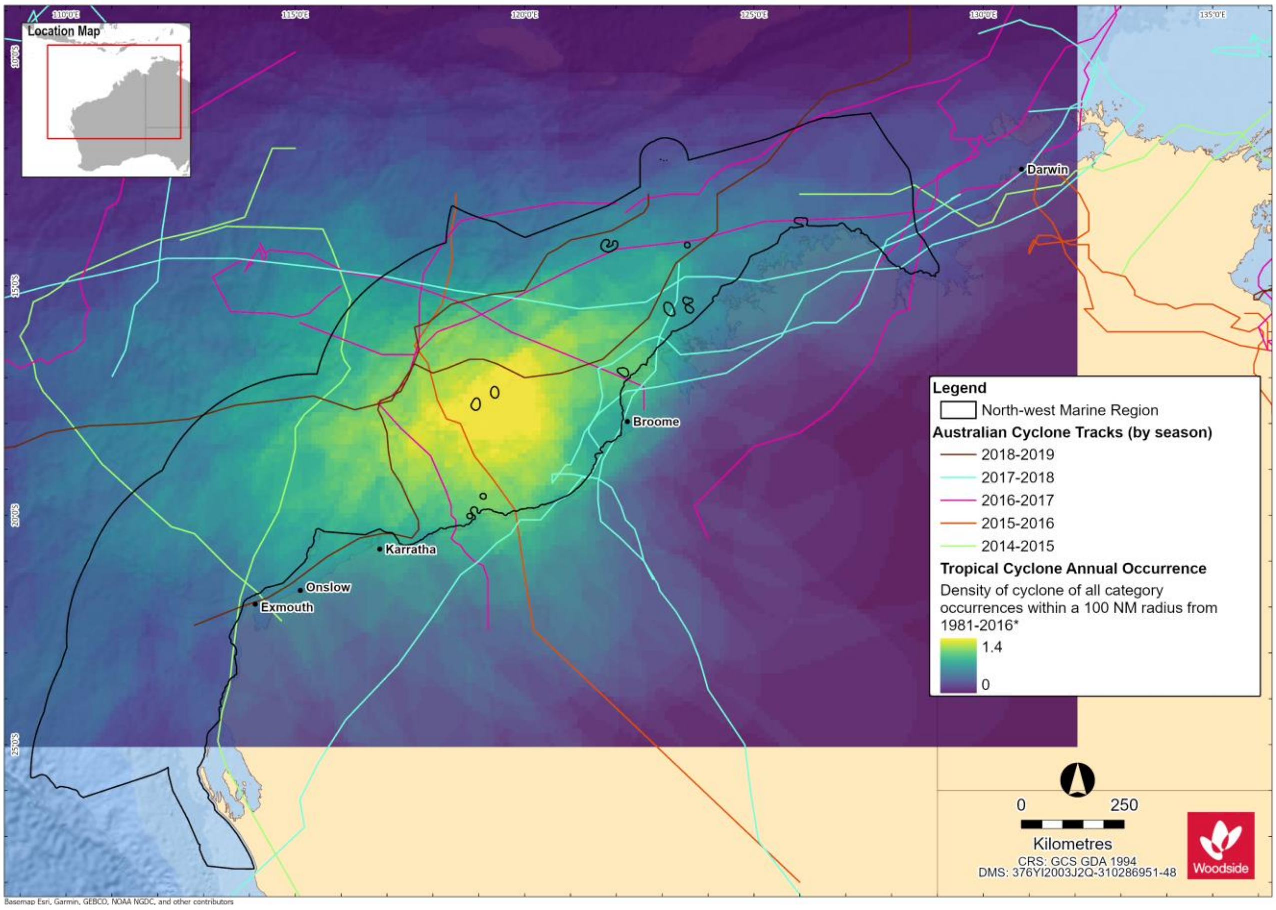

Figure 2-4. Tropical cyclone annual occurrence and cyclone tracks for NWMR

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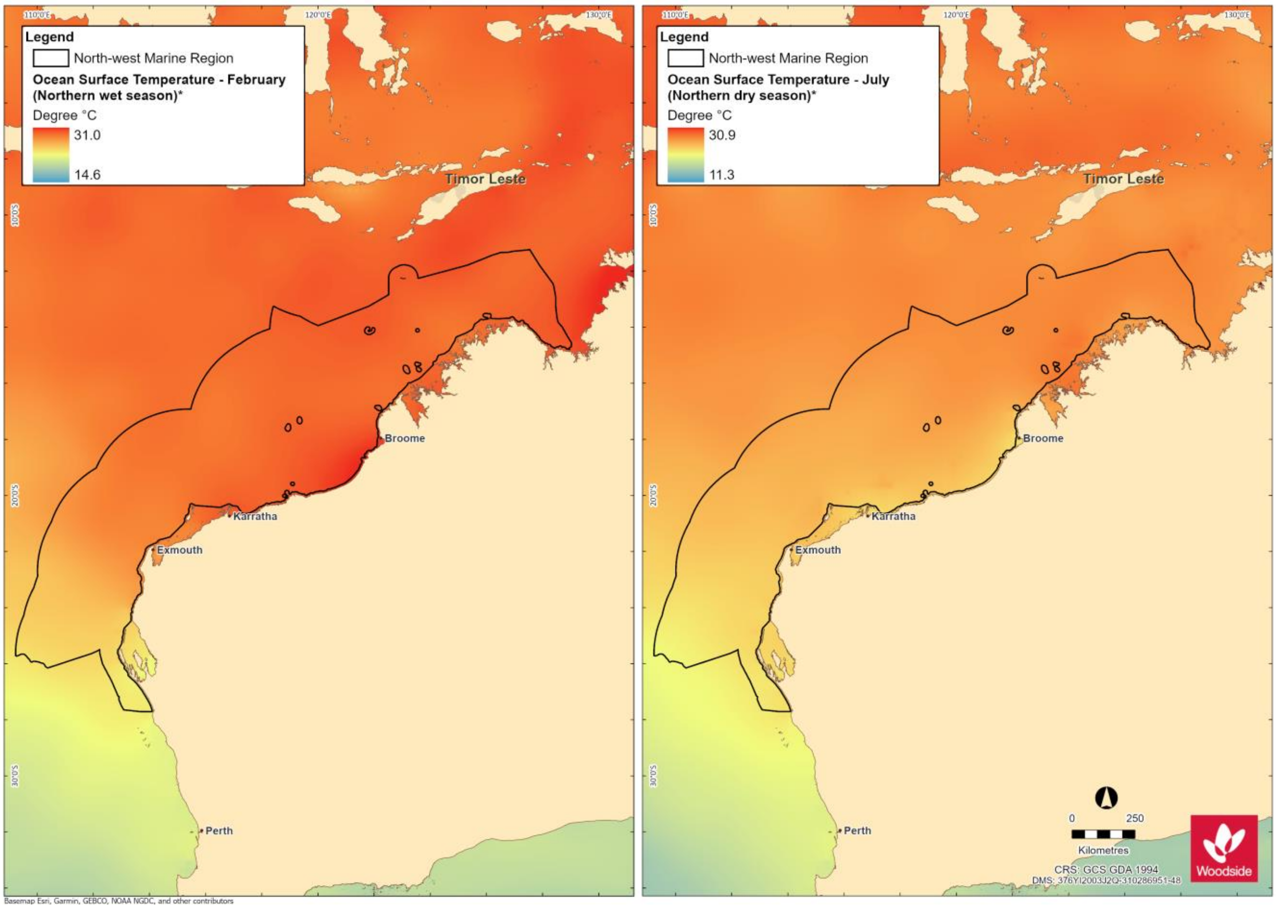

Figure 2-5. Ocean surface temperature for NWMR: (a) summer (February, northern wet season) and (b) winter (July, northern dry season)

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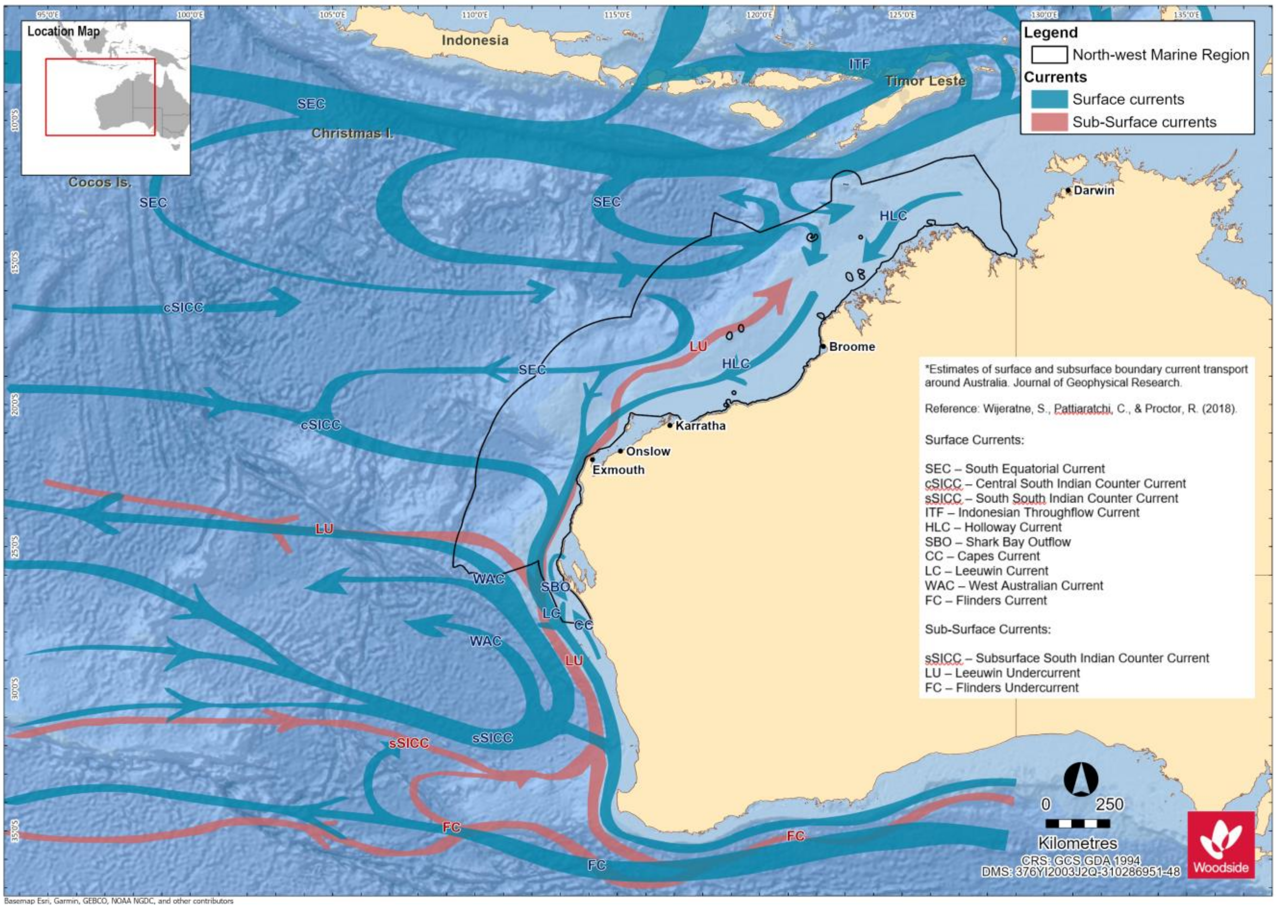

Figure 2-6. Ocean surface and sub-surface currents of the NWMR and wider region

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2.3.1 Browse

Table 2-4 Summary meteorology and oceanography for Browse (refer to Appendix B for supporting metocean figures)

Receptor	Description
Meteorology	
Seasonal patterns	The Browse area overlapping the Kimberley marine system experiences tropical monsoon climate with two distinct seasons: the wet season from December to March and dry season from April to November.
Air temperature	The mean annual air temperature recorded at Troughton Island between 2010 and 2020 ranged from 30.1ºC in 2011 to 32.6ºC in 2016 and highest mean monthly air temperatures were recorded for the months of November and December (BOM, 2021b).
Rainfall	Rainfall recorded from Troughton Island in the Browse basin ranged from barely detectable (<1 mm) mean monthly level to >100 mm in December to March, with the highest rainfall recorded for January. Reflecting the wet monsoon season of the Kimberley marine system (BOM, 2021c).
Wind	The dry season experiences high pressure systems that bring east to south-easterly winds with average wind speeds during the season of approximately 16.6 km/hr and maximum wind gusts of 65 km/hr. In contrast the wet season brings predominately westerly winds with average wind speeds approximately 17 km/hr and maximum gusts exceeding 100 km/hr (generally associated with tropical cyclones (MetOcean Engineers, 2005).
Oceanography	
Currents	Surface currents exhibit seasonal directionality, with flow to the south-west during March to June and more variable outside this period (Woodside, 2019). This is consistent with the stronger Leeuwin Current flow during winter months, with more variable currents driven by local wind stress during periods of weaker Leeuwin Current flow.

2.3.2 North West Shelf / Scarborough

Table 2-5 Summary meteorology and oceanography for the North West Shelf and Scarborough (refer to Appendix B for supporting metocean figures)

Receptor	Description
Meteorology	
Seasonal patterns	The NWS and Scarborough areas experience the monsoonal climate of the wider NWMR with a distinct wet and dry seasonal regime and transitions periods between seasons.
Air temperature	Air temperatures as measured at the North Rankin A platform on NWS ranged from a maximum average of 39.5ºC in summer to a minimum average temperature of 15.6ºC in winter (Woodside, 2012).
Rainfall	Rainfall patterns annually reveal the wet season with highest rainfalls during the late summer, often associated with the passage of tropical low-pressure systems and cyclones. Rainfall in the dry season is typically extremely low. (Pearce *et al.* 2003).
Wind	Winds are typically from the southwest during the wet season (summer) and tending from the south-east during the dry season (winter). The summer south-westerly winds are driven by high pressure cells that pass from west to east over the Australian continent. During the winter period, the relative position of the high-pressure cells shifts further north, leading to prevailing south-easterly winds from the mainland (Pearce *et al.* 2003).
Oceanography	
Currents	The large-scale ocean currents of the NWMR, primarily the Indonesian Throughflow and Leeuwin Current (and Holloway Current), are the primary influence on the NWS and Scarborough areas. The ITF and Leeuwin Current are strongest during the late summer and winter and flow reversals to the north-east, typically short-lived and weak, when there are strong south-westerly winds can generate localised upwelling on the shelf edge (Holloway and Nye, 1985; James *et al.* 2004 and Condie *et al.* 2006).

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2.3.3 North-west Cape

Table 2-6 Summary meteorology and oceanography for the North-west Cape (refer to Appendix B for supporting metocean figures)

Receptor	Description
Meteorology	
Seasonal patterns	The climate of the NWMR is dry tropical exhibiting a hot summer season and a mild winter season. There are often distinct transition periods between the summer and winter regimes, characterised by periods of relatively low winds.
Air temperature	Air temperatures in the North-west Cape area range from high summer temperatures (maximum average of 37.5ºC) and mild winter temperatures (minimum average of 12.2ºC).
Rainfall	Rainfall typically occurs during the summer, with highest rainfall during later summer and autumn, often associated with the passage of tropical low-pressure systems and cyclones. Rainfall is typically low in winter.
Wind	Winds vary seasonally, generally from the south-west quadrant during summer months and the south, south-east quadrant during the autumn and winter months. The summer south-westerly winds are driven by high pressure cells that pass from west to east over the Australian continent. Winds typically weaken and are more variable during the transitional period between the summer and winter seasons, generally between April to August.
Oceanography	
Currents	Surface currents exhibit seasonal directionality, with flow to the south-west during March to June and more variable outside this period (Woodside, 2016). This is consistent with the stronger Leeuwin Current flow during winter months, with more variable currents driven by local wind stress during periods of weaker Leeuwin Current flow.

2.4 Physical Environment of NWMR

Based on the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) Version 4.0, there are eight provincial bioregions that occur within the NWMR, which are based on patterns of demersal fish diversity, benthic habitat and oceanographic data (Commonwealth of Australia, 2006), **Figure 2-7**. Of the eight provincial bioregions that occur within the NWMR, these include four offshore (~65% of total NWMR area) and four shelf (~35% of total NWMR area) bioregions (Baker *et al.,* 2008).

The NWMR is a tropical carbonate margin that comprises an extensive area of shelf, slope and abyssal plain/deep ocean floor, as well as complex areas of bathymetry such as plateau, terraces and major canyons (Harris *et al.*, 2005). A series of reefs are located on the outer shelf/slope of the NWMR, including Ashmore, Cartier, Scott and Seringapatam reefs (Baker *et al*., 2008). The distribution of seafloor geomorphic features has been systematically mapped over much of the Australian margin and adjacent seafloor. The mapped area can be divided into 10 geomorphic regions, of which the NWMR overlays two; the Western Margin and Northern Margin (Harris *et al.*, 2005). Most of the region consists of either continental slope (61%) or continental shelf (28%) (DEWHA, 2007a) with more than 40% of the NWMR having a water depth less than 200 m. The shallow shelf is contrasted by features such as the Cuvier and Argo abyssal plains, which reach depths more than five kilometres. A unique feature of the region is the significant narrowing of the continental shelf around North-west Cape (approximately 7 km wide) from the broad continental shelf in the north of the region (approximately 400 km wide at Joseph Bonaparte Gulf) (DEWHA, 2007a), **Figure 2-8.**

The geological history of the region, as well as its geomorphology and oceanography, has influenced the composition and distribution of sediments (DEWHA, 2007a). The sedimentology of the NWMR is dominated by marine carbonates, which show a broad zoning and fining with water depth. Main trends of the NWMR sediments include a tropical carbonate shelf that is dominated by sand and gravel, an outer shelf/slope zone that is dominated by mud and a relatively homogenous rise and abyssal plain/deep ocean floor that is dominated by non-carbonate mud (Baker *et al.,* 2008), **Figure 2-9**.

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The distribution and resuspension of sediments on the inner shelf is strongly influenced by the strength of tides across the continental shelf as well as episodic events such as cyclones. Further offshore, on the mid to outer shelf and on the slope itself, sediment movement is primarily influenced by ocean currents and internal tides (DEWHA, 2007a).

This variation in bathymetry and interactions with oceanographic processes provides a diversity of habitats to marine fauna and flora within the NWMR.

2.5 Air quality

The ambient air quality of all three marine regions is largely unpolluted due to the extent of the open ocean area, the activities currently carried out in each and the relative remoteness of each region.

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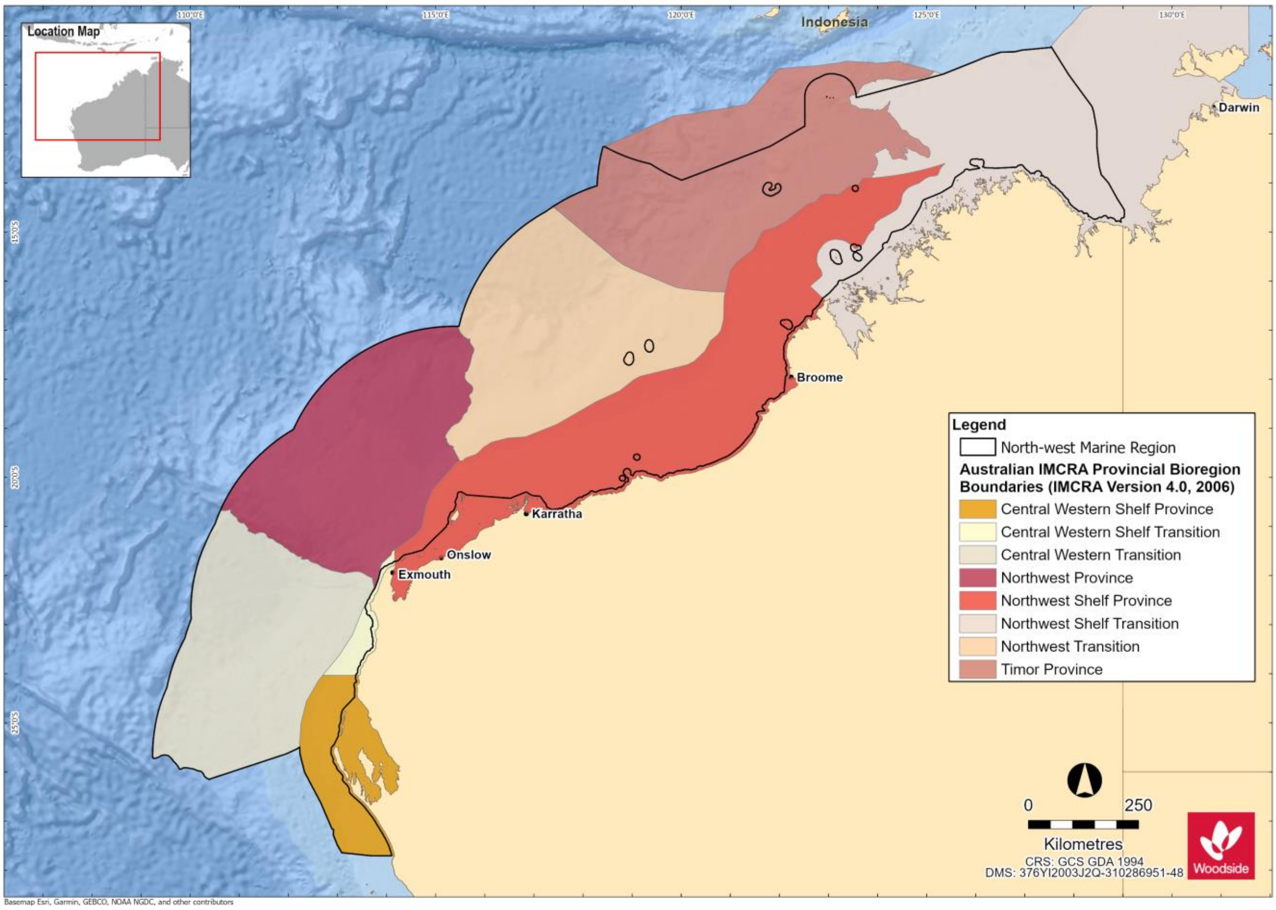

Figure 2-7. The eight provincial bioregions of the NWMR (Commonwealth of Australia, 2006)

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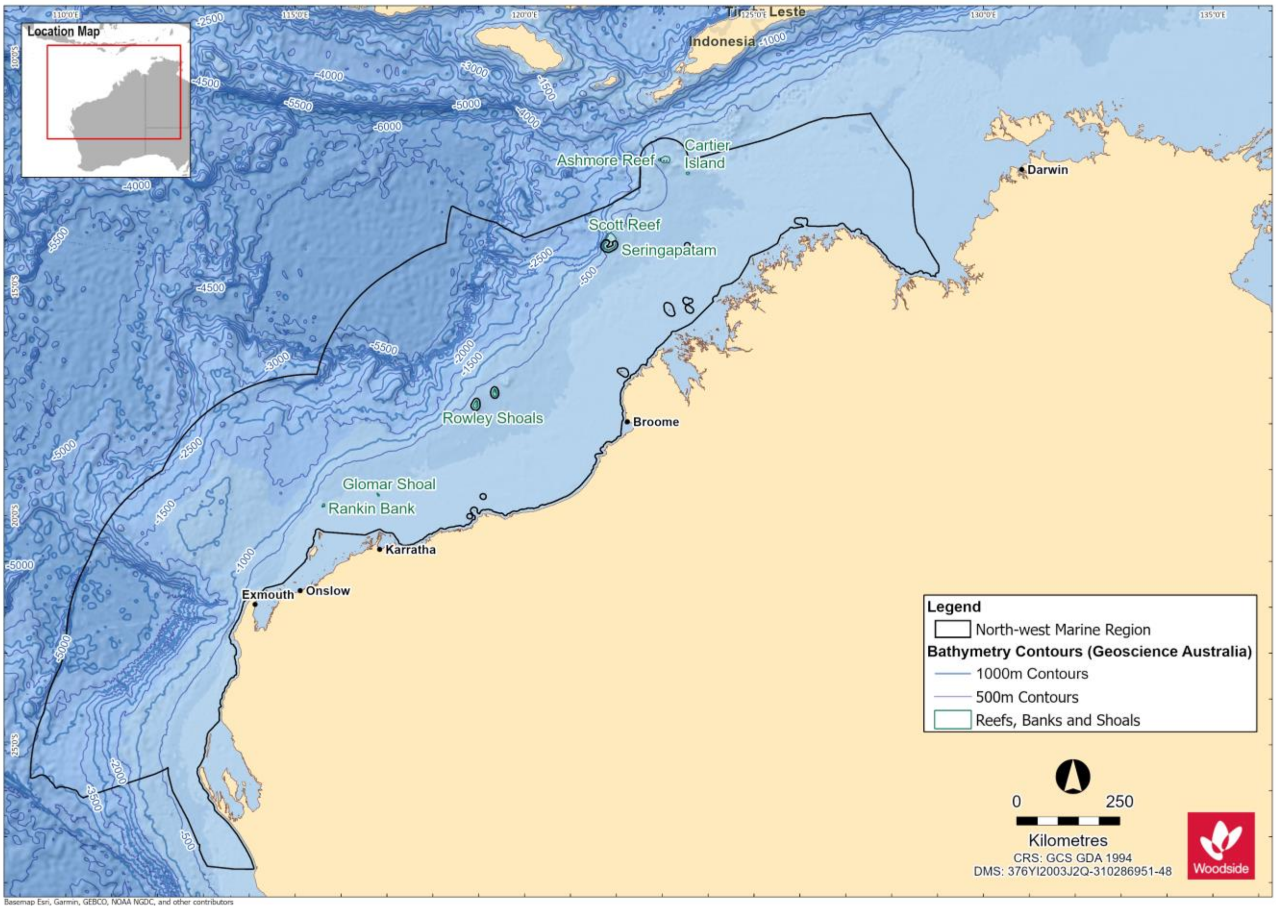

Figure 2-8. Bathymetry of the NWMR

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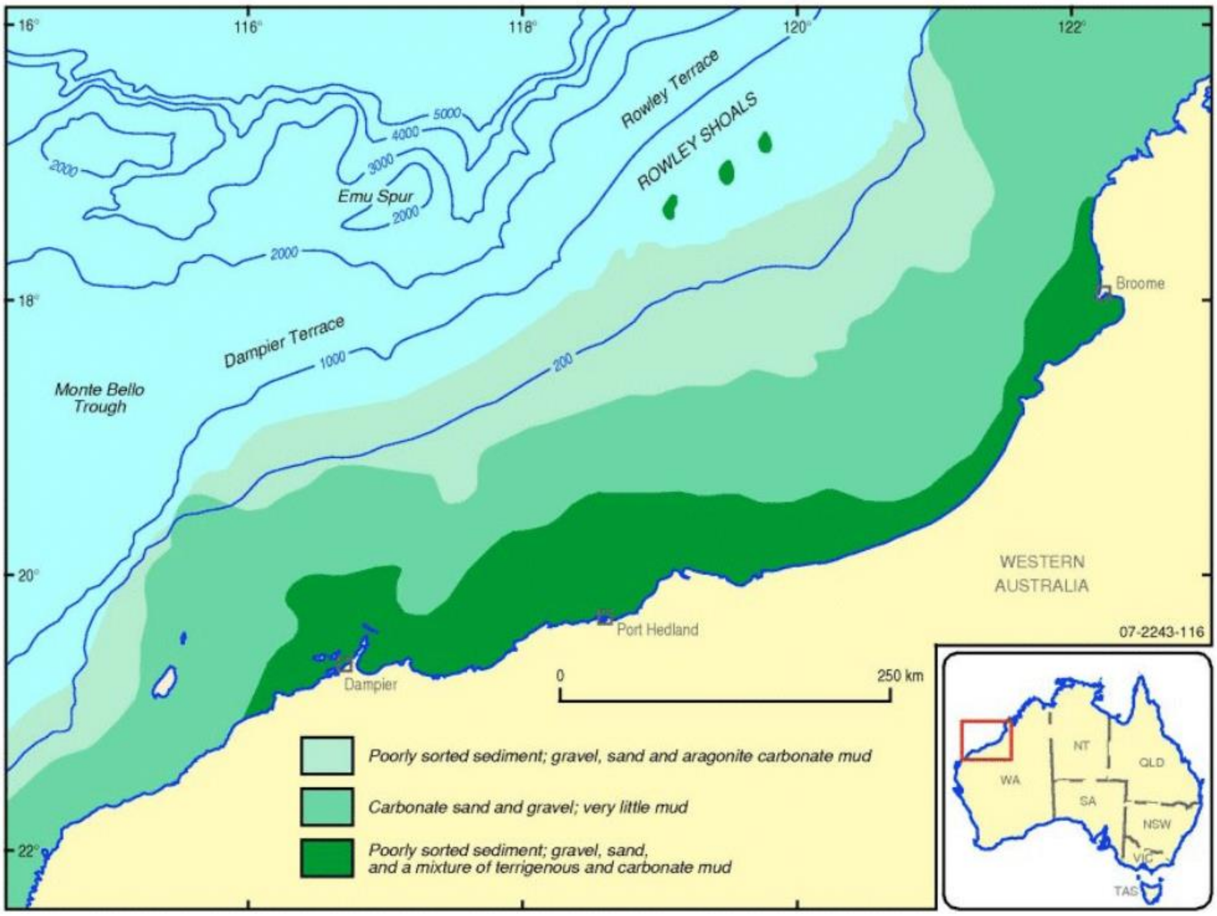

Figure 2-9. Overview of the seabed sediments of the NWMR (Baker *et al*., 2008)

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3. MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE (EPBC ACT)

3.1 Summary of Matters of National Environmental Significance (MNES)

This section summarises the matters of national environmental significance (MNES) reported for the three bioregions; NWMR **(Table 3-1**), SWMR (**Table 3-2**) and NMR (**Table 3-3**), based on the Protected Matters search reports (**Appendix A**).

Additional information on these MNES are provided in subsequent sections (referenced below).

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Table 3-1 Summary of MNES identified by the EPBC Act Protected Matters Search Tool (PMST) as potentially occurring within the NWMR

MNES	Number	Description	Section of this Document
World Heritage Properties	2	Shark Bay The Ningaloo Coast	**Section 10**
National Heritage Places	5	Shark Bay The Ningaloo Coast The West Kimberley The Dampier Archipelago (including Burrup Peninsula) Dirk Hartog Landing Site 1616	**Section 10**
Wetlands of International Importance (Ramsar)	3	Ashmore Reef National Nature Reserve Eighty Mile Beach Roebuck Bay[1]	**Section 10**
Commonwealth Marine Area	2	EEZ and Territorial Sea Key Ecological Features (KEFs) Australian Marine Parks (AMPs) Australian Whale Sanctuary Extended Continental Shelf	**Section 9** **Section 10**
Listed Threatened Ecological Communities	1	Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Terrestrial community and not considered further
Listed Threatened Species	70	Refer NWMR PMST report (**Appendix A**)	**Section 5 – Section 8**
Listed Migratory Species	84	Refer NWMR PMST report (**Appendix A**)	**Section 5 – Section 8**

*[1] Roebuck Bay is a designated Wetland of International Importance (Ramsar site), which was not included in the PMST Report (**Appendix A**).*

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Table 3-2 Summary of MNES identified by the EPBC Act Protected Matters Search Tool (PMST) as potentially occurring within the SWMR

MNES	Number	Description	Section of this Document
World Heritage Properties	0	N/A	N/A
National Heritage Places	3	Cheetup Rock Shelter Batavia Shipwreck Site and Survivor Camps Area 1629 – Houtman Abrolhos HMAS Sydney II and HSK Kormoran Shipwreck Sites	**Section 10**
Wetlands of International Importance (Ramsar)	4	Becher Point Wetlands Forrestdale and Thomsons Lakes Peel-Yalgorup System Vasse-Wonnerup System	**Section 10**
Commonwealth Marine Area	2	EEZ and Territorial Sea KEFs AMPs Australian Whale Sanctuary Extended Continental Shelf	**Section 9** **Section 10**
Listed Threatened Ecological Communities	3	Banksia Woodlands of the Swan Coastal Plain ecological community Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community	Terrestrial communities and not considered further
Listed Threatened Species	65	Refer SWMR PMST report (**Appendix A**)	N/A
Listed Migratory Species	67	Refer SWMR PMST report (**Appendix A**)	N/A

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Table 3-3 Summary of MNES identified by the EPBC Act Protected Matters Search Tool (PMST) as potentially occurring within the NMR

MNES	Number	Description	Section of this Document
World Heritage Properties	0	N/A	N/A
National Heritage Places	0	N/A	N/A
Wetlands of International Importance (Ramsar)	0	N/A	N/A
Commonwealth Marine Area	2	EEZ and Territorial Sea KEFs AMPs Australian Whale Sanctuary Extended Continental Shelf	**Section 9** **Section 10**
Listed Threatened Ecological Communities	0	N/A	N/A
Listed Threatened Species	33	Refer NMR PMST report (**Appendix A**)	N/A
Listed Migratory Species	70	Refer NMR PMST report (**Appendix A**)	N/A

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3.2 Part 13 Statutory Instruments for EPBC Act Listed Threatened and Migratory Species in the NWMR, SWMR and NMR

A screening process was conducted to identify which EPBC Act listed threatened and migratory species, and associated Part 13 statutory instruments, are relevant in the context of the assessment of impacts and risks associated with petroleum activities in each of the Woodside activity areas, using the following criteria:

- overlap between the Woodside activity areas with habitat critical for the survival of marine turtles, and with BIAs (overlapping the marine environment) for any listed threatened species as reported in the PMST searches;
- published literature, unpublished reports and/or credible anecdotal information (e.g. feedback from stakeholders) indicating species presence/occurrence within the Woodside activity areas;
- temporal overlap between the likely timing of petroleum activities and peak periods for key behaviours (e.g. breeding, nesting, calving, resting, foraging, migration); and
- environmental aspects associated with petroleum activities have been identified as a key threat to a species in a Part 13 statutory instrument (e.g. anthropogenic noise, light emissions, marine debris).

Relevant EPBC Act threatened and migratory species and their Part 13 statutory instruments are listed in **Table 3-4**. For the full list of EPBCA Act listed species for each marine bioregion refer to the PMST reports (**Appendix A**).

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Table 3-4 Summary of MNES identified by the EPBC Act Protected Matters Search Tool (PMST) to be considered for impact or risk evaluation for Woodside operations

Species	EPBC Act Part 13 Statutory Instrument
All vertebrate marine fauna	Threat Abatement Plan for the impacts of marine debris on vertebrate marine life (Commonwealth of Australia, 2018)
Marine Mammals	
Blue whale	Conservation Management Plan for the Blue Whale: A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2015–2025 (Commonwealth of Australia, 2015a)
Southern right whale	Conservation Management Plan for the Southern Right Whale: A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2011–2021 (DSEWPAC, 2012d)
Sei whale	Conservation Advice *Balaenoptera borealis* sei whale (Threatened Species Scientific Committee, 2015a)
Humpback whale	Conservation Advice *Megaptera novaeangliae* humpback whale (Threatened Species Scientific Committee, 2015b)
Fin whale	Conservation Advice *Balaenoptera physalus* fin whale (Threatened Species Scientific Committee, 2015c)
Australian sea lion	Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) 2013 (DSEWPAC, 2013a) (due to expire in October 2023) Conservation Advice *Neophoca cinerea* Australian Sea Lion (Threatened Species Scientific Committee, 2020a) (in effect under the EPBC Act from 23-Dec-2020)
Marine Reptiles	
All marine turtle species (loggerhead, green, leatherback, hawksbill, flatback, olive ridley)	Recovery Plan for Marine Turtles in Australia 2017-2027 (Commonwealth of Australia, 2017)
Short-nosed sea snake	Approved Conservation Advice for *Aipysurus apraefrontalis* (Short-nosed Sea Snake) (DSEWPAC, 2011a)
Leaf-scaled sea snake	Approved Conservation Advice for *Aipysurus foliosquama* (Leaf-scaled Sea Snake) (DSEWPAC, 2011b)
Fishes, Sharks, Rays and Sawfishes	
Grey nurse shark (west coast population)	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) 2014 (DOE, 2014)
White shark	Recovery Plan for the White Shark (*Carcharodon carcharias*) 2013 (DSEWPAC, 2013b)
Whale shark	Conservation Advice *Rhincodon typus* whale shark (Threatened Species Scientific Committee, 2015d)
All sawfishes (largetooth, green, dwarf, speartooth, narrow)	Sawfish and River Sharks Multispecies Recovery Plan (Commonwealth of Australia, 2015b)

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Species	EPBC Act Part 13 Statutory Instrument
Seabirds	
Migratory seabird species	Draft Wildlife Conservation Plan for Migratory Seabirds (Commonwealth of Australia, 2019)
Southern giant petrel	National recovery plan for threatened albatrosses and giant petrels 2011–2016 (DSEWPAC, 2011c)
Indian yellow-nosed albatross	National recovery plan for threatened albatrosses and giant petrels 2011–2016 (DSEWPAC, 2011c)
Abbott's booby	Conservation Advice for the Abbott's booby - *Papasula abbotti* (Threatened Species Scientific Committee, 2020b)
Australian fairy tern	Approved Conservation Advice for *Sterna nereis nereis* (Fairy Tern) (DSEWPAC, 2011d)
Australian lesser noddy	Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy (Threatened Species Scientific Committee, 2015e)
Soft-plumaged petrel	Conservation Advice *Pterodroma mollis* soft-plumaged petrel (Threatened Species Scientific Committee, 2015f)
Shorebirds	
Migratory shorebird species	Wildlife Conservation Plan for Migratory Shorebirds (Commonwealth of Australia, 2015c)
Eastern curlew, far eastern curlew	Conservation Advice *Numenius madagascariensis* eastern curlew (DOE, 2015a)
Curlew sandpiper	Conservation Advice *Calidris ferruginea* curlew sandpiper (DOE, 2015b)
Great knot	Conservation Advice *Calidris tenuirostris* Great knot (Threatened Species Scientific Committee, 2016a)
Red knot, knot	Conservation Advice *Calidris canutus* Red knot (Threatened Species Scientific Committee, 2016b)
Bar-tailed godwit (*menzbieri*)	Conservation Advice *Limosa lapponica menzbieri* Bar-tailed godwit (northern Siberia) (Threatened Species Scientific Committee, 2016c)
Greater sand plover	Conservation Advice *Charadrius leschenaultii* Greater sand plover (Threatened Species Scientific Committee, 2016d)
Lesser sand plover	Conservation Advice *Charadrius mongolus* Lesser sand plover (Threatened Species Scientific Committee, 2016e)

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4. HABITAT AND BIOLOGICAL COMMUNITIES

4.1 Regional context

The NWMR habitats range from nearshore benthic primary producer habitats such as seagrass beds, coral communities and mangrove forests, to offshore soft sediment seabed habitats and submerged and emergent reef systems. These habitats support biological communities that range from low density sessile and mobile benthos, such as sponges, molluscs and echinoids (with noted areas of sponge hotspot diversity) in offshore soft sediment habitat (DSEWPAC, 2012a) to complex, diverse, remote coral reef systems.

Benthic primary producer habitats, such as seagrass beds, coral communities and mangrove forests within the SWMR, are described as a mixture of tropical and temperate species, due to the seasonal influences of the tropical waters carried south by the Leeuwin Current and the temperate waters carried north by the Capes Current (DSEWPAC, 2012b).

The NMR shares similar habitat types to the NWMR. The predominant habitat of the region includes soft muddy sediments on relatively flat terrain. Other habitat types include seagrasses, reefs, shoals and coastal habitats such as mangroves and coastal wetlands (Rochester *et al.*, 2007).

The summary of key habitats and biological communities provided in the following sub-sections is focused on the primary features of relevance to the activity areas within the NWMR – primarily the offshore habitats of the continental shelf and slope, submerged shoals and banks, and remote oceanic reef systems of recognised conservation value.

4.2 Biological Productivity of NWMR

Primary productivity of the NWMR is generally low and 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. Seasonal weather patterns also influence the delivery of nutrients from deep-water to shallow water. Cyclones and north-westerly winds during the North-west monsoon (approximately November–March) and the strong offshore winds of the South-east monsoon (approximately April–September) facilitate the upwelling and mixing of nutrients from deep-water to shallow water environments (Brewer *et al.*, 2007).

The Indonesian Throughflow (ITF) has an important effect on productivity in the northern areas of the Region. Generally, its deep, warm and low nutrient waters suppress upwelling of deeper comparatively nutrient-rich waters, thereby forcing the highest rates of primary productivity to occur at depths associated with the thermocline. When the ITF is weaker, the thermocline lifts bringing deeper, more nutrient-rich waters into the photic zone and hence resulting in conditions favourable to increased productivity (DEWHA, 2007a). Similarly, the Leeuwin Current has a significant role in determining primary productivity in the southern areas of the NWMR. As with the ITF, the overlying warm oligotrophic waters of the Leeuwin Current suppress upwelling. A subsurface chlorophyll maximum is therefore formed at a depth in the water column where nutrients and light are sufficient for photosynthesis to proceed. Seasonal changes in the strength of the Leeuwin Current influence primary productivity levels and seasonal interactions between the Leeuwin and Ningaloo currents in the south of the NWMR are believed to be particularly important (DEWHA, 2007a).

Internal tides (defined as internal waves generated by the barotropic tide) are a striking characteristic of many parts of the NWMR and are associated with highly stratified water columns. Internal waves (solitons), which can raise cooler, generally more nutrient rich water higher in the water column, are generated between water depths of 400 m and 1000 m where bottom topography results in a significant change in water depth over a relatively short distance. Cyclones are episodic events in the NWMR that contribute to spikes in productivity through enrichment of surface water layers due to enhanced vertical mixing of the water column. Temporary increases in primary productivity as a result of cyclones generally last between one and two weeks, and it is believed that the impacts of

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cyclones are generally limited to waters less than 100 m deep and affect benthic communities more substantially than pelagic systems (DEWHA, 2007a).

Water depth also has a significant overriding influence over productivity in the marine environment, due to its influence on light availability. This is reflected by distinct onshore and offshore assemblages of major pelagic groups of phytoplankton, microzooplankton, mesoplankton and ichthyoplankton. Productivity booms are thought to be triggered by seasonal changes to physical drivers or episodic events, as detailed above, which result in rapid increases in primary production over short periods, followed by extended periods of lower primary production. The trophic systems in the NWMR are able to take advantage of blooms in primary production, enabling nutrients generated to be used by different groups of consumers over long periods (DEWHA, 2007a).

Little detailed information is available about the trophic systems in the NWMR. The utilisation of available nutrients is thought to differ between pelagic and benthic environments, influenced by water depth and vertical migration of some species groups in the water column. In the pelagic system, it is thought that approximately half of the nutrients available are utilised by microzooplankton (e.g. protozoa) with the remainder going to macro/meso-zooplankton (e.g. copepods). As primary and secondary consumers, gelatinous zooplankton (e.g. salps, coelenterates) and jellyfish are thought to play an important role in the food web, contributing a significant proportion of biomass in the marine system during and for periods after booms in primary productivity. Salps are semi-transparent, barrel-shaped marine animals that can reproduce quickly in response to bursts in primary productivity and provide a food source for many pelagic fish species (DEWHA, 2007a).

4.3 Planktonic Communities in the NWMR

The NWMR has two distinct phytoplankton assemblages; a tropical oceanic community in offshore waters and a tropical shelf community confined to the NWS (Hallegraeff, 1995). MODIS (Moderate Resolution Imaging Spectrometer) satellite datasets from the NWMR indicates that chlorophyll (and thus phytoplankton) levels are low in summer months (December to March) and higher in the winter months (Schroeder *et al.*, 2009). Low chlorophyll levels during summer months may be a result of lower plankton productivity during the wet season or lower nutrient inputs from warm surface waters dominant during summer. However, it is likely that much of the primary production is taking place below the surface, where the MODIS imagery does not penetrate (Schroeder *et al.*, 2009). The winter months are relatively cloud free and surface chlorophyll is high throughout most of the region.

Zooplankton and may include organisms that complete their lifecycle as plankton (e.g. copepods, euphausiids) as well as larval stages of other taxa such as fishes, corals and molluscs. Peaks in zooplankton such as mass coral spawning events (typically in March and April) (Rosser and Gilmour, 2008) and fish larvae abundance (CALM, 2005a) can occur throughout the year. Spatial and temporal patterns in the distribution and abundance of macro-zooplankton on the North-west Shelf are influenced by sporadic climatic and oceanographic events, with large inter-annual changes in assemblages (Wilson *et al.*, 2003). Amphipods, euphausiids, copepods, mysids and cumaceans are among the most common components of the zooplankton in the region (Wilson *et al.*, 2003).

4.3.1 Browse

Phytoplankton within the Browse activity area is expected to reflect the conditions of the NWMR. 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).

Zooplankton within the activity area may include organisms that complete their lifecycle as plankton (e.g. copepods, euphausiids) as well as larval stages of other taxa such as fishes, corals and molluscs. Peaks in zooplankton such as mass coral spawning events (typically in March and April) (Rosser and Gilmour, 2008; Simpson *et al.*, 1993) and fish larvae abundance (CALM, 2005a) can occur throughout the year.

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The influence of the Indonesian Throughflow restricts upwelling across the Kimberley System (approximately equates to the Browse activity area). However, small-scale topographically associated current movements and upwellings are thought to occur, which inject nutrients into specific locations within the system and result in ‘productivity hot-spots’. Similarly, internal waves, generated at the shelf break (e.g. west of Browse Island and around submerged cliffs) play a role in making nutrients available in the photic zone. Productivity within shallow nearshore waters is driven primarily by tidal movement and terrestrial runoff whereby nutrients are mixed by tidal action and new inputs of organic matter come from the land.

4.3.2 North-west Shelf / Scarborough

Plankton communities within the NWS / Scarborough activity area are expected to reflect conditions of the NWMR. Within the Pilbara system of the NWMR (approximately equates to the NWS / Scarborough activity area). Internal tides along the NWS and Exmouth Plateau result in the drawing of deeper cooler waters into the photic zone, stirring up nutrients and triggering primary productivity. Broadly the greatest productivity within this sub-system is found around the 200 m isobath associated with the shelf break.

4.3.3 North-west Cape

Waters of the North-west Cape experience a relatively high diversity of phytoplankton groups including diatoms, coccolithophorids and dinoflagellates. During the warmer months blooms of *Trichodesmium* occur in the region, these have been observed particularly on the frontal systems around Point Murat (Heyward *et al*., 2000).

Average Leeuwin Current phytoplankton biomass is characteristic of low productivity oceanic waters like the Indian, Pacific and Atlantic Oceans (Hanson *et al.*, 2005). However, the Canyons linking the Cuvier Abyssal Plain and Cape Range Peninsula KEF are connected to the Commonwealth waters adjacent to Ningaloo Reef, and may also have connections to Exmouth Plateau. The canyons are thought to interact with the Leeuwin Current to produce eddies inside the heads of the canyons, resulting in waters from the Antarctic intermediate water mass being drawn into shallower depths and onto the shelf (Brewer *et al.* 2007). These waters are cooler and richer in nutrients and strong internal tides may also aid upwelling at the canyon heads (Brewer *et al.* 2007). The narrow shelf width (about 10 kilometres) near the canyons facilitates nutrient upwelling and relatively high productivity. This high primary productivity leads to high densities of primary consumers, such as micro and macro-zooplankton, such as amphipods, copepods, mysids, cumaceans, euphausiids (Brewer *et al.*, 2007).

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4.4 Habitats and Biological Communities in the NWMR

4.4.1 Offshore Habitats and Biological communities

The NWMR has a large area of continental shelf and continental slope, with a range of bathymetric features such as canyons, plateaus, terraces, ridges, reefs, banks and shoals. The marine environment in this region is typified by tropical to sub-tropical marine ecosystems with diverse habitats from soft sediments, canyons, remote coral reefs and limestone pavement.

The key habitats and biological communities representative of the broader NWMR are summarised in **Table 4-1**.

The key habitats and biological communities representative of the broader SWMR and NMR are summarised in **Table 4-2** and **Table 4-3**.

4.4.2 Shoreline habitats and biological communities

The NWMR encompasses offshore and coastal waters, islands and mainland shoreline habitats typified by mangroves, tidal flats, saltmarshes, sandy beaches, and smaller areas of rocky shores. Each of these shoreline types has the potential to support different flora and fauna assemblages due to the different physical factors (e.g. waves, tides, light, etc.) influencing the habitat.

The key shoreline habitats representative of the broader NWMR are summarised in **Table 4-1**.

The key shoreline habitats representative of the broader SWMR and NMR are summarised in **Table 4-2** and **Table 4-3**.

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Table 4-1 Habitats and biological communities within the NWMR

Habitat/Community	Browse	NWS / Scarborough	North-west Cape	Reference
Offshore habitats and biological communities				
Soft sediment with infauna	The offshore environment of the NWMR comprises predominately of seabed habitats dominated by soft sediments (sandy and muddy substrata with occasional patches of coarser sediments) and sparse benthic biota. The benthic communities inhabiting the predominantly soft, fine sediments of the offshore habitats are characterised by infauna such as polychaetes, and sessile and mobile epifauna such as crustacea (shrimp, crabs and squat lobsters) and echinoderms (starfish, cucumbers).The density of benthic fauna is typically lower in deep-sea sediment habitats (greater than 200 m) than in shallower coastal sediment habitats, but the diversity of communities may be similar.			
Soft sediment with hard substrate outcropping	A unique seafloor feature combining both soft sediment and hard substrates, including outcrops, terraces, continental slope, and escarpments. This habitat is found in offshore areas of the NWMR, often associated with key ecological features such as the Ancient coastline at 125 m depth contour KEF.			**Section 9**
	Ancient Coastline at 125 m Depth Contour KEF Continental Slope Demersal Fish Communities KEF	Ancient Coastline at 125 m Depth Contour KEF Continental Slope Demersal Fish Communities KEF	Ancient Coastline at 125 m Depth Contour KEF Continental Slope Demersal Fish Communities KEF	**Section 9**
Coral Reef	Coral reef habitats within the NWMR have a high species diversity that includes corals, and associated reef species such as fishes, crustaceans, invertebrates, and algae. Coral reef habitats of the offshore environment of the NWMR include remote oceanic reef systems, large platform reefs, submerged banks and shoals.			
	Browse Island Scott Reef Seringapatam Reef Ashmore Reef Cartier Island Hibernia Reef	Rowley Shoals (including Mermaid Reef, Clerke Reef, Imperieuse Reef) Glomar Shoal Rankin Bank	-	**Section 10**
Seagrass and Macroalgae communities	Seagrass beds and benthic macroalgae reefs are a main food source for many marine species and also provide key habitats and nursery grounds (Heck Jr. *et al.*, 2003; Wilson *et al.*, 2010). In the northern half of Western Australia, these habitats are restricted to sheltered and shallow waters, including around offshore reef systems, due to large tidal movement, high turbidity, large seasonal freshwater run-off and cyclones.			
	Scott Reef Seringapatam Reef Ashmore Reef	Rowley Shoals (including; Mermaid Reef, Clerke Reef, Imperieuse Reef)		**Section 10**
Filter Feeders/ heterotrophic	Filter feeder epifauna such as sponges, ascidians, soft corals and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWHA, 2008). Filter feeders generally live in areas that have strong currents and hard substratum, often associated with deeper environments of the shoals and banks in the offshore NWMR.			
	Lower outer reef slopes of the oceanic reef	Glomar Shoal Rankin Bank	Cape Range canyon system	**Section 10**

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Habitat/Community	Browse	NWS / Scarborough	North-west Cape	Reference
	systems such as Scott Reef	Ancient coastline at 125 m depth contour KEF		
Sandy Beaches	Sandy beaches are dynamic environments, naturally fluctuating in response to external forcing factors (e.g. waves, currents, etc). Sandy beaches vary in length, width and gradient, and in sediment type, composition, and grain size throughout the NWMR, being found around islands and reefs in the offshore areas of the region.			
	Browse Island Scott Reef (Sandy Islet) Ashmore Reef Cartier Island	Montebello Islands Lowendal Islands Barrow Island	Muiron Islands	**Section 10**
Nearshore/coastal habitats and biological communities				
Coral Reef	Coral reef habitats typically found in nearshore regions of the NWMR include the fringing reefs around coastal islands and the mainland shore.			
	Kimberley East Holothuria and Long reefs Bonaparte and Buccaneer Archipelagos Montgomery Reef Adele complex (Beagle, Mavis, Albert, Churchill reefs, Adele Island)	Dampier Archipelago Montebello, Lowendal and Barrow Island Groups	Ningaloo Reef Exmouth Gulf Shark Bay	**Section 10**
Seagrass and Macroalgae communities	Seagrass beds and benthic macroalgae reefs are a main food source for many marine species and also provide key habitats and nursery grounds (Heck Jr. *et al.*, 2003; Wilson *et al.*, 2010). In the nearshore areas of the NWMR, these habitats are restricted to sheltered and shallow waters due to large tidal movement, high turbidity, large seasonal freshwater run-off and cyclones. These areas include in bays and sounds and around reef and island groups.			
	King Sound	Roebuck Bay Dampier Archipelago Montebello, Lowendal and Barrow Island Groups	Ningaloo Reef Exmouth Gulf Shark Bay	**Section 10**
Filter Feeders/ heterotrophic	Filter feeder epifauna such as sponges, ascidians, soft corals and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWHA, 2007a). Filter feeders generally live in areas that have strong currents and hard substratum. Conversely, higher diversity infauna are mainly associated with soft unconsolidated sediment and infauna communities are considered widespread and well represented along the continental shelf and upper slopes of the NWMR. In nearshore areas of the NWMR, these species are generally found around reef systems.			
	-	Deeper habitats of Rankin Bank and Glomar Shoal	Deeper habitats of Ningaloo Reef and the protected sponge zone in the south	

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Habitat/Community	Browse	NWS / Scarborough	North-west Cape	Reference
Mangroves	Mangroves grow in intertidal mud and sand, with specially adapted aerial roots (pneumatophores) that provide for gas exchange during low tide (McClatchie *et al.*, 2006). Mangrove forests can help stabilise coastal sediments, provide a nursery ground for many species of fish and crustacean, and provide shelter or nesting areas for seabirds (McClatchie *et al.*, 2006). Mangroves are confined to shoreline habitats, in nearshore areas of the NWMR.			
	Dampier Peninsula (including Carnot Bay, Beagle Bay and Pender Bay)	Pilbara Coastline (including; Ashburton River Delta, Coolgra Point, Robe River Delta, Yardie Landing, Yammadery Island and the Mangrove Islands) Montebello, Lowendal and Barrow Island Groups Roebuck Bay	Shark Bay Mangrove Bay, Cape Range Peninsula Exmouth Gulf	
Saltmarshes	Saltmarshes communities are confined to shoreline habitats and are typically dominated by dense stands of halophytic plants such as herbs, grasses, and low shrubs. The diversity of saltmarsh plant species increases with increasing latitude (in contrast to mangroves). The vegetation in these environments is essential to the stability of the saltmarsh, as they trap and bind sediments. The sediments are generally sandy silts and clays and can often have high organic material content.			
	-	Eighty Mile Beach Roebuck Bay	Shark Bay	
Sandy Beaches	Sandy beaches are dynamic environments, naturally fluctuating in response to external forcing factors (e.g. waves, currents, etc). Sandy beaches vary in length, width and gradient, and in sediment type, composition, and grain size throughout the NWMR. Sandy beaches are important for both resident and migratory seabirds and shorebirds and can also provide an important habitat for turtle nesting and breeding. They are located along many coastlines of the nearshore environments of the NWMR.			
	Cape Domett Lacrosse Island	Eighty Mile Beach Eco Beach Dampier Archipelago Inshore Pilbara Islands (Northern, Middle, and Southern)	Ningaloo coast Muiron Islands Exmouth Gulf	

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Table 4-2 Habitats within the SWMR

Habitat/Community	Location
Offshore	
Soft sediment with infauna	Most of the SWMR seafloor is composed of soft unconsolidated sediments, but due to large variations in bathymetry there are marked differences in sedimentary composition and benthic assemblage structure across the region. Despite the prevalence of these habitats in the SWMR, very little is known about the composition or distribution of the region's sedimentary infauna (DEWHA, 2008b)
Soft sediment with hard substrate outcropping	A unique seafloor feature combining both soft sediment and hard substrates, including outcrops, terraces, continental slope, and escarpments.
	Perth Canyon Marine Park Ancient coastline at 90-120 m depth contour KEF Diamantina Fracture Zone Naturaliste Plateau
Coral Reef	To date, studies and understanding of the corals within the SWMR have concentrated on the shallow water areas in State Waters. Within the deeper Commonwealth waters of the SWMR little is known of the distribution of corals.
Filter Feeders/ heterotrophic	Filter feeder epifauna such as sponges, ascidians, soft corals and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWR, 2007). Filter feeders generally inhabit deeper habitat (below the photic zone) that have strong currents and hard substratum
	Ancient coastline at 90-120 m depth Diamantina Fracture Zone Naturaliste Plateau Perth Canyon Marine Park South-west Corner Marine Park
Nearshore	
Coral Reef	The northern extent of the SWMR coincides loosely with the disappearance of abundant and diverse coral from coastal habitats. To the south of Shark Bay, abundant corals occur predominantly around offshore islands, with corals at inshore sites occurring in very isolated patches of non-reef coral communities, usually of reduced species richness.
	Houtman Abrolhos Islands Rottnest Island
Seagrass and Macroalgae communities	Within the SWMR, macroalgae and seagrass communities are noted for their extent, species richness and endemism. The clear waters of the region allow light to reach greater depths, with some species found at much greater depths than usual (down to 120 m) (DEWR, 2007). Of the known species there are more than 1000 species of macro-algae and 22 species of seagrass consisting of tropical and temperate species. Seagrass and macro-algae occur in areas with sheltered bays and in the inter-reef lagoons along exposed sections of the coast.
	Houtman Abrolhos Islands Jurien Marine Park Shoalwater Islands Marine Park Geographe Marine Park Cockburn Sound Rottnest Island

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Habitat/Community	Location
	Commonwealth marine environment within and adjacent to the west-coast inshore lagoons KEF Commonwealth marine environment within and adjacent to Geographe Bay KEF Commonwealth marine environment surrounding the Recherche Archipelago KEF
Filter Feeders/ heterotrophic	Filter feeder epifauna such as sponges, ascidians, soft corals and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWR, 2007). Filter feeders generally live in areas that have strong currents and hard substratum.
	Houtman Abrolhos Islands Recherche Archipelago
Mangroves	Mangroves grow in intertidal mud and sand, with specially adapted aerial roots (pneumatophores) that provide for gas exchange during low tide (McClatchie *et al.*, 2006). Mangrove forests can help stabilise coastal sediments, provide a nursery ground for many species of fish and crustacean, and provide shelter or nesting areas for seabirds (McClatchie *et al.*, 2006). Mangroves are confined to shoreline habitats, in nearshore areas of the SWMR.
	Houtman Abrolhos Islands
Sandy Beaches	Sandy beaches within the SWMR are important for both resident and migratory seabirds and shorebirds and can also host breeding populations of the Australian sea lion. They are found along many coastlines of the nearshore environments of the SWMR. In addition to this, beaches in the SWMR provide a variety of socio-economic values including tourism, commercial and recreational fishing, and support other recreational activities.
	Houtman Abrolhos Islands Marmion Marine Park Ngari Capes Marine Park Walpole and Nornalup Inlets Marine Park

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Table 4-3 Habitats and Biological Communities within the NMR

Habitat/Community	Location
	Offshore habitats and biological communities
Soft sediment with infauna	Most of the offshore environment of the NMR is characterised by relatively flat expanses of soft sediment seabed. The soft sediments of the region are characterised by moderately abundant and diverse communities of infauna and mobile epifauna dominated by polychaetes, crustaceans, molluscs, and echinoderms.
Soft sediment with hard substrate outcropping	A unique seafloor feature combining both soft sediment and hard substrates, including outcrops, terraces, continental slope, and escarpments. The variability in substrate composition may contribute to the presence of unique ecosystems. Species present include sponges, soft corals and other sessile filter feeders associated with hard substrate sediments.
	Carbonate bank and terrace system of the Van Diemen Rise KEF Pinnacles of the Bonaparte Basin KEF
Coral Reef	Offshore coral reefs within the NMR is generally associated with a series of submerged shoals and banks. The shoals/banks in the region support tropical marine biota consistent with that found on emergent reef systems of the Indo West Pacific region such as Ashmore Reef, Cartier Island, Seringapatam Reef and Scott Reef (Heyward *et al.,* 1997)
	Pinnacles of the Bonaparte Basin KEF Evans Shoal Tassie Shoal Blackwood Shoal
Filter Feeders/ heterotrophic	Filter feeder epifauna such as sponges, ascidians, soft corals and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWHA, 2007b). Filter feeders generally live in areas that have strong currents and hard substratum and typically associated with the deeper habitats of the submerged shoals and banks, and canyon features.
	Carbonate bank and terrace system of the Van Diemen Rise KEF Pinnacles of the Bonaparte Basin KEF Tributary Canyons of the Arafura Depression KEF Evans Shoal Tassie Shoal Goodrich Bank
	Nearshore
Coral Reef	Within the NMR corals occur both as reefs and in non-reef coral communities. Nearshore reefs include patch reefs and fringing reefs sparsely distributed within the region. Coral reefs within the NMR provides breeding and aggregation areas for many fish species including mackerel and snapper and offer refuges for sea snakes and apex predators such as sharks.
	Submerged coral reefs of the Gulf of Carpentaria KEF Darwin Harbour
Seagrass and Macroalgae communities	Seagrasses provide key habitats in the NMR. They stabilise coastal sediments and trap and recycle nutrients. They provide nursery grounds for commercially harvested fish and prawns and provide feeding grounds for dugongs and green turtles. Seagrass distribution in the region is largely associated with sheltered small bays and inlets including shallow waters surrounding inshore islands.
	Field Island The mainland coastline adjacent to Kakadu National Park

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Habitat/Community	Location
Filter Feeders/ heterotrophic	Filter feeder epifauna such as sponges, ascidians, soft corals, and gorgonians are animals that feed by actively filtering suspended matter and food particles from water, by passing the water over specialised filtration structures (DEWHA, 2007b). Filter feeders generally live in areas that have strong currents and hard substratum.
	Cape Helveticus
Mangroves	Mangroves grow in intertidal mud and sand, with specially adapted aerial roots (pneumatophores) that provide for gas exchange during low tide (McClatchie *et al.*, 2006). Mangroves provide habitat for waterbirds and support many commercially and recreationally important fish and crustacean species for parts of their life cycles. They buffer the coast from large tidal movements, storm surges and flooding.
	Tiwi Islands Darwin Harbour The mainland coastline adjacent to the Daly River
Sandy Beaches	Sandy beaches vary in length, width and gradient, and in sediment type, composition, and grain size throughout the NMR and are important for both resident and migratory seabirds and shorebirds. Sandy beaches can also provide an important habitat for turtle nesting. They are located along many coastlines of the nearshore environments of the islands and mainland shores of the NMR.
	Tiwi Islands Cobourg Peninsula Joseph Bonaparte Gulf

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5. FISHES, SHARKS AND RAYS

5.1 Regional Context

Western Australian waters provide important habitat for listed fishes, sharks, and rays including areas that support key life stages such as breeding, foraging, and migration routes for fish species. Pelagic and demersal fishes occupy a range of habitats throughout each of the regions, from coral reefs to open offshore waters, and are an extremely important component of ecosystems, providing a link between primary production and higher predators, with many species being of conservation value and important for commercial and recreational fishing.

The fish fauna in the NWMR is diverse. Of the approximately 500 shark species found worldwide, 94 are found in the region (DEWHA, 2008). Approximately 54 species of syngnathids (seahorses, seadragons, pipehorses and pipefishes) and one species of solenostomids (ghostpipefishes) are also known to occur in the NWMR or adjacent State waters (DSEWPAC, 2012a).

The fish fauna of the SWMR includes more than 900 species occupying a large variety of habitats. However, only three species of bony fishes known to occur in the region are listed under the EPBC Act as threatened or marine species, and seven listed species of shark (DSEWPAC, 2012b).

The NMR is considered an important area for the sawfish and river shark species group, with five species of sawfishes and river sharks listed under the EPBC Act known to occur in the region (DSEWPAC, 2012c). Approximately 28 species of syngnathids and two species of solenostomids are listed marine and known to occur in the NMR, however there is a paucity of knowledge on the distribution, relative abundance and habitats of these species in the region (DEWHA, 2008).

The following sections focus on the fish species (including sharks and rays) listed as threatened or migratory that are known to occur within the NWMR. In addition, listed, conservation dependent fish and shark species for the NWMR are described. A detailed account of commercial and recreational fisheries that operate in the region is provided in **Section 11**.

Table 5-1 outlines the threatened and migratory fish species that may occur within the NWMR, with their conservation status and relevant recovery plans and/or conservation advice. **Table 5-2** provides information for species of fish that are listed as conservation dependent that may occur within the NWMR, NMR and SWMR. Note that currently there are no approved Conservation Advices in place for any of these five species.

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Table 5-1 Fish species (including sharks and rays) identified by the EPBC Act PMST for the NWMR

Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			WA *Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Rhincodon typus	Whale shark	Vulnerable	Migratory	Marine	Other specially protected fauna	Conservation Advice *Rhincodon typus* whale shark. (Threatened Species Scientific Committee, 2015d)
Carcharias taurus	Grey nurse shark (west coast population)	Vulnerable	N/A	Marine	Vulnerable	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DOE, 2014a)
Carcharodon carcharias	White shark	Vulnerable	Migratory	Marine	Vulnerable	Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPAC, 2013b)
Isurus oxyrinchus	Shortfin mako	N/A	Migratory	Marine	N/A	N/A
Isurus paucus	Longfin mako	N/A	Migratory	Marine	N/A	N/A
Lamna nasus	Porbeagle shark Mackerel shark	N/A	Migratory	Marine	N/A	N/A
Carcharhinus longimanus	Oceanic whitetip shark	N/A	Migratory	Marine	N/A	N/A
Anoxypristis cuspidata	Narrow sawfish	N/A	Migratory	Marine	N/A	N/A
Pristis clavata	Dwarf sawfish	Vulnerable	Migratory	Marine	Priority	Sawfish and River Sharks Multispecies Recovery Plan (Commonwealth of Australia, 2015b)
Pristis pristis	Largetooth (Freshwater) sawfish	Vulnerable	Migratory	Marine	Priority	
Pristis zijsron	Green sawfish	Vulnerable	Migratory	Marine	Vulnerable	
Glyphis garricki	Northern river shark	Endangered	N/A	Marine	Priority	
Manta alfredi	Reef manta ray	N/A	Migratory	Marine	N/A	N/A
Manta birostris	Giant manta ray	N/A	Migratory	Marine	N/A	N/A

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Table 5-2 EPBC Act listed Conservation Dependent species of fishes and sharks that may occur in the NWMR, NMR and SWMR

Species Name	Common Name	Likely Occurrence / Distribution	Listing Advice
Hoplostethus atlanticus	Orange roughy, Deep-sea perch, Red roughy	SWMR	No conservation listing advice for this species. Refer to the Marine bioregional plan for the SWMR (DSEWPAC, 2012b) for further information
Thunnus maccoyii	Southern bluefin tuna	NWMR and SWMR	Threatened Species Scientific Committee (2010)
Sphyrna lewini	Scalloped hammerhead	NWMR, NMR and SWMR	Threatened Species Scientific Committee (2018)
Centrophorus zeehaani	Southern dogfish, Endeavour dogfish, Little gulper shark	SWMR	Threatened Species Scientific Committee (2013)
Galeorhinus galeus	School shark, Eastern school shark, Snapper shark, Tope, Soupfin shark	SWMR	Threatened Species Scientific Committee (2009)

5.2 Protected Sharks, Sawfishes and Rays in the NWMR

The EPBC Act Protected Matters search (**Appendix A**) identified seven species of shark and five species of river shark or sawfish listed as threatened and/or migratory within the NWMR. In addition, two species of ray (the reef manta ray and giant manta ray) are listed as migratory within the region (refer **Table 5-2**).

5.2.1 Sharks and Sawfishes

The shark species known to occur within the NWMR include: the whale shark, grey nurse shark, white shark, shortfin mako, and longfin mako (**Table 5-2**).

Five species of river shark or sawfish known to occur in the NWMR and include: the narrow sawfish, northern river shark, freshwater sawfish, green sawfish and dwarf sawfish (**Table 5-2**).

There are identified BIAs within the NWMR for the whale shark, freshwater sawfish, green sawfish, and dwarf sawfish (refer **Section 5.3.2**).

Table 5-2 Information on the threatened shark and sawfish species within the NWMR

Species	Preferred Habitat and Diet	Habitat Location
Whale shark	Preferred habitat: They have a widespread distribution in tropical and warm temperate seas, both oceanic and coastal (Last and Stevens, 2009). The species is widely distributed in Australian waters. Diet: Whale sharks are planktivorous sharks and feed on a variety of planktonic organisms including krill, jellyfish, and crab larvae (Last and Stevens, 2009).	Ningaloo Reef is the main known aggregation site for whale sharks in Australian waters and has the largest density of whale sharks per kilometre in the world (Martin, 2007). Refer **Table 5-3** for the BIA summary for the whale shark.
Grey nurse shark (west coast population)	Preferred habitat: Most commonly found in temperate waters on, or close to, the bottom of the continental shelf, from close inshore to depths of about 200 m (McAuley, 2004). Diet: A variety of teleost and elasmobranch fishes and some cephalopods (Gelsleichter *et al.*, 1999; Smale, 2005).	Details of movement patterns of the western sub-population are unclear (McAuley, 2004) and key aggregation sites have not been formally identified within the NWMR (Chidlow *et al.*, 2006). The NWMR represents the northern limit of the west coast population.

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Species	Preferred Habitat and Diet	Habitat Location
White shark	Preferred habitat: 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). Diet: Smaller white sharks (less than 3 m in length) feed primarily on teleost and elasmobranch fishes, broadening their diet as larger sharks to include marine mammals (Last and Stevens, 2009).	There are no known aggregation sites for white sharks in the NWMR, and this species is most often found south of North-west Cape, in low densities (DSEWPAC, 2012a). Given the migratory nature of the species, most likely has a broad distribution within the NWMR. No BIAs identified for NWMR.
Shortfin mako	Preferred habitat: The shortfin mako shark is a pelagic species with a circumglobal, wide-ranging oceanic distribution in tropical and temperate seas (Mollet *et al.*, 2000). 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). Diet: Feeds on a variety of prey, such as teleost fishes, other sharks, marine mammals, and marine turtles (Campana *et al.*, 2005).	Given the migratory nature of the species, most likely has a broad distribution within the NWMR. No BIAs identified for NWMR.
Longfin mako	Preferred habitat: A pelagic species with a wide-ranging oceanic distribution in tropical and temperate seas (Mollet *et al.*, 2000). Diet: Primarily teleost fishes and cephalopods (primarily squid) (Last and Stevens, 2009).	Records on longfin mako sharks are sporadic and their complete geographic range is not well known (Reardon *et al.*, 2006). Given the migratory nature of the species, most likely has a broad distribution within the NWMR. No BIAs identified for NWMR.
Mackerel/Porbeagle shark	Preferred habitat: The porbeagle shark primarily inhabits offshore waters around the edge of the continental shelf. They occasionally move into coastal waters, but these movements are temporary (Campana and Joyce, 2004; Francis *et al.*, 2002). The porbeagle shark is known to dive to depths exceeding 1300 m (Campana *et al.*, 2010; Saunders *et al.*, 2011). Diet: Primarily teleost fish, elasmobranchs, and cephalopods (primarily squid) (Joyce *et al.*, 2002; Last and Stevens, 2009).	In Australia, the species occurs in waters from southern Queensland to south-west Australia (Last and Stevens, 2009). Distribution within the NWMR is unknown, but there are several records for this species on the NWS in the Atlas of Living Australia (ALA).
Oceanic whitetip shark	Preferred habitat: The oceanic whitetip shark is globally distributed in warm-temperate and tropical oceans (Andrzejaczek *et al.*, 2018). The species may occur in tropical and sub-tropical offshore and coastal waters around Australia. They primarily occupy pelagic waters in the upper 200 m of the water column; however, they have been observed diving to depths of around 1000 m, potentially associated with foraging behaviour (Howey-Jordan *et al.*, 2013; D'Alberto *et al.*, 2017). The species is highly migratory, travelling large distances between shallow reef habitats in coastal waters and oceanic waters (Howey-Jordan *et al.*, 2013). The species does exhibit a strong preference for warm and shallow waters above 120 m. Diet: Opportunistic feeders and generally target a variety of finfishes and pelagic squid, depending on habitat. Target pelagics such as tuna in open ocean as noted by the large bycatch numbers in the long line fisheries.	Given the migratory nature of the species, most likely has a broad distribution within the NWMR. No BIAs identified for NWMR.

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Species	Preferred Habitat and Diet	Habitat Location
Narrow sawfish	Preferred habitat[1]: Shallow coastal, estuarine, and riverine habitats, however it may occur in waters up to 40 m deep (D'Anastasi *et al.*, 2013). Diet: Shoaling fishes, such as mullet, as well as molluscs and small crustaceans (Cliff and Wilson, 1994).	Shallow coastal waters of the Pilbara and Kimberly coasts (Last and Stevens, 2009).
Northern river shark	Preferred habitat[1]: Rivers, tidal sections of large tropical estuarine systems and macrotidal embayments, as well as inshore and offshore marine habitats (Pillans *et al.*, 2009; Thorburn and Morgan, 2004). Adults have been recorded only in marine environments. Juveniles and sub-adults have been recorded in freshwater, estuarine and marine environments (Pillans *et al.*, 2009). Diet: Variety of fish and crustaceans (Stevens *et al.*, 2005)	Within the NWMR records have come from both the west and east Kimberley, including King Sound, the Ord and King rivers, West Arm of Cambridge Gulf and also from Joseph Bonaparte Gulf (Thorburn and Morgan, 2004; Stevens *et al.*, 2005; Thorburn, 2006; Field *et al.*, 2008; Pillans *et al.*, 2008, Whitty *et al.*, 2008; Wynen *et al.*, 2008).
Largetooth (Freshwater) sawfish	Preferred habitat: Sandy or muddy bottoms of shallow coastal waters, estuaries, river mouths and freshwater rivers, and isolated water holes. Diet: Shoaling fishes, such as mullet, as well as molluscs and small crustaceans (Cliff and Wilson, 1994).	Refer **Table 5-3** for the BIA summary for the freshwater sawfish.
Green sawfish	Preferred habitat[1]: Inshore coastal environments including estuaries, river mouths, embayments, and along sandy and muddy beaches, as well as offshore marine habitat (Stevens *et al.*, 2005; Thorburn *et al.*, 2003). Diet: Schools of baitfish and prawns (Poganoski *et al.*, 2002), molluscs and small crustaceans (Cliff and Wilson, 1994).	Refer **Table 5-3** for the BIA summary for the green sawfish.
Dwarf sawfish	Preferred habitat[1]: Shallow (2 to 3 m) silty coastal waters and estuarine habitats, occupying relatively restricted areas and moving only small distances (Stevens *et al.*, 2008) Diet: Shoaling fish such as mullet, molluscs, and small crustaceans (Cliff and Wilson, 1994).	Refer **Table 5-3** for the BIA summary for the dwarf sawfish.

1 Preferred habitat as described within the Sawfish and River Sharks Multispecies Recovery Plan (Commonwealth of Australia, 2015b).

5.2.2 Rays

Rays are commonly found in the NWMR. Two listed and migratory species of ray known to occur within the NWMR: the reef manta ray and giant manta ray.

No BIAs for either the reef or giant manta ray species have been identified in the NWMR.

Table 5-3 Information on migratory ray species within the NWMR

Species	Preferred Habitat and Diet	Habitat Location
Reef manta ray	Preferred habitat: The reef manta ray is commonly sighted within productive nearshore environments, such as island groups, atolls or continental coastlines. However, the species has also been recorded at offshore coral reefs, rocky reefs, and seamounts (Marshall *et al.*, 2009). Diet: Feed on planktonic organisms including krill and crab larvae.	A resident population of reef manta rays has been recorded at Ningaloo Reef. No BIAs identified for NWMR.
Giant manta ray	Preferred habitat: The species primarily inhabits near-shore environments along productive coastlines with regular upwelling, but they appear	The Ningaloo Coast is an important area for giant manta rays from March to August (Preen *et al.*, 1997).

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Species	Preferred Habitat and Diet	Habitat Location
	to be seasonal visitors to coastal or offshore sites including offshore island groups, offshore pinnacles and seamounts (Marshall *et al.*, 2011). Diet: Feed on planktonic organisms including krill and crab larvae.	No BIAs identified for NWMR.

5.3 Fish, Shark and Sawfish Biological Important Areas in the NWMR

A review of the National Conservation Values Atlas identified Biologically Important Areas (BIAs) for four species of shark and sawfish (whale shark, freshwater sawfish, green sawfish and dwarf sawfish) within the NWMR. The BIAs for the whale shark and the sawfish species include foraging, nursing and pupping areas. These are described in **Table 5-4**.

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Table 5-4 Fish, whale shark and sawfish BIAs within the NWMR

Species	Woodside Activity Area			BIAs		
	Browse	NWS/S	NWC	Pupping	Nursing	Foraging
Whale shark	✓	✓	✓	No pupping BIA identified within the NWMR	No nursing BIA identified within the NWMR	Foraging (high density) in Ningaloo Marine Park and adjacent Commonwealth waters (March–July) Foraging northward from Ningaloo along the 200 m isobath (July – Nov).
Green sawfish	✓	✓	-	Pupping in Cape Keraudren (pupping occurs in summer in a narrow area adjacent to shoreline) Pupping in Willie Creek Pupping in Roebuck Bay Pupping in Cape Leveque Pupping in waters adjacent to Eighty Mile Beach Pupping (likely) in Camden Sound.	Nursing in Cape Keraudren Nursing in waters adjacent to Eighty Mile Beach	Foraging in Cape Keraudren Foraging in Roebuck Bay Foraging in Cape Leveque Foraging in Camden Sound
Largetooth (freshwater) sawfish	✓	✓	-	Pupping in the mouth of the Fitzroy River (January to May) Roebuck Bay (Jan – May) Pupping likely in waters adjacent to Eighty Mile Beach	Nursing (likely) in King Sound Roebuck Bay (Jan – May)	Foraging in the mouth of the Fitzroy River (January to May) Foraging in King Sound Roebuck Bay (Jan – May) Foraging in waters adjacent to Eighty Mile Beach
Dwarf sawfish	✓	✓	-	Pupping in King Sound Pupping in waters adjacent to Eighty Mile Beach	Nursing in King Sound Nursing waters adjacent to Eighty Mile Beach	Foraging in King Sound Foraging in Camden Sound Foraging in waters adjacent to Eighty Mile Beach

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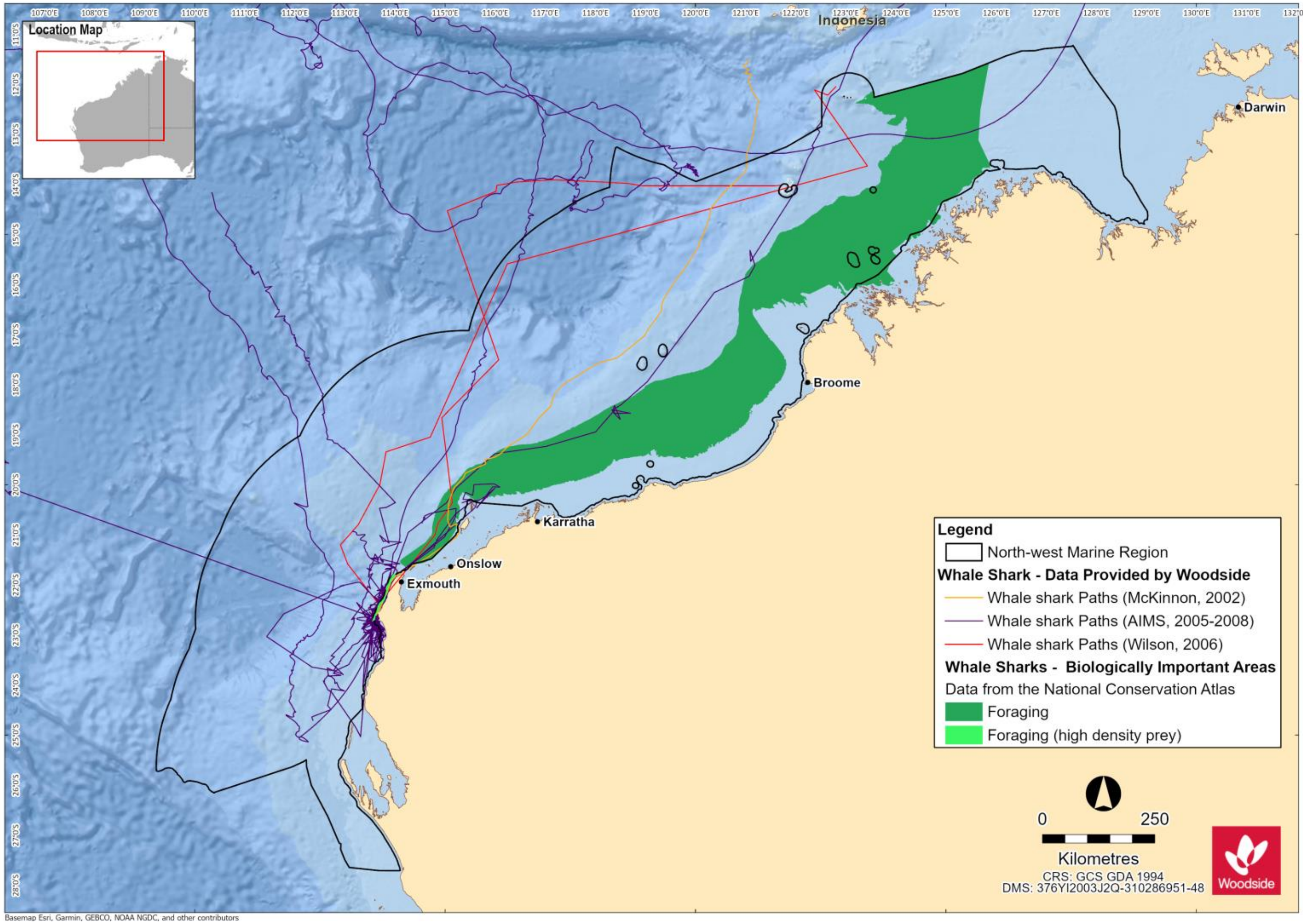

Figure 5-1 Whale shark BIAs for the NWMR and tagged whale shark tracks

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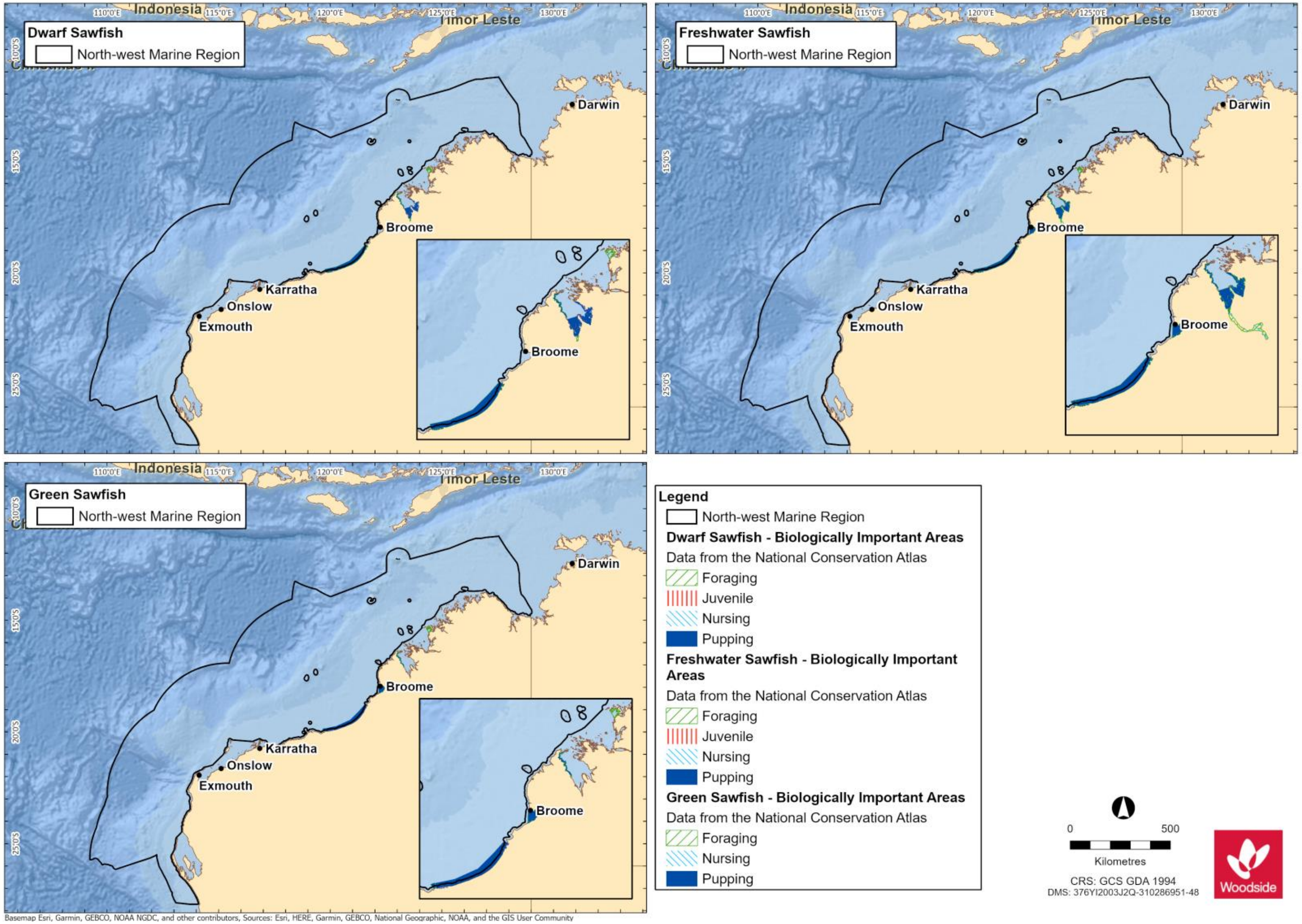

Figure 5-2 Sawfish BIAs for the NWMR

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5.4 Fish Assemblages of the NWMR

5.4.1 Regional Context for Fish Assemblages of NWMR

The NWMR contains a diverse range of fishes of tropical Indo-west Pacific affinity (Allen *et al.*, 1988). The region is characterised by the highest level of endemism and species diversity compared with other areas of the Australian continental slope. Last *et al.* (2005) recorded 1431 species from the three bioregions encompassing the continental slope, whilst also acknowledging some information gaps.

The NWMR is known for its demersal slope fish assemblages; the continental slope of the Timor Province and the North-west Transition supports more than 418 and 505 species of demersal fishes respectively, of which 64 are considered to be endemic. This is the second richest area for demersal fish species across the entire Australian continental slope. Conversely, the broad Southern Province, which covers most of southern Australia, supports 463 species, only 26 possibly being endemic. The continental slope demersal fish assemblages of the NWMR have been identified as a KEF (DEWHA, 2008), as described in **Section 9**.

The NWMR also features a diversity of pelagic fishes (those living in the pelagic zone) and bentho-pelagic fishes, including tuna, billfish, bramids, lutjanids, serranids and some sharks (DEWHA, 2007a). These species feed on salps and jellyfish, and more often on secondary consumers such as squid and bait fish. Water depth provides an indication of the level of interaction between pelagic and benthic communities within the NWMR; in waters deeper than 1000 m, for instance, the trophic system is pelagically-driven and benthic communities rely on particulates that fall to the seafloor (DEWHA, 2007a).

Pelagic fishes play an important ecological role within the NWMR; small pelagic fishes, such as lantern fish, inhabit a range of marine environments, including inshore and continental shelf waters and form a vital link in and between many of the region's trophic systems, feeding on pelagic phytoplankton and zooplankton and providing a food source for a wide variety of predators including large pelagic fishes, sharks, seabirds and marine mammals (Bulman, 2006; Mackie *et al.*, 2007). Large pelagic fishes, such as tuna, mackerel, swordfish, sailfish and marlin, are found mainly in oceanic waters and occasionally on the continental shelf (Brewer *et al.*, 2007). Both juvenile and adult phases of the large pelagic species are highly mobile and have a wide geographic distribution, although the juveniles more frequently inhabit warmer or coastal waters (DEWHA, 2008).

5.4.2 Listed Fish Species in the NWMR

The family Syngnathidae is a group of bony fishes that includes seahorses, pipefishes, pipehorses and seadragons. Along with syngnathids, members of the related Solenostomidae family (ghost pipefishes) are also found in the NWMR (DSEWPAC, 2012a).

There are 44 solenostomid and syngnathid species that are listed marine species that may occur within the NWMR, although no species is currently listed as threatened or migratory, according to the PMST report (**Appendix A**).

Syngnathids live in nearshore and inner shelf habitats, usually in shallow coastal waters, among seagrasses, mangroves, coral reefs, macroalgae dominated reefs, and sand or rubble habitats (Dawson, 1985; Lourie *et al.*, 1999, Lourie *et al.*, 2004; Vincent, 1996). Two species, the winged seahorse (*Hippocampus alatus*) and western pipehorse (*Solegnathus sp. 2*) have been identified in deeper waters of the NWMR (up to 200 m) (DSEWPAC, 2012a), however, these species were not identified by the Protected Matters search of the NWMR.

Knowledge about the distribution, abundance and ecology of both syngnathids and solenostomids in the NWMR is limited. No BIAs for syngnathids and solenostomids have been identified in the NWMR.

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5.4.3 Browse

The proposed Browse activity area includes biologically important habitat for the whale shark and three sawfish species:

- whale shark (foraging northward from Ningaloo along the 200 m isobath (July – Nov),
- freshwater sawfish (pupping, nursing and foraging areas),
- green sawfish (pupping, nursing and foraging areas); and
- dwarf sawfish (pupping, nursing and foraging areas).

BIAs for the shark and sawfish species are outlined in **Table 5-4** and **Figure 5-1**.

The proposed Browse activity area has partial overlap with the Continental slope demersal fish communities KEF.

5.4.4 NWS / Scarborough

The NWS / Scarborough activity area includes biologically important habitat for the whale shark and three sawfish species:

- whale shark (foraging northward from Ningaloo along the 200 m isobath (July – Nov),
- freshwater sawfish (pupping, nursing and foraging areas),
- green sawfish (pupping, nursing and foraging areas); and
- dwarf sawfish (pupping, nursing and foraging areas).

BIAs for the whale shark and sawfish species are outlined in **Table 5-4** and **Figure 5-1**.

The NWS / Scarborough activity area has partial overlap with the Continental slope demersal fish communities KEF. The continental slope between North-west Cape and the Montebello Trough has more than 500 fish species, 76 of which are endemic, which makes it the most diverse slope bioregion in Australia (Last *et al.*, 2005).

5.4.5 North-west Cape

The North-west Cape activity area includes biologically important foraging habitat for the whale shark:

- whale shark, including:
  - Foraging (high density) in Ningaloo Marine Park and adjacent Commonwealth waters (March–July); and
  - Foraging northward from Ningaloo along the 200 m isobath (July – Nov).

BIAs for the whale shark are outlined in **Table 5-4** and **Figure 5-1**.

The North-west Cape activity area coincides with part of the Continental slope demersal fish communities KEF.

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6. MARINE REPTILES

6.1 Regional Context for Marine Reptiles

The NWMR contains important habitat for listed marine reptiles, including areas that support key life stages such as nesting, internesting, migration and foraging for marine turtle species, and habitats supporting resident sea snake and crocodile populations.

Six of the seven marine turtle species occur in Australian waters, and all six (the green turtle, hawksbill turtle, loggerhead turtle, flatback turtle, leatherback turtle and olive ridley turtle) occur in the NWMR and NMR.

There are 25 listed species of sea snake reported within or adjacent to the NWMR (Guinea, 2007a; Udyawer *et al*., 2016), of which four are endemic to reef habitats in the remote parts of the region. Nineteen (19) listed sea snake species are known to occur in the NMR, as reported in the Protected Matters search (**Appendix A**).

There are significantly fewer marine reptile species that frequently occur within the SWMR and presently include three species of listed marine turtle and one sea snake species. Other species of sea snake may occur because of the southward-flowing Leeuwin Current, as vagrants in the region (DSEWPAC, 2012b).

The following sections focus on the listed marine reptile species known to occur within the NWMR.

Table 6-1 outlines the threatened and migratory marine reptile species that occur within the NWMR, with their conservation status and relevant recovery plans and/or conservation advice.

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Table 6-1 Marine reptile species identified by the EPBC Act PMST as potentially occurring within or utilising habitats in the NWMR for key life cycle stages

Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			WA *Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Caretta caretta	Loggerhead turtle	Endangered	Migratory	Marine	Endangered	Recovery Plan for Marine Turtles in Australia 2017-2027 (Commonwealth of Australia, 2017)
Chelonia mydas	Green turtle	Vulnerable	Migratory	Marine	Vulnerable	
Dermochelys coriacea	Leatherback turtle	Endangered	Migratory	Marine	Vulnerable	
Eretmochelys imbricata	Hawksbill turtle	Vulnerable	Migratory	Marine	Vulnerable	
Natator depressus	Flatback turtle	Vulnerable	Migratory	Marine	Vulnerable	
Lepidochelys olivacea	Olive ridley turtle	Endangered	Migratory	Marine	Vulnerable	
Aipysurus apraefrontalis	Short-nosed sea snake	Critically endangered	N/A	Marine	Critically endangered	Approved Conservation Advice for *Aipysurus apraefrontalis* (Short-nosed Sea Snake) (DSEWPAC, 2011a)
Aipysurus foliosquama	Leaf-scaled sea snake	Critically endangered	N/A	Marine	Critically endangered	Approved Conservation Advice for *Aipysurus foliosquama* (Leaf-scaled Sea Snake) (DSEWPAC, 2011b)
Crocodylus porosus	Salt-water crocodile	N/A	Migratory	Marine	Other protected fauna	N/A

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6.2 Marine Turtles in the NWMR

According to the Protected Matters search (**Appendix A**) six species of marine turtle known to occur within the NWMR are listed as threatened and migratory (three Vulnerable and three Endangered) under the EPBC Act—the green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), flatback (*Natator depressus*), loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*) and olive ridley (*Lepidochelys olivacea*) turtle (DSEWPAC, 2012a) (refer **Table 6-1**).

The NWMR supports globally significant breeding populations of four marine turtle species: the green, hawksbill, flatback and loggerhead turtle. Olive ridley turtles are known to forage within the NWMR, but there are only occasional records of the species nesting in the region. Leatherback turtles regularly forage over Australian continental shelf waters within the NWMR but there are also no records of the species nesting in the region (DSEWPAC, 2012a).

The six marine turtle species reported for the NWMR also occur within the NMR.

Three marine turtle species; the green, loggerhead, and leatherback turtle, have presumed feeding areas within the SWMR; however, no known nesting areas exist within the region (DSEWPAC, 2012b).

Discrete genetic stocks have evolved within each marine turtle species. This is the result of marine turtles returning to the location where they hatched. These genetically distinct stocks are defined by the presence of regional breeding aggregations. Stocks are composed of multiple rookeries in a region and are delineated by where there is little or no migration of individuals between nesting areas. Turtles from different stocks typically overlap at feeding grounds (Commonwealth of Australia, 2017). There are 17 genetic stocks across both the NWMR and NMR (nine in the NWMR, six in the NMR, and two overlapping both regions). Of these 17 genetic stocks, nine are known to occur within Woodside's three areas of activity (**Table 6-2**).

6.2.1 Life Cycle Stages

Marine turtles are highly migratory during non-reproductive life phases and have high site fidelity during breeding and nesting life phases. Majority of their lives are spent in the ocean, but the adult female marine turtles will come ashore to lay eggs in the sand above the high water mark on natal beaches (Commonwealth of Australia, 2017). **Figure 6-1** summarises the generalised life cycle of marine turtles. Species-specific life cycle information is outlined within the Recovery Plan for Marine Turtles of Australia (Commonwealth of Australia, 2017).

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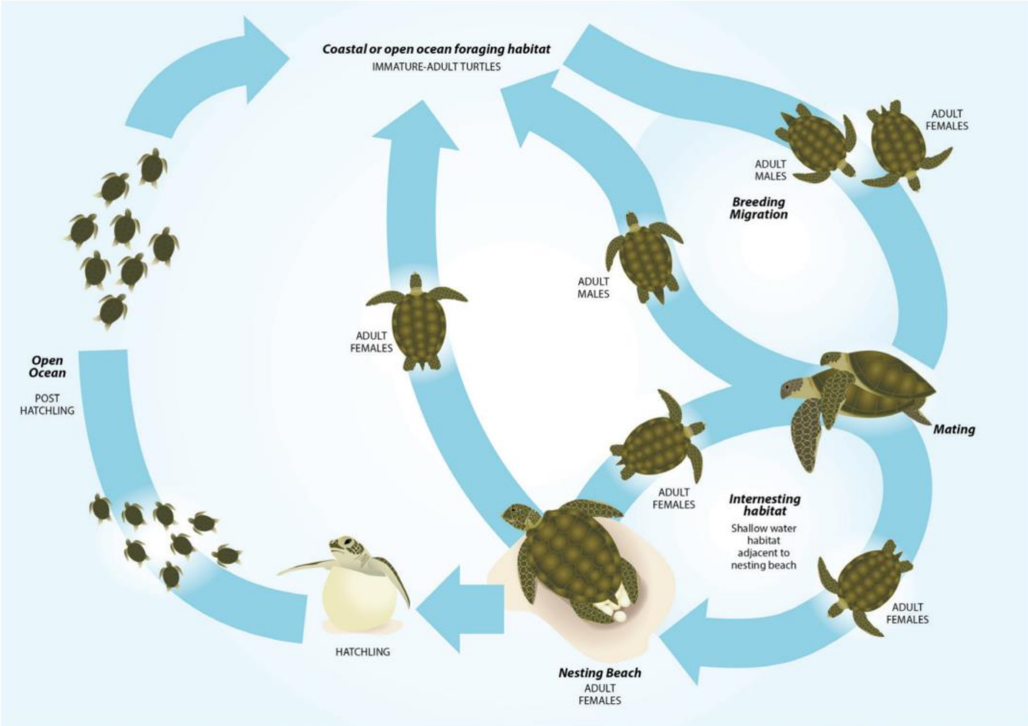

Figure 6-1 Generalised life cycle of marine turtles (Commonwealth of Australia, 2017)

6.2.2 Habitat Critical to Survival for Marine Turtles in the NWMR

The Recovery Plan for Marine Turtles of Australia (Commonwealth of Australia, 2017) identifies habitat critical to the survival of a species for marine turtle stocks under the EPBC Act. Habitat critical to survival is defined by the EPBC Act *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* as areas necessary:

- for activities such as foraging, breeding or dispersal;
- for the long-term maintenance of the species (including the maintenance of species essential to the survival of the species);
- to maintain genetic diversity and long term evolutionary development; and
- for the reintroduction of populations or recovery of the species.

The Recovery Plan for Marine Turtles of Australia (Commonwealth of Australia, 2017) has identified nesting locations and associated internesting areas as habitat critical to survival for four marine turtle species within the NWMR and these are identified, described and mapped in **Table 6-2** and **Figure 6-2**. No habitat critical to survival has been identified within the NWMR for olive ridley or leatherback turtles.

Table 6-2 outlines the relevant genetic stock, habitat critical to survival and key life cycle stage seasonality of the four species of marine turtles within the NWMR.

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Table 6-2 Genetic stock, habitat critical to survival and key life cycle stage seasonality of the four species of marine turtles within the NWMR

Species	Woodside Activity Area			Habitat Critical to Survival			
	Browse	NWS/S	NWC	Nesting (* Major Rookery[1])	Internesting Buffer	Seasonality-Nesting	Preferred Habitat[2]
Green Turtle							
NWS Stock (G-NWS)	✓	✓	✓	Adele Island Maret Island Cassini Island Lacepede Islands* Barrow Island* Montebello Islands (all with sandy beaches)* Serrurier Island Dampier Archipelago Thevenard Island Northwest Cape* Ningaloo coast	20 km radius	Nov-Mar	Nearshore reef habitats in the photic zone.
Ashmore Reef Stock (G-AR)	✓	-	-	Ashmore Reef* Cartier Reef*		All year (peak: Dec-Jan)	
Scott Reef-Browse Island Stock (G-ScBr)	✓	-	-	Scott Reef (Sandy Islet)* Browse Island*		Nov-Mar	
Hawksbill Turtle							
Western Australia Stock (H-WA)	-	✓	-	Dampier Archipelago (including Rosemary Island and Delambre Island)* Montebello Islands (including Ah Chong Island, South East Island and Trimouille Island)* Lowendal Islands (including Varanus Island, Beacon Island and Bridled Island) Sholl Island	20 km radius	Oct-Feb	Nearshore and offshore reef habitats.

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Species	Woodside Activity Area			Habitat Critical to Survival			
	Browse	NWS/S	NWC	Nesting (* Major Rookery[1])	Internesting Buffer	Seasonality-Nesting	Preferred Habitat[2]
Flatback Turtle							
Cape Domett Stock (F-CD)	✓	-	-	Cape Domett* Lacrosse Island	60 km radius	All year (peak: Jul-Sep)	Nearshore and offshore sub-tidal and soft bottomed habitats of offshore islands.
South-west Kimberley Stock (F-swKim)	-	✓	-	Eighty Mile Beach* Eco Beach* Lacepede Islands		Oct-Mar	
Pilbara Stock (F-Pil)	-	✓	-	Montebello Islands Mundabullangana Beach* Barrow Island* Cemetery Beach Dampier Archipelago (including Delambre Island* and Huay Island) Coastal islands from Cape Preston to Locker Island		Oct-Mar	
Unknown genetic stock Kimberley, Western Australia	✓	✓	-	Maret Islands Montilivet Islands Cassini Island Coronation Islands (includes Lamarck Island) Napier-Broome Bay Islands (West Governor Island, Sir Graham Moore Island – near Kalumbaru) Champagny, Darcy and Augustus Islands (Camden Sound)		May-July	

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Species	Woodside Activity Area			Habitat Critical to Survival			
	Browse	NWS/S	NWC	Nesting (* Major Rookery[1])	Internesting Buffer	Seasonality-Nesting	Preferred Habitat[2]
Loggerhead Turtle							
Western Australia Stock (LH-WA)	-	-	✓	Dirk Hartog Island* Muiron Islands* Gnaraloo Bay* Ningaloo coast	20 km radius	Nov-May	Nearshore and island coral reefs, bays and estuaries in tropical and warm temperate latitudes.

[1] *Major rookeries as outlined in the Recovery Plan (Commonwealth of Australia, 2017)*

[2] *Preferred habitat as outlined in the Recovery Plan (Commonwealth of Australia, 2017)*

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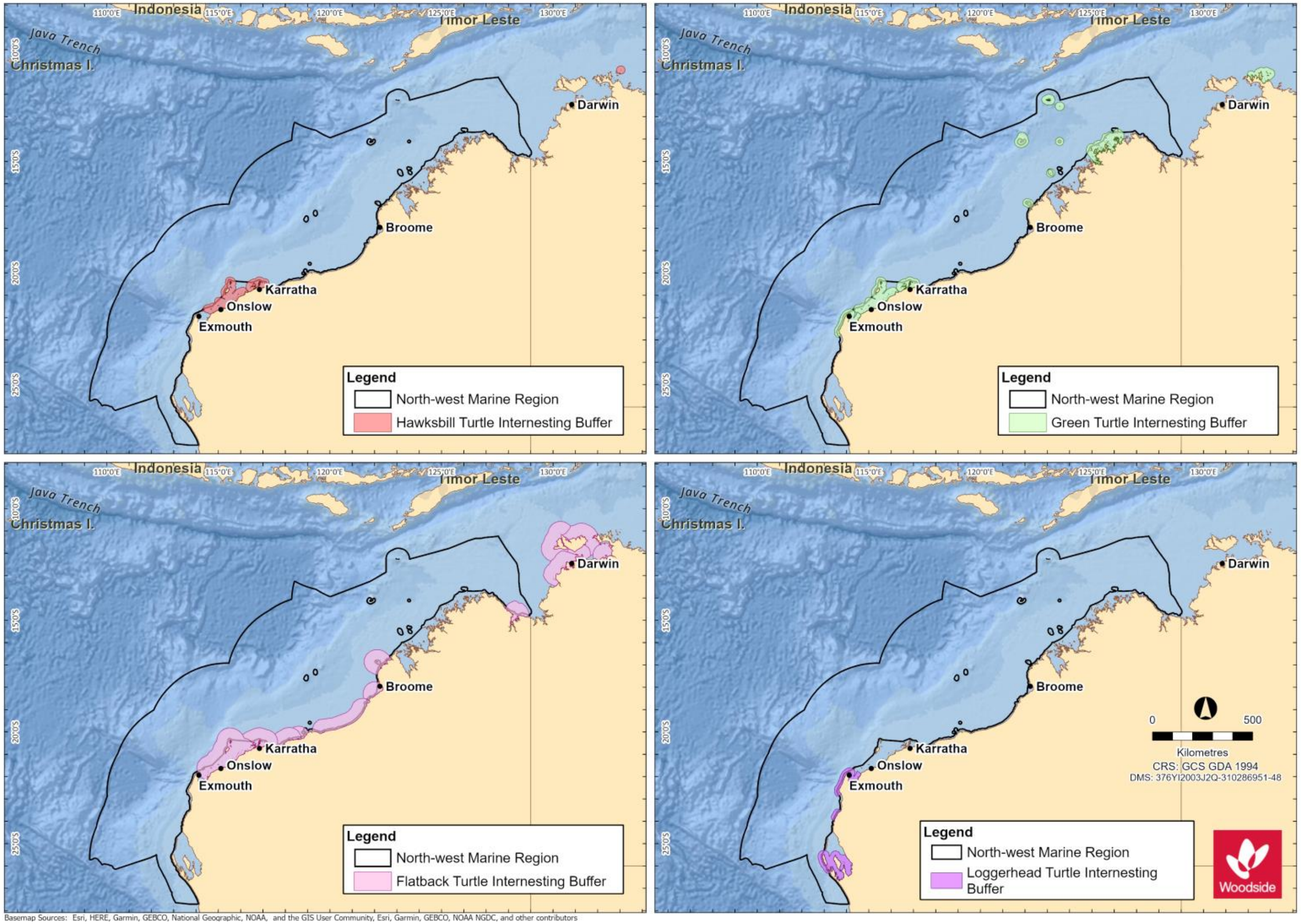

Figure 6-2 Marine turtle species habitat critical to survival (nesting beaches and internesting buffers) for the NWMR

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6.3 Marine Turtle Biological Important Areas in the NWMR

A review of the National Conservation Values Atlas (DAWE, 2020[2]) identified BIAs for the four marine turtle species that occur within the NWMR. These are described in **Table 6-3**. Note that nesting and internesting BIAs are not listed in **Table 6-3** as they are defined as in the Recovery Plan as habitat critical to survival for marine turtles nesting beaches and internesting areas (refer **Table 6-2**).

[2] http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf

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Table 6-3 Marine turtle BIAs within the NWMR

Species	Woodside Activity Area			BIAs		
	Browse	NWS/S	NWC	Mating	Foraging	Migration[3]
Green turtle	✓	✓	✓	No mating BIA identified within the NWMR.	Foraging inshore areas of Barrow Island Foraging at Montgomery Reef Foraging at Montebello Islands Foraging at Dixon Island Foraging around Ashmore Reef Foraging at Seringapatam Reef and Scott Reef Foraging in the De Grey River area to Bedout Island Foraging around the Islands between Cape Preston and Onslow and inshore of Barrow Island Foraging around Dampier Archipelago (islands to the west of the Burrup Peninsula) Foraging at Legendre Island and Huay Island Foraging around Delambre Island Foraging in the Joseph Bonaparte Gulf Foraging in waters adjacent to James Price Point	Green turtles can migrate more than 2600 km between their feeding and nesting grounds. Individual turtles foraging in the same area do not necessarily take the same migration route (Limpus *et al.*, 1992). Ferreira et al. (2021) broadly identified two migratory corridors, one used by the NWS stock-Pilbara and another used by the NWS stock-Kimberley and the Scott-Browse stock with some overlap at the northern and southern extents respectively. This study showed that the foraging distribution of green turtles from two stocks in WA expands throughout north-west and northern Australian coastal waters, including the NT and Queensland.
Hawksbill turtle	✓	✓	✓	No mating BIA identified within the NWMR.	Foraging around the Lowendal Island group Foraging at Delambre Island Foraging around Dixon Island Foraging in the De Grey River area to Bedout Island Foraging around the islands between Cape Preston and	Individuals may migrate up to 2400 km between their nesting and foraging grounds (DSEWPAC, 2012a).

[3] Migration BIA does not exist for Marine Turtles – general information provided.

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Species	Woodside Activity Area			BIAs		
	Browse	NWS/S	NWC	Mating	Foraging	Migration[3]
					Onslow and inshore of Barrow Island Foraging around the islands of the Dampier Archipelago (to the west of the Burrup Peninsula) Foraging at Ashmore Reef	
Flatback turtle	✓	✓	-	Lacepede Islands Mating at Montebello Islands Mating at Dampier Archipelago (islands to the west of the Burrup Peninsula) Mating at Barrow Island A year-round internesting buffer biologically important area (BIA) of 80 km is located north and north-west of the Montebello Islands, extending 20 km further than the habitat critical to survival. However, use level for this BIA has been defined as very low (Commonwealth of Australia, 2017) and the habitat critical to survival internesting buffer is the legally recognised area of protection under the EPBC Act *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* Refer to the Marine Bioregional Plan for the North-west Marine Region (DSEWPAC, 2012a) for locations of seasonal 80 km internesting buffer BIAs for flatback turtles	Foraging at the islands between Cape Preston and Onslow and inshore of Barrow Island. Foraging at Montebello Islands Foraging at Dampier Archipelago (islands to the west of the Burrup Peninsula) Foraging at Legendre Island and Huay Island Foraging at Delambre Island Foraging in the Joseph Bonaparte Depression Foraging in waters adjacent to James Price Point	There is evidence that some flatback turtles undertake long-distance migrations between breeding and feeding grounds (Limpus *et al.*, 1983). However, flatback turtles generally do not have a pelagic phase to their lifecycle. Instead, hatchlings grow to maturity in shallow coastal waters thought to be close to their natal beaches (DSEWPAC, 2012a).

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Species	Woodside Activity Area			BIAs		
	Browse	NWS/S	NWC	Mating	Foraging	Migration[3]
Loggerhead turtle	✓	✓	-	No mating BIA identified within the NWMR	Foraging in the De Grey River area to Bedout Island Foraging on the Western Joseph Bonaparte Depression Foraging in the waters adjacent to James Price Point	Adult loggerhead turtles dispersing from Dirk Hartog Island beaches (near Shark Bay) have remained within WA waters from southern WA to the Kimberley. Turtles dispersing from the North-west Cape–Muiron Islands nesting area have ranged north as far as the Java Sea and the north-western Gulf of Carpentaria, and to south-west WA (DSEWPAC, 2012).
Olive ridley turtle	✓	✓	-	No mating BIA identified within the NWMR	Foraging in the Western Joseph Bonaparte Depression and Gulf Foraging in the Dampier Archipelago (islands to the west of the Burrup Peninsula)	Migration routes and distances between nesting beaches and foraging areas are not known for Australian olive ridley turtles.

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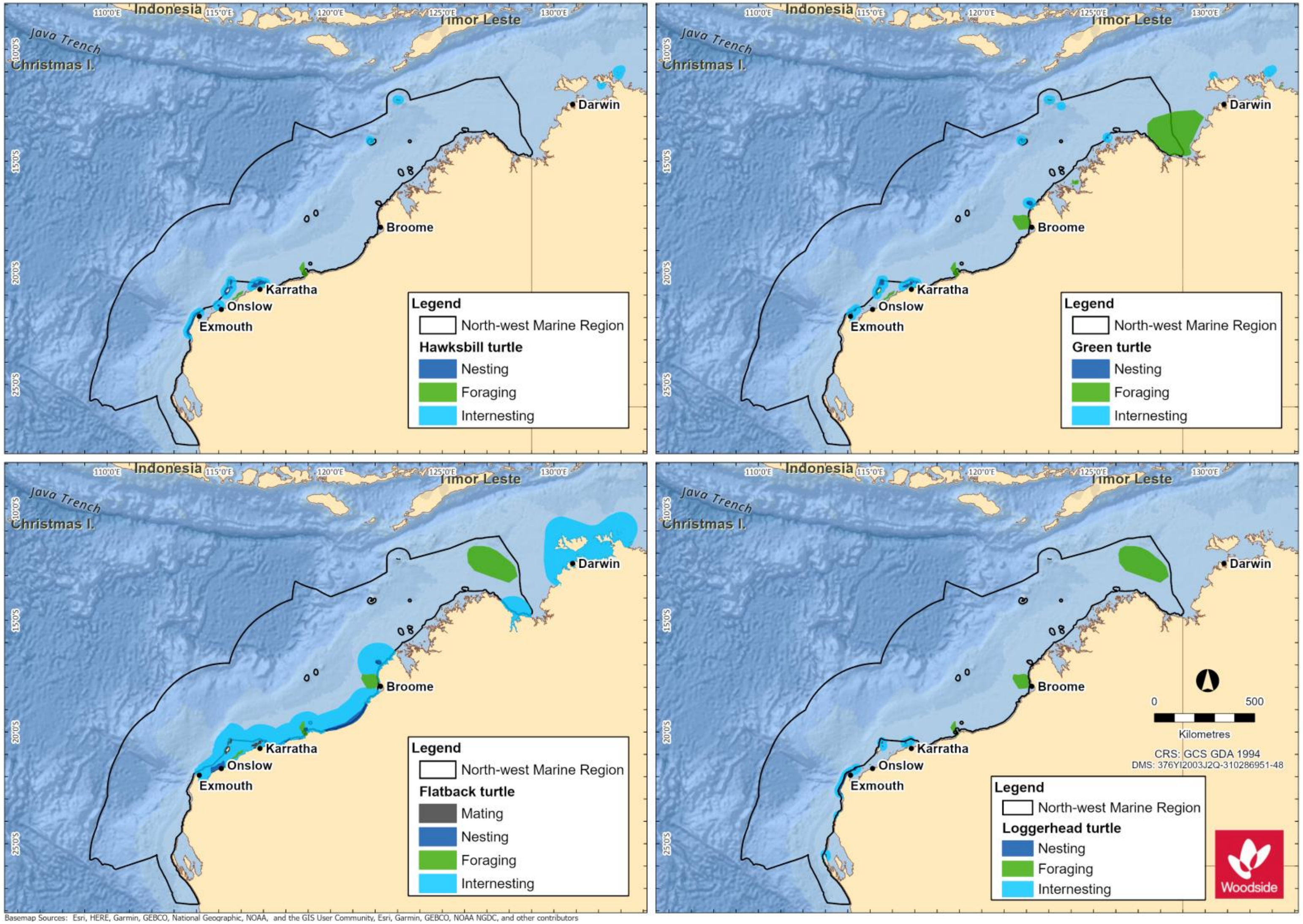

Figure 6-3 Marine turtle species BIAs within the NWMR

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6.4 Marine Turtle Summary for NWMR

Six of the seven marine turtle species occur within the Woodside activity areas. Across all three areas, globally significant breeding populations of four marine turtle species; the green, hawksbill, flatback and loggerhead turtle, have been recorded.

However, offshore waters do not represent biologically important habitat for marine turtles in any of the three Woodside activity areas. Isolated records of transient individuals (on post-nesting migration) are expected, but there is no evidence of important habitat or behaviours for marine turtles in offshore, open water environment of the NWS, in general.

6.4.1 Browse

The proposed Browse activity area includes major nesting areas that support globally significant breeding populations of two marine turtle species:

- the green turtle, including two distinct genetic stocks (Ashmore Reef and Scott Reef-Browse Island); and
- the flatback turtle, Cape Domett genetic stock.

Locations of habitat critical for each of the two species are outlined in **Table 6-2** and **Figure 6-2**.

BIAs for the green and flatback turtle are outlined in **Table 6-3** and **Figure 6-3**.

Table 6-4 Marine turtle key information for Browse activity area

Species / Genetic Stock	Key Information
Green Turtle	
Ashmore Reef Stock (G-AR)	The G-AR stock nests in a localised area of the Indian Ocean in the Ashmore Reef and Cartier Island AMP areas. Population estimates are not available for Ashmore Reef, although annual breeding numbers are thought to be in the low hundreds (Whiting, 2000). Designated habitat critical for the G-AR stock are the nesting locations of Ashmore Reef and Cartier Reef, and an internesting buffer of 20 km radius around these rookeries, year-round with peak internesting activity occurring December to January (refer Table 6 of the Recovery Plan). Juvenile and adult turtles forage within the tidal/sub-tidal habitats of offshore islands and coastal waters with coral reef, mangrove, sand, rocky reefs, and mudflats where there are algal turfs or seagrass meadows present (Commonwealth of Australia, 2017).
Scott Reef-Browse Island Stock (G-ScBr)	The G-ScBr stock is a discrete unit known to nest at only two locations within the north-east Indian Ocean—Sandy Islet and Browse Island. There is currently very limited data available for the G-ScBr stock, therefore population numbers are not known. Designated habitat critical for the G-ScBr stock are the nesting locations of Sandy Islet and Browse Island, and an internesting buffer of 20 km radius around these rookeries, for the period November to March (refer Table 6 of the Recovery Plan). Surveys conducted at Scott Reef in 2006, 2008 and 2009 indicate that the summer months from late November to February are the preferred breeding season for green turtles at Sandy Islet (Guinea, 2009). Satellite tagging studies (Pendoley, 2005; Guinea, 2011) have provided an indication of the behaviour and migratory routes of adult green turtles leaving Scott Reef. Most animals appear to swim through South Reef lagoon and disperse toward the Western Australian mainland via two distinct post-nesting migration pathways; travelling east and north toward the Bonaparte Archipelago and then north along the coast to foraging areas in NT waters, or travelling south to Cape Leveque and then south along the coast to the Turtle Islands off the mouth of the De Grey River in the Pilbara region (Ferreira *et al*., 2021).

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Species / Genetic Stock	Key Information
Flatback Turtle	
Cape Domett Stock (F-CD)	Cape Domett is an important high density nesting area. Combined with a smaller site at Lacrosse Island, the F-CD stock is one of the largest flatback turtle stocks in Australia. Average nesting abundance at Cape Domett is estimated at 3250 females per year (Whiting *et al.*, 2008). Designated habitat critical for the F-CD stock are the nesting locations of Cape Domett and Lacrosse Island, and an internesting buffer of 60 km radius around these rookeries, year-round with peak internesting activity occurring July to September. Extending further than the habitat critical internesting buffer, an internesting buffer BIA of 80 km is located at Cape Domett and Lacrosse Island.

6.4.2 North-west Shelf / Scarborough

The NWS / Scarborough activity area includes major nesting areas that support globally significant breeding populations of three marine turtle species, representing four discreet genetic stocks:

- the green turtle, NWS genetic stock;
- the hawksbill turtle, WA genetic stock; and
- the flatback turtle, South-west Kimberley stock and Pilbara genetic stocks.

Locations of habitat critical for each of the four species are outlined in **Table 6-2** and **Figure 6-2**.

BIAs for the green, hawksbill, and flatback are outlined in **Table 6-3** and **Figure 6-3**.

Table 6-5 Marine turtle key information for NWS / Scarborough activity area

Species / Genetic Stock	Key Information
Green Turtle	
NWS Stock (G-NWS)	The G-NWS stock is one of the largest green turtle stocks in the world and the largest in the Indian Ocean. The G-NWS stock is estimated at approximately 20,000 individuals (DSEWPAC, 2012a) and the trend for the stock is reported as stable (Commonwealth of Australia, 2017). Major rookeries of the G-NWS stock within the NWS / Scarborough activity area are located at Barrow Island and the Montebello Islands. These areas are designated habitat critical for the stock and include an internesting buffer of 20 km radius around these rookeries, November to March.
Hawksbill Turtle	
Western Australia Stock (H-WA)	The H-WA stock is the largest in the Indian Ocean. The majority of the nesting for this stock is located in the Pilbara. The Dampier Archipelago has the largest nesting aggregation recorded. In particular, Rosemary Island supports the most significant hawksbill turtle rookery in the WA region and one of the largest in the Indian Ocean; approximately 500-1000 females nest on the island annually, more than at any other WA rookery (Pendoley, 2005; Pendoley *et al.*, 2016). Major rookeries of the H-WA stock within the NWS / Scarborough activity area are located at Rosemary Island, Delambre Island and the Montebello Islands. These areas are designated habitat critical for the stock and include an internesting buffer of 20 km radius around these rookeries, October to February.
Flatback Turtle	
South-west Kimberley Stock (F-swKim)	The genetic relationship between this nesting aggregation and the Cape Domett and Pilbara stocks is currently under review. Population numbers of the F-swKim stock are unknown. Major rookeries of the F-swKim stock are located at Eighty Mile Beach and Eco Beach. These areas are designated habitat critical for the stock and include an internesting buffer of 60 km radius around these rookeries, October to March.

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Species / Genetic Stock	Key Information
Pilbara Stock (F-Pil)	The extent of genetic relatedness of flatback turtles along the WA coast is currently under review. Population numbers of the F-Pil stock are unknown. This stock nests on many islands in the Pilbara and southern Kimberley, with major rookeries at Mundabullangana Beach, Delambre Island and Barrow Island. These areas are designated habitat critical for the F-Pil stock and include an internesting buffer of 60 km radius around these rookeries, October to March. Extending further than the habitat critical internesting buffer, a year-round internesting buffer BIA of 80 km is located north and north-west of the Montebello Islands. However, use level for this BIA has been defined as very low (Commonwealth of Australia, 2017) and the habitat critical internesting buffer is the legally recognised area of protection under the EPBC Act *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance*. Post-nesting satellite tracking indicates foraging occurs along the WA coast in water shallower than 130 m and within 315 km of shore (Commonwealth of Australia, 2017).

6.4.3 North-west Cape

The North-west Cape activity area includes major nesting areas that support globally significant breeding populations of two marine turtle species, representing two discreet genetic stocks:

- the green turtle, NWS genetic stock; and
- the loggerhead turtle, Western Australia genetic stock.

Locations of habitat critical for each of the two species are outlined in **Table 6-2** and **Figure 6-2**.

BIAs for the green and loggerhead turtles are outlined in **Table 6-3** and **Figure 6-3**.

A 2018 survey, including on-beach monitoring of the Muiron Islands and Ningaloo Coast from North-west Cape to Bungelup (Rob *et al.*, 2019), supports the concept that North-west Cape and the Muiron Islands are major important nesting areas for green and loggerhead turtles, as identified in the Recovery Plan (Commonwealth of Australia, 2017).

Table 6-6 Marine turtle key information for North-west Cape activity area

Species / Genetic Stock	Key Information
Green Turtle	
NWS Stock (G-NWS)	The G-NWS stock is one of the largest green turtle stocks in the world and the largest in the Indian Ocean. The G-NWS stock is estimated at approximately 20,000 individuals (DSEWPAC, 2012a) and the trend for the stock is reported as stable (Commonwealth of Australia, 2017). There is one major rookery of the G-NWS stock located within the North-west Cape activity area. Located on the mainland coast of the North-west Cape, this area is designated habitat critical for the stock and includes an internesting buffer of 20 km radius around the rookery, November to March.
Loggerhead Turtle	
Western Australia Stock (LH-WA)	The LH-WA stock is one of the largest in the world (Limpus, 2009). The trend for the stock is reported as stable (Commonwealth of Australia, 2017). Major rookeries of the LH-WA stock are located at Dirk Hartog Island, Muiron Islands and Gnaraloo Bay. These areas are designated habitat critical for the stock and include an internesting buffer of 20 km radius around these rookeries, November to May. Dirk Hartog Island in the Shark Bay Marine Park, with an average of 122 nests per day over 2.1 km (Reinhold and Whiting, 2014), is recognised as the most important loggerhead turtle rookery in WA (Commonwealth of Australia, 2016; as cited in Rob *et al.*, 2019).

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6.5 Sea Snakes

Sea snakes are commonly found in the NWMR and NMR, but less so in the SWMR, and occupy three broad habitat types: shallow water coral reef and seagrass habitats, deepwater soft bottom habitats away from reefs, and surface water pelagic habitats (Guinea, 2007a).

There are 25 listed species of sea snake reported within or adjacent to the NWMR (Guinea, 2007a; Udyawer *et al*., 2016), of which four are endemic to reef habitats in the remote parts of the region:

- dusky sea snake (*Aipysurus fuscus*);
- large headed sea snake (*Hydrophis pacificus*);
- short-nosed sea snake (*Aipysurus apraefrontalis*); and
- leaf-scaled sea snake (*Aipysurus foliosquama*).

The short-nosed sea snake and the leaf-scaled sea snake are listed threatened species (Critically Endangered) under the EPBC Act **(Table 6-7**).

There is currently limited knowledge about the ranges and distribution patterns of sea snake species in the NWMR, in addition to a lack of understanding of population status and threats. Recent findings of *A. apraefrontalis* and *A. foliosquama* in locations outside of their previously defined ranges have highlighted the lack of information on species distributions in the NWMR (Udyawer *et al.*, 2016). Udyawer *et al.* (2020) used a correlative modelling approach to understand habitat associations and identify suitable habitats for five sea snake species (*A. apraefrontalis, A. foliosquama, A. fuscus, A. l. pooleorum* and *A. tenuis*). Species-specific habitat suitability was modelled across 804,244 km^2 of coastal waters along the NWS, and the resulting habitat suitability maps enabled the identification of key locations of suitable habitat for these five species (refer **Table 6-6**).

No habitat critical to survival or BIAs for sea snake species have been identified in the NWMR. While the Ashmore Reef and Cartier Island AMPs have been recognised for their high diversity and density of sea snakes (DSEWPAC, 2012a), surveys have revealed a steep decline in sea snake numbers at Ashmore Reef (Guinea, 2007b; Lukoschek *et al.*, 2013). Leaf-scaled and short-nosed sea snakes have been absent from surveys at Ashmore Reef since 2001, despite an increase in survey intensity (Guinea, 2006, 2007b; Guinea and Whiting, 2005; Lukoschek *et al.*, 2013). The reason for the decline is unknown.

Table 6-7 Information on the two threatened sea snake species within the NWMR

Species	Preferred Habitat and Diet	Habitat Location
Short-nosed sea snake	Preferred habitat: Primarily on the reef flats or in shallow waters of the outer reef edges to depths of 10 m (Minton *et al*., 1975). Typically, movement is restricted to within 50 m of reef flat habitat (Guinea and Whiting, 2005). Diet: Primarily fishes and eels.	The short-nosed sea snake has been recorded from Exmouth Gulf to the reefs of the Sahul Shelf, although most records come from Ashmore and Hibernia reefs (Guinea and Whiting, 2005). Key locations of suitable habitat: Ashmore Reef, Exmouth Gulf, Muiron Islands, Montebello Islands (Udyawer *et al.*, 2020).
Leaf-scaled sea snake	Preferred habitat: The leaf-scaled sea snake occurs in shallow protected areas of reef flats, typically in water depth less than 10 m. Diet: Primarily shallow water coral-associated wrasse, gudgeons, clinids and eels (McCosker, 1975; Voris, 1972; Voris and Voris, 1983)	The leaf-scaled sea snake has only been recorded at Ashmore and Hibernia reefs (Guinea and Whiting, 2005), indicating it has a very limited distribution. Key locations of suitable habitat: Ashmore Reef, Shark Bay, Exmouth Gulf, Barrow Island and Montebello Islands (Udyawer *et al.*, 2020).

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6.6 Crocodiles

The salt-water crocodile (*Crocodylus porosus*) is a listed migratory species under the EPBC Act known to occur within the NWMR. The species is found in most major river systems of the Kimberley, including the Ord, Patrick, Forrest, Durack, King, Pentecost, Prince Regent, Lawley, Mitchell, Hunter, Roe and Glenelg rivers. The largest populations occur in the rivers draining into the Cambridge Gulf and the Prince Regent River and Roe River systems. There have also been isolated records in rivers of the Pilbara region, around Derby near Broome and as far south as Carnarvon on the mid-west coast.

No BIAs for salt-water crocodile have been identified in the NWMR.

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7. MARINE MAMMALS

7.1 Regional Context

The offshore waters of WA include important habitat for marine mammals, including areas that support key life stages such as breeding, foraging, and migration. Of the 45 species of cetacean occurring in Australian waters, 27 species occur regularly in the waters of the NWMR, nine species in the waters of the NMR and 33 species in the SWMR. The waters of the NWMR and the NMR also support significant populations of dugong (DSEWPAC, 2012a, c).

The NWMR is an important migratory pathway between feeding grounds in the Southern Ocean and breeding grounds in tropical waters of the NWMR for several cetacean species (DSEWPAC, 2012a). Numerous large mysticetes (baleen whale) species, in particular the humpback whale, are known to utilise the region for migration and calving, and the pygmy blue whale for foraging and as a migration pathway between southern feeding and northern breeding/feeding areas, north of the equator.

The SWMR is an important area for numerous marine mammal species including pinniped species, large, migratory whale species and resident coastal whale and dolphin species (DSEWPAC, 2012b).

The NMR and adjacent areas are important for several species of cetacean, particularly inshore dolphin species. These species, and other marine mammals, rely on the waters of the NMR and adjacent coastal areas for breeding and foraging. However, there is little knowledge of the seasonal movements, migrations and breeding seasonality for many of the marine mammal species in the NMR due to lack of extensive surveys (DSEWPAC, 2012c).

Table 7-1 outlines the threatened and migratory marine mammal species that may occur within the NWMR, with their conservation status and relevant recovery plans and/or conservation advice.

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Table 7-1 Marine mammal species identified by the EPBC Act PMST as occurring within the NWMR

Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			WA *Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Cetaceans - Mysticeti						
Balaenoptera musculus	Blue whale	Endangered	Migratory	Cetacean	Endangered	Conservation Management Plan for the Blue Whale - A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2015-2025 (Commonwealth of Australia, 2015a)
Eubalaena australis	Southern right whale	Endangered	Migratory	Cetacean	Vulnerable	Conservation Management Plan for the Southern Right Whale: A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2011-2021 (DSEWPAC, 2012d)
Balaenoptera borealis	Sei whale	Vulnerable	Migratory	Cetacean	Endangered	Conservation Advice *Balaenoptera borealis* sei whale (Threatened Species Scientific Committee, 2015a)
Megaptera novaeangliae	Humpback whale	Vulnerable	Migratory	Cetacean	Conservation dependent	Conservation Advice *Megaptera novaeangliae* humpback whale (Threatened Species Scientific Committee, 2015b)
Balaenoptera physalus	Fin whale	Vulnerable	Migratory	Cetacean	Endangered	Conservation Advice *Balaenoptera physalus* fin whale (Threatened Species Scientific Committee, 2015c)
Balaenoptera edeni	Bryde's whale	N/A	Migratory	Cetacean	N/A	N/A
Balaenoptera bonaerensis	Antarctic minke whale	N/A	Migratory	Cetacean	N/A	N/A
Cetaceans - Odontoceti						
Physeter macrocephalus	Sperm whale	N/A	Migratory	Cetacean	Vulnerable	N/A
Orcinus orca	Killer whale	N/A	Migratory	Cetacean	N/A	N/A
Orcaella heinsohni	Australian snubfin dolphin	N/A	Migratory	Cetacean	Priority	N/A
Sousa chinensis	Indo-Pacific humpback dolphin	N/A	Migratory	Cetacean	Priority	N/A

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Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			WA *Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Tursiops aduncus	Spotted bottlenose dolphin (Arafura/Timor Sea populations)	N/A	Migratory	Cetacean	N/A	N/A
Sirenians and Pinnipeds						
Dugong dugon	Dugong	N/A	Migratory	Marine	Other protected fauna	N/A
Neophoca cinerea	Australian sea lion	Endangered	N/A	Marine	Vulnerable	Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) 2013 (DSEWPAC, 2013a) Conservation Advice *Neophoca cinerea* Australian Sea Lion (Threatened Species Scientific Committee, 2020a) (in effect under the EPBC Act from 23-Dec-2020)

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7.2 Cetaceans in the NWMR

Cetaceans are generally widely distributed and highly mobile. In general, distribution patterns reflect seasonal feeding areas, characterised by high productivity, and migration routes associated with reproductive patterns. The NWMR is thought to be an important migratory pathway between feeding grounds in the Southern Ocean and breeding grounds in tropical waters for several cetacean species (DSEWPAC, 2012a).

From the Protected Matters search, 34 EPBC Act listed species were recorded as potentially occurring or having habitat within the NWMR (**Appendix A**). Of those, 12 cetacean species are listed as threatened and/or migratory, including baleen whales, toothed whales and dolphins that occur within the NWMR (**Table 7-2**).

7.3 Dugongs in the NWMR

The dugong is listed as migratory under the EPBC Act. Dugongs inhabit seagrass meadows in coastal waters, estuarine creeks and streams, and reef systems (DSEWPAC, 2012a).

Some of the coastal waters adjacent to the NWMR support significant populations of dugongs, including Shark Bay, Exmouth Gulf, in and adjacent to Ningaloo Reef, in coastal waters along the Kimberley coast, and on the edge of the continental shelf at Ashmore Reef (DEWHA, 2008).

Although the patterns of dugong movement in WA are not well understood, it is thought that dugongs move in response to availability of seagrass (Marsh *et al.*, 1994; Preen *et al.*, 1997) and water temperature.

There are a number of BIAs for dugong within and adjacent to waters of the NWMR (refer **Section 7.5**).

7.4 Pinnipeds in the NWMR

The Australian sea lion is listed as a species that may occur, or may have habitat within the NWMR (Protected Matters search - **Appendix A**). It is included here as the Australian sea lion is the only pinniped endemic to Australia (Strahan, 1983) and has been recorded within the southern extent of the NWMR at Shark Bay, WA (Kirkwood *et al.*, 1992). The most northern known breeding colony is at the Houtman Abrolhos Islands in the SWMR. The Australian sea lion's breeding range extends from the Houtman Abrolhos Islands, WA to The Pages Island, east of Kangaroo Island, SA. The Australian sea lion was listed as endangered in 2020 (Threatened Species Scientific Committee, 2020a). An assessment of the status and trends in abundance of this endemic, coastal pinniped species (Goldsworthy *et al.* 2021) documented an overall reduction in pup abundance over three generations, providing strong evidence that the species meets IUCN endangered criteria.

There are no BIAs for the Australian sea lion in the NWMR.

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Table 7-2 Information on the threatened/migratory marine mammal species within the NWMR

Species	Key Information
	Baleen whales (Mysticeti)
Humpback whale	In Australian waters two genetically distinct populations migrate annually along the west (Group IV) and east coasts (Group V) between May and November. In WA, the migration pathway for the Group IV population (also known as Breeding Stock D) extends from Albany to the Kimberley coastline, passing through the NWMR (Threatened Species Scientific Committee, 2015b). Since the 1982 moratorium on commercial whaling population numbers have recovered significantly; from approximately 2000 to 3000 individuals in 1991, to between 19,200–33,850 individuals in 2008 (Bannister and Hedley, 2001; Bejder *et al.*, 2019; Hedley *et al.*, 2011). Aerial surveys off the WA coast undertaken between 2000 and 2008 produced a population estimate for the Group IV population of 26,100 individuals (CI 20,152–33,272) in 2008 (Salgado Kent *et al.*, 2012). Current population growth for the Group IV population is estimated to be between 9.7 and 13% per annum (Threatened Species Scientific Committee, 2015b). Using the Salago-Kent *et al.* (2012) estimate of 26,100 individuals and an annual population growth rate of ~10%, current population size could be in excess of 75,000 individuals (Woodside, 2019). The Group IV population migrates northward from their Antarctic feeding grounds around May each year, reaching the NWMR around early June. The southward migration subsequently starts in mid-September, around the time of breeding and calving (typically August to September) (Threatened Species Scientific Committee, 2015b). Within the NWMR there are key calving areas between Broome and the northern end of Camden Sound, and resting areas in the southern Kimberley region, Exmouth Gulf and Shark Bay. In particular, high numbers of humpback whales are observed in Camden Sound and Pender Bay from June to September each year (Threatened Species Scientific Committee, 2015b). There are reports of neonates further south, suggesting that the calving areas may be poorly defined. Aerial photogrammetric surveys in 2013 and 2015 recorded large numbers of humpback whale calves along North-west Cape, with estimated minimum relative calf abundance of 463–603 in 2013 and 557–725 in 2015 (Irvine *et al.*, 2018). The majority of calves sighted in both years (85% in 2013; 94% in 2015) were neonates, and these observations indicate that a minimum of approximately 20% of the expected number of calves of this population are born near, or south of, North-west Cape. Thus, the calving grounds for the Group IV population extend south from Camden Sound to at least North-west Cape, 1000 km south-west of the currently recognized calving area (Irvine *et al.*, 2018). There are BIAs for migration and breeding and calving for the humpback whale along the WA coast and within the NWMR (refer **Table 7-3** and **Figure 7-1**).
Blue whale	There are two recognised sub-species of blue whale in the Southern Hemisphere, both of which are recorded in Australian waters. These are the southern (or 'true') blue whale (*Balaenoptera musculus*) and the 'pygmy' blue whale (*Balaenoptera musculus brevicauda*) (Commonwealth of Australia, 2015a). In general, southern blue whales occur in waters south of 60°S and pygmy blue whales occur in waters north of 55°S (i.e. not in the Antarctic). On this basis, nearly all blue whales sighted in the NWMR are likely to be pygmy blue whales. The East Indian Ocean (EIO) pygmy blue whale population is seasonally distributed from Indonesia (a potential breeding ground) to south-west of Australia and east across the Great Australian Bight and Bonney Upwelling to beyond the Bass Strait (Blue Planet Marine, 2020). Migration seems to be variable, with some individuals appearing as resident to areas of high productivity and others undertaking migrations across long distances (Commonwealth of Australia, 2015a). McCauley *et al.* (2018) describe three migratory stages around Australia for the EIO pygmy blue whale population: a 'southbound migratory stage' where whales travel southwards from Indonesian waters offshore from the WA coastline, mostly from October to December but possibly into January of the following year; a protracted 'southern Australian stage' (January to June) where animals spread across southern waters of the Indian Ocean and south of Australia; and a 'northbound migratory stage' (April to August) where animals travel north back to Indonesia again. There are currently insufficient data to accurately estimate population numbers of the pygmy blue whale in Australian waters (Blue Planet Marine, 2020; Commonwealth of Australia, 2015a). There are, however, two estimates of population size of the EIO pygmy blue whale for WA. McCauley and Jenner (2010) calculated the population to be between 662 and 1559 individuals in 2004 based on passive acoustics (whale vocalisations), and Jenner *et al.* (2008) (based on photographic mark and recapture) calculated between 712 and 1754 individuals, but both estimates did not account for animals

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Species	Key Information
	travelling further west into the Indian Ocean (McCauley *et al.*, 2018). More recent passive acoustic data estimates a 4.3% growth rate that applies to the proportion of EIO pygmy blue whales seasonally present in offshore water of the south-eastern Australia and may not reflect the full population but does imply an increasing population (McCauley *et al.*, 2018). The pygmy blue whale is typically present in the Perth Canyon from November to June, with an observed peak between March and May (Commonwealth of Australia, 2015a; Blue Planet Marine, 2020). The pygmy blue whale feeds in the Perth Canyon at depths of 200 to 300 m, which overlaps the typical distribution of krill (200–500 m water depth (day) to surface (night) (McCauley *et al.*, 2004; Commonwealth of Australia, 2015a). Other possible feeding grounds off the WA coast include the wider area around the Perth Canyon, and possible foraging areas off the Ningaloo Coast and at Scott Reef (Commonwealth of Australia, 2015a). Refer **Table 7-3** and **Figure 7-2** for the location and type of BIAs for blue whales in the NWMR. There is a migratory BIA for the pygmy blue whale within WA waters, which extends for most of the length of the NWMR within offshore waters.
Bryde's whale	The Bryde's whale is the least migratory of its genus and is restricted geographically from the equator to approximately 40°N and S, or the 20° isotherm (Bannister *et al.*, 1996). The species is known to exhibit inshore and offshore forms in other international locations that vary in morphology and migratory behaviours (Bannister *et al.*, 1996). This appears to also be the case within Australian waters. Bryde's whales have been identified as occurring in both oceanic and inshore waters, with the only key localities recognised in WA being in the Houtman Abrolhos Islands and north of Shark Bay (Bannister *et al.*, 1996). Data suggests offshore whales migrate seasonally, heading towards warmer tropical waters during the winter; however, information about migration within the NWMR is not well known (McCauley and Duncan, 2011). McCauley (2011) detected Bryde's whales using acoustic loggers deployed in and around Scott Reef from 2006 to 2009. Other acoustic logger data of Bryde's whale vocalisations recorded between Ningaloo and north of Darwin showed no apparent trends or seasonality (McCauley, 2011). There are no identified BIAs for this species in the National Conservation Values Atlas.
Southern right whale	The southern right whale occurs primarily in waters between about 20°S and 60°S and moves from high latitude feeding grounds in summer to warmer, low latitude, coastal locations in winter (Bannister *et al.*, 1996). Southern right whales aggregate in calving areas along the south coast of WA outside of the NWMR. However, there have been sightings in waters of the NWMR as far north as Ningaloo (Bannister and Hedley, 2001), and a stranding record exists for the far north Kimberley coast (ALA, 2020). Southern right whale calving grounds are found at mid to lower latitudes and are occupied during the austral winter and early-mid spring. They are regularly present on the southern Australian coast from about mid-May to mid-November, and peak periods for mating are from mid-July through August. Mating occurs within these breeding grounds as evidenced by many observations of intromission and mating behaviours. Southern right whales in south-western Australia appear to be increasing at the maximum biological rate but there is limited evidence of increase in south-eastern Australian waters (DSEWPAC, 2012d). There are no identified BIAs for this species in the NWMR.
Antarctic minke whale	The Antarctic minke whale is distributed worldwide and has been recorded off all Australian states (but not in the NT), feeding in cold waters and migrating to warmer waters to breed. It is thought that the Antarctic minke whale migrates up the WA coast to about 20°S to feed and possibly breed (Bannister *et al.*, 1996); however, detailed information about timing and location of migrations and breeding grounds within the NWMR is not well known. In the high latitudinal winter breeding grounds in other regions, the species appears to be distributed off the continental shelf edge. No population estimates are available for Antarctic minke whales in Australian waters. There are no identified BIAs for this species in the National Conservation Values Atlas.
Sei whale	The sei whale is a baleen whale with a worldwide oceanic distribution and is expected to seasonally migrate between low latitude wintering areas and high latitude summer feeding grounds (Bannister *et al.*, 1996; Prieto *et al.*, 2012). There are no known mating or calving areas in Australian waters. The species has a preference for deep waters, typically occurs in oceanic basins and continental slopes (Prieto *et al.*, 2012), and exhibits a migration pathway influenced by seasonal feeding and breeding patterns. Sei whales have been infrequently recorded in Australian waters (Bannister *et al.*, 1996). Reliable estimates of the sei whale population size in Australian waters are currently not possible due to a lack of dedicated surveys and their elusive characteristics. Similarly, the extent of occurrence and area of occupancy of sei whales in Australian waters cannot be calculated due to the

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Species	Key Information
	rarity of sighting records. They will typically travel in small pods of three to five individuals, with some segregation by age, sex and reproductive status. Calving grounds are presumed to exist in low latitudes with mating and calving potentially occurring during winter months (Threatened Species Scientific Committee, 2015a). There are no known mating or calving areas in Australian waters, and there are no identified BIAs for this species in the National Conservation Values Atlas.
Fin whale	The fin whale is a large baleen whale distributed worldwide. Fin whales migrate annually between high latitude summer feeding grounds and lower latitude over-wintering areas (Bannister *et al.*, 1996) and follow oceanic migration paths. The species is uncommonly encountered in coastal or continental shelf waters. 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). The species has been observed in groups of six to 10 individuals, as well as in pairs and alone (Threatened Species Scientific Committee, 2015c). Accurate distribution patterns are not known within Australian waters and the majority of data are from stranding events. Fin whales have been recorded vocalising off the Perth Canyon, WA, between January and April 2000 (McCauley *et al.*, 2000). It is currently not possible to accurately estimate the population size of fin whales in Australian waters predominantly due to the species' behaviour and local ecology, as the proportion of time they spend at the surface varies greatly depending on these factors. In addition, natural fluctuations of fin whales in Australian waters are unknown; however, long-range movements do appear to be prey-related. A recent study by Aulich *et al.* (2019) used passive acoustic monitoring as a tool to identify the migratory movements of fin whales in Australian waters. On the west coast, the earliest arrival of these animals occurred at Cape Leeuwin in April, and between May and October they migrated along the WA coastline to the Perth Canyon, which likely acts as a way-station for feeding (Aulich *et al.*, 2019). Some whales were found to continue migrating as far north as Dampier (Aulich *et al.*, 2019). There are no identified BIAs for this species in the National Conservation Values Atlas.
Toothed whales (Odontoceti)	
Sperm whale	Sperm whales are the largest of the toothed whales and are distributed worldwide in deep waters (greater than 200 m) off continental shelves and sometimes near shelf edges (Bannister *et al.*, 1996). The species tends to inhabit offshore areas at depths of 600 m or more and is uncommon in waters less than 300 m deep (Ceccarelli *et al.*, 2011). 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. In the open ocean, there is a generalised movement of sperm whales southwards in summer, and corresponding movement northwards in winter, particularly for males. Detailed information about the distribution and migration patterns of sperm whales off the WA coast is not available. Females with young may reside within the NWMR all year round, males may migrate through the region and the species may be associated with canyon habitats (Ceccarelli *et al.*, 2011). Sperm whales have been recorded in deep waters off North-west Cape and appear to occasionally venture into shallower waters in other areas. Twenty-three (23) sightings of sperm whales (variable pod sizes, ranging from one to six animals) were recorded by marine mammal observers (MMOs) during the North West Cape MC3D marine seismic survey (December 2016 to April 2017) (Woodside, 2020). These animals were observed in deep, continental slope waters of the Montebello Saddle (maximum distance of approximately 90 km from North-west Cape), and the waters overlying the Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEF. The deep waters above the gully/saddle on the inner edge of the plateau (the Montebello Saddle) are thought to be important for sperm whales that may feed in the region (based on 19th Century whaling records; Townsend, 1935). There are no identified BIAs for this species in the NWMR.
Killer whale	The preferred habitat of killer whales includes oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions, in both warm and cold waters. Killer whales appear to be more common in cold, deep waters; however, they have been observed along the continental slope and shelf, particularly near seal colonies, as well as in shallow coastal areas of WA (Bannister *et al.*, 1996; Thiele and Gill, 1999). The total number of killer whales in Australian waters is unknown, however, it may be that the total number of mature animals within waters around the continent is less than 10,000. Killer whales are known to make seasonal movements, and probably follow regular migratory routes, but no information is available for the

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Species	Key Information
	species in Australian waters. Killer whales are top-level carnivores, and there are reports from around Australia of attacks on dolphins, juvenile humpback whales, blue whales, sperm whales, dugongs and Australian sea lions (Bannister *et al.*, 1996). Killer whales are known to target humpback whales, particularly calves, off Ningaloo Reef during the humpback southern migration season (Pitman *et al.*, 2015). Overall, observations suggest that humpback calves are a predictable, plentiful, and readily taken prey source for killer whales off Ningaloo Reef for at least five months of the year. Additionally, there are records of killer whales attacking dugongs in Shark Bay (Anderson and Prince, 1985). However, there are no recognised key localities or important habitats for killer whales within the NWMR (DSEWPAC, 2012a). There are no identified BIAs for this species in the NWMR.
Australian snubfin dolphin	Stranding and museum specimen records indicate that Australian snubfin dolphins occur only in waters off northern Australia, from approximately Broome on the west coast to the Brisbane River on the east coast (Parra *et al.*, 2002). Aerial and boat-based surveys indicate that Australian snubfin dolphins occur mostly in protected shallow waters close to the coast, and close to river and creek mouths (Parra, 2006; Parra *et al.*, 2006; Parra *et al.*, 2002). Within the NWMR, species has been found in the shallow coastal waters and estuaries along the Kimberley coast. Beagle and Pender bays on the Dampier Peninsula, and tidal creeks around Yampi Sound and between Kuri Bay and Cape Londonderry are important areas for Australian snubfin dolphins (DEWHA, 2008). Roebuck Bay has generally been considered the south-western limit of snubfin dolphin distribution across northern Australia, but the species has been recorded in Port Hedland harbour, the Dampier Archipelago, Montebello Islands, Exmouth Gulf and off North-west Cape (Allen *et al.*, 2012). A first comprehensive catalogue of snubfin dolphin sightings has been compiled for the Kimberley, north-west Western Australia (Bouchet *et al.* 2021) and documented that snubfin dolphins are consistently encountered in shallow water (<21 m depth) close to (<15 km) freshwater inputs with high detection rates in known hotspots such as Roebuck Bay and Cygnet Bay as well as suitable coastal habitat in the wider Kimberley region. Refer **Table 7-3** and **Figure 7-3** for the location and type of BIAs for Australian snubfin dolphins in the NWMR.
Indo-Pacific humpback dolphin (Australian humpback dolphin)	Previously included with *Sousa chinensis*, the Australian humpback dolphin (*S. sahulensis*) was elevated to a species in 2014. *S. chinensis* is now applied for humpback dolphins in the eastern Indian and western Pacific Oceans and *S. sahulensis* for humpback dolphins in the waters of the Sahul Shelf from northern Australia to southern New Guinea (Jefferson and Rosenbaum, 2014). The Australian humpback dolphin is listed as *S. chinensis* under EPBC Act. The Australian humpback dolphin (referred to as 'humpback dolphin' hereafter) inhabits the tropical/subtropical waters of the Sahul Shelf across northern Australia and southern Papua New Guinea (Jefferson and Rosenbaum, 2014). Based on historical stranding data, museum specimens and opportunistic sightings collected during aerial and boat-based surveys for other fauna it has been inferred that humpback dolphins occur from the WA/NT border south-west to Shark Bay (Hanf *et al.*, 2016). Allen *et al.* (2012) suggested that humpback dolphins use a range of inshore habitats, including both clear and turbid coastal waters across northern WA. The waters surrounding North-west Cape are an important area for the species. Boat-based surveys up to 5 km out from the coast (Brown *et al.*, 2012) recorded humpback dolphins from 0.3 to 4.5 km away from shore and in depths ranging from 1.2 to 20 m, with a mean of ~8 m. Other studies around North-west Cape, surveying waters up to 5 km from the coast, recorded humpback dolphins in water depths of up to 40 m (Hanf *et al.*, 2016). Based on density, site fidelity and residence patterns, North-west Cape is clearly an important habitat toward the south-western limit of this species' range (Hunt *et al.*, 2017). Aerial surveys targeting dugongs over the western Pilbara have recorded humpback dolphins more than 60 km from the mainland in shallow shelf waters (i.e. <30 m deep) near Barrow Island and the western Lowendal Islands (Hanf, 2015). The species has also been recorded in fringing coral reef and shallow, sheltered sandy lagoons at the Montebello Islands (Raudino *et al.*, 2018). Over the past ten years a number of studies have focused on populations of humpback dolphins along the Kimberley coast, including Roebuck Bay, the Dampier Peninsula, Cone Bay, Yampi Sound, Prince Regent River and the Cambridge Gulf (Brown *et al.*, 2016). Refer Table **Table 7-3** and **Figure 7-4** for the location and type of BIAs for Indo-Pacific humpback dolphins in the NWMR.
Indo-Pacific bottlenose dolphin (Spotted bottlenose dolphin)	There are four known sub-populations of spotted bottlenose dolphins, of which the Arafura/Timor Sea populations were identified as potentially occurring within the NWMR. The species is restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands, from Shark Bay to the western edge of the Gulf of Carpentaria. The species

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Species	Key Information
	forages in a range of habitats but is generally restricted to water depths of less than 200 m (DSEWPAC, 2012a). Important foraging/breeding areas include the shallow coastal waters and estuaries along the Kimberley coast and Roebuck Bay. Refer **Table 7-3** the location and type of BIAs for spotted bottlenose dolphins in the NWMR.
Sirenians	
Dugong	Dugongs are distributed along the WA coast throughout the Gascoyne, Pilbara and Kimberley. Specific areas supporting dugong populations include: Shark Bay; Ningaloo and Exmouth Gulf; the Pilbara coast (Exmouth Gulf to De Grey River [Marsh *et al.*, 2002]); and Eighty Mile Beach and the Kimberley coast, including Roebuck Bay (Brown *et al.*, 2014). Dugong distribution is correlated with the seagrass habitats upon which it feeds, although water temperature has also been correlated with dugong movements and distribution (Preen *et al.*, 1997; Preen, 2004). Dugongs are known to migrate between seagrass habitats (hundreds of kilometres) (Sheppard *et al.*, 2006), and in Shark Bay they exhibit seasonal movements as a behavioural thermoregulatory response to winter water temperatures (Holley *et al.*, 2006; Marsh *et al.*, 2011). Aerial surveys since the mid-1980s indicate that dugong populations are now stable at a regional scale in Shark Bay and in the Exmouth/Ningaloo Reef. Refer **Table 7-3** and **Figure 7-5** for the location and type of BIAs for dugong in the NWMR.
Pinnipeds	
Australian sea lion	The Australian sea lion is the only endemic pinniped (true seals, fur seals and sea lions) in Australian waters. It is a member of the Otariidae (eared seals) family. The birth interval in Australian sea lions is around 17–18 months. The Australian sea lion is unique among pinnipeds in being the only species that has a non-annual breeding cycle that is also temporally asynchronous across its range (DSEWPAC, 2013a; Threatened Species Scientific Committee, 2020a). This means the breeding period (copulation and birthing) in one colony will occur at different times to breeding in another colony. The Australian sea lion is considered to be a specialised benthic forager—that is, it feeds primarily on the sea floor. Studies have shown that the species will eat a range of prey, including fish, cephalopods (squid, cuttlefish and octopus), sharks, rays, rock lobsters and penguins (DSEWPAC, 2013a; Threatened Species Scientific Committee, 2020a). The Australian sea lion feeds on the continental shelf, most commonly in depths of 20–100 m, and they typically travel up to about 60 km from their colony on each foraging trip, with a maximum distance of around 190 km when over shelf waters. The current breeding distribution of the Australian sea lion extends from the Houtman Abrolhos Islands on the west coast of WA to the Pages Islands in SA. Sites for the 58 breeding colonies occurring in WA and SA are designated as habitat critical to the survival of the species under the Recovery Plan for the Australian sea lion (DSEWPAC, 2013a). Of these, four are located in the SWMR along the west coast of WA: Abrolhos Islands (Easter Group), Beagle Island, North Fisherman Island and Buller Island. There are also a number of foraging BIAs for both males and females along the west coast, extending from the Abrolhos Islands south to Rockingham. There is no designated habitat critical to survival or identified BIAs for this species in the NWMR. **Figure 7-6** shows the foraging BIAs for the Australian sea lion to the south of the NWMR.

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7.5 Biological Important Areas in the NWMR

BIAs representing important life cycle stages and behaviours for six species of marine mammal in the NWMR: the humpback whale, the pygmy blue whale, Australian snubfin dolphin, Australian humpback dolphin, spotted bottlenose dolphin and dugong, are presented in **Table 7-3**.

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Table 7-3 Marine mammal BIAs within the NWMR

Species	Woodside Activity Area			BIAs				
	Browse	NWS/S	NWC	Resting	Foraging	Breeding	Calving	Migration
Humpback whale[1]	✓	✓	✓	Shark Bay Exmouth Gulf (north migration – early June) (south migration – late Aug to Oct) Southern Kimberley region	No foraging BIA identified within the NWMR	Kimberley coast from the Lacepede Islands to north of Camden Sound (mid Aug – early Sept)	Core calving in waters off the Kimberley coast from the Lacepede Islands to north of Camden Sound (mid Aug – early Sept)	Southern border of the NWMR to north of the Kimberley (arrive June)
Blue whale and Pygmy blue whale [1 2]	✓	✓	✓	No resting BIA identified within the NWMR	Possible foraging areas off Ningaloo and Scott Reef	No breeding BIA identified within the NWMR	No calving BIA identified within the NWMR	Augusta to Derby. Along the shelf edge at depths of 500 m to 1000 m; appear close to Ningaloo coast Montebello Islands area on southern migration (north: April – Aug) (south: Oct – late Dec)
Australian snubfin dolphin [1]	✓	✓	-	No resting BIA identified within the NWMR	Roebuck Bay Cambridge Gulf Camden Sound area King Sound (south) King Sound (north) Yampi Sound Talbot Bay Maret Islands Bigge Island Admiralty Gulf Parry Harbour Bougainville Peninsula Vansittart Bay Anjo Peninsula Napier	Roebuck Bay Cambridge Gulf Camden Sound area King Sound (south) King Sound (north) Yampi Sound Talbot Bay Maret Islands Bigge Island Admiralty Gulf Parry Harbour Bougainville Peninsula Vansittart Bay, Anjo Peninsula Napier Broome Bay Deep Bay Prince Regent River King George River Cape Londonderry	Roebuck Bay Cambridge Gulf Camden Sound area King Sound (south) King Sound (north) Yampi Sound Talbot Bay Maret Islands Bigge Island Admiralty Gulf Parry Harbour Bougainville Peninsula Vansittart Bay Anjo Peninsula Napier Broome Bay Deep Bay Prince Regent River	No migration BIA identified within the NWMR

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Species	Woodside Activity Area			BIAs				
	Browse	NWS/S	NWC	Resting	Foraging	Breeding	Calving	Migration
					Broome Bay Deep Bay Prince Regent River King George River Cape Londonderry Ord River	Ord River	King George River Cape Londonderry Ord River	
Indo-Pacific humpback dolphin	✓	✓	-	No resting BIA identified within the NWMR	Roebuck Bay Willie Creek Prince Regent River King Sound (north) Yampi Sound Talbot Bay Walcott Inlet Doubtful Bay Deception Bay Augustus Island Maret Islands Bigge Island King Sound, southern sector Vansittart Bay, Anjo Peninsula	Roebuck Bay Willie Creek Prince Regent River King Sound (north) Yampi Sound Talbot Bay Walcott Inlet Doubtful Bay Deception Bay Augustus Island	Roebuck Bay Willie Creek Prince Regent River	No migration BIA identified within the NWMR
Spotted bottlenose dolphin	✓	✓	✓	No resting BIA identified within the NWMR	Roebuck Bay Cambridge Gulf Camden Sound area King Sound (south) King Sound (north) Yampi Sound	Roebuck Bay Cambridge Gulf Camden Sound area King Sound (south) King Sound (north) Yampi Sound	No calving BIA identified within the NWMR	No migration BIA identified within the NWMR

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Species	Woodside Activity Area			BIAs				
	Browse	NWS/S	NWC	Resting	Foraging	Breeding	Calving	Migration
Dugong[1]	✓	✓	✓	No resting BIA identified within the NWMR	Exmouth Gulf Ningaloo Reef Shark Bay Roebuck Bay Dampier Peninsula	No breeding BIA identified within the NWMR	Exmouth Gulf Ningaloo Reef Shark Bay	Not listed as a migratory species

1. *DSEWPAC (2012a)*

2. *Commonwealth of Australia (2015a)*

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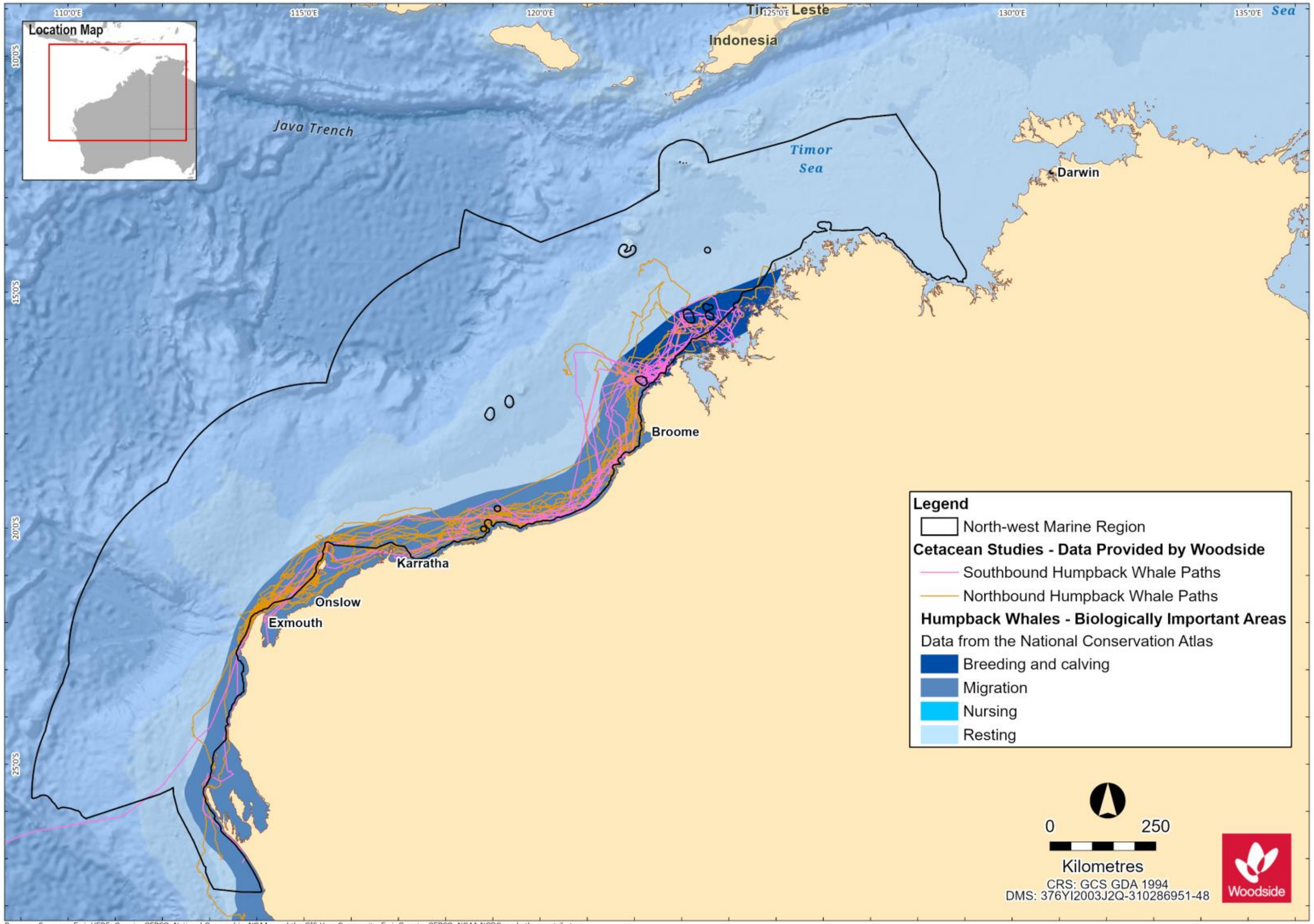

Figure 7-1 Humpback whale BIAs for the NWMR and tagged tracks for north and south bound migrations

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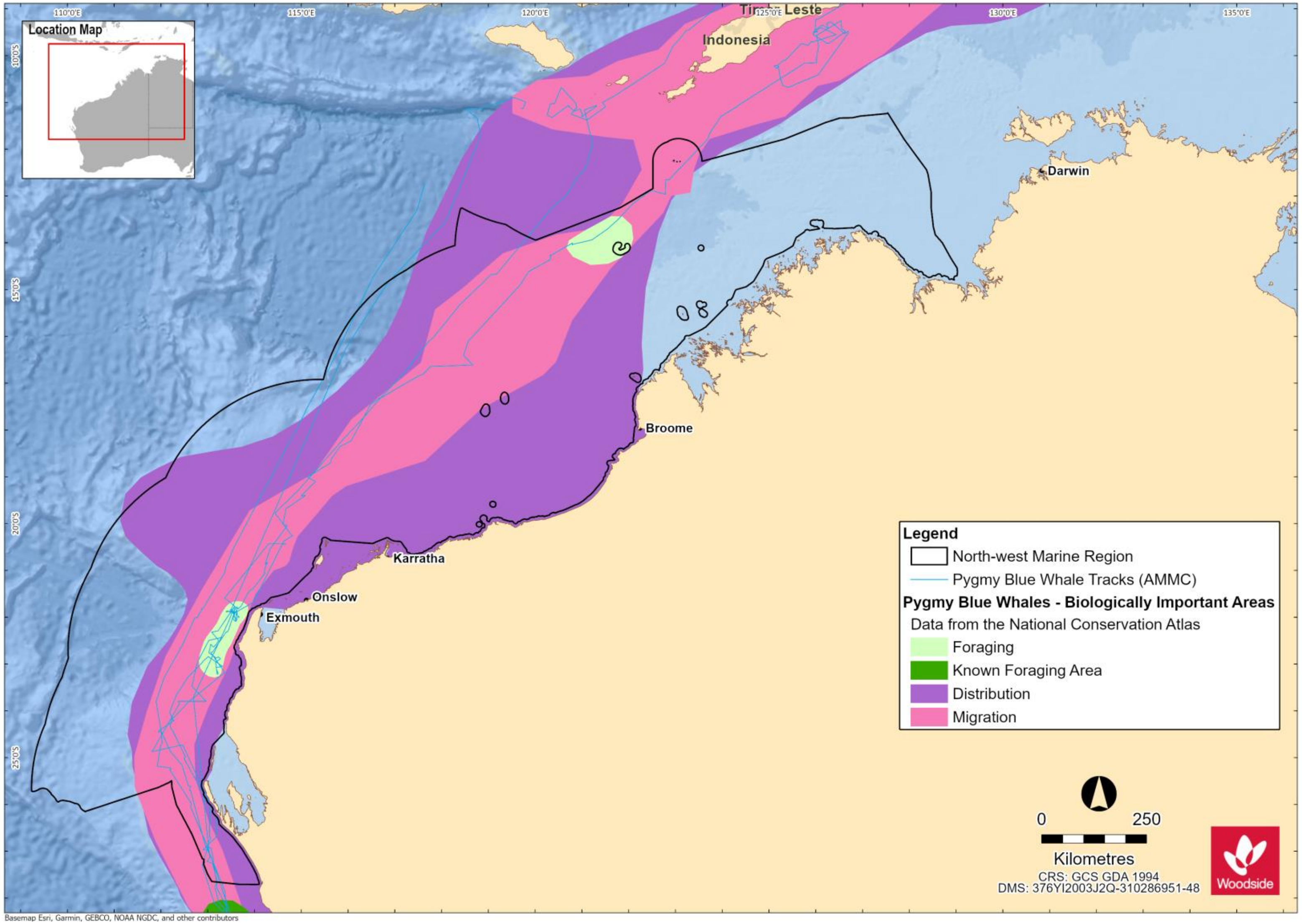

Figure 7-2 Pygmy blue whale BIAs for the NWMR and tagged whale tracks for northbound migration

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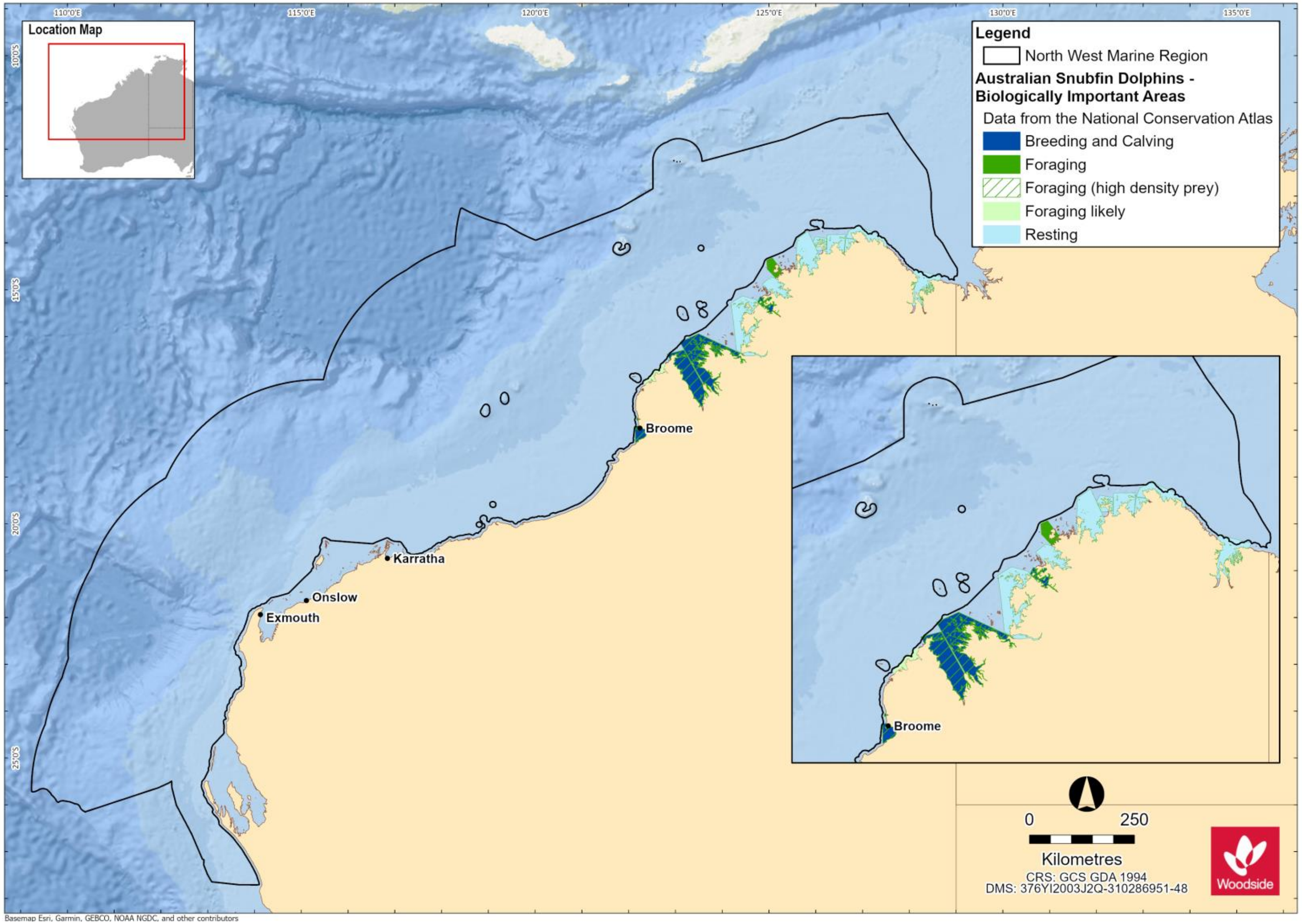

Figure 7-3 Australian snubfin dolphin BIAs for the NWMR

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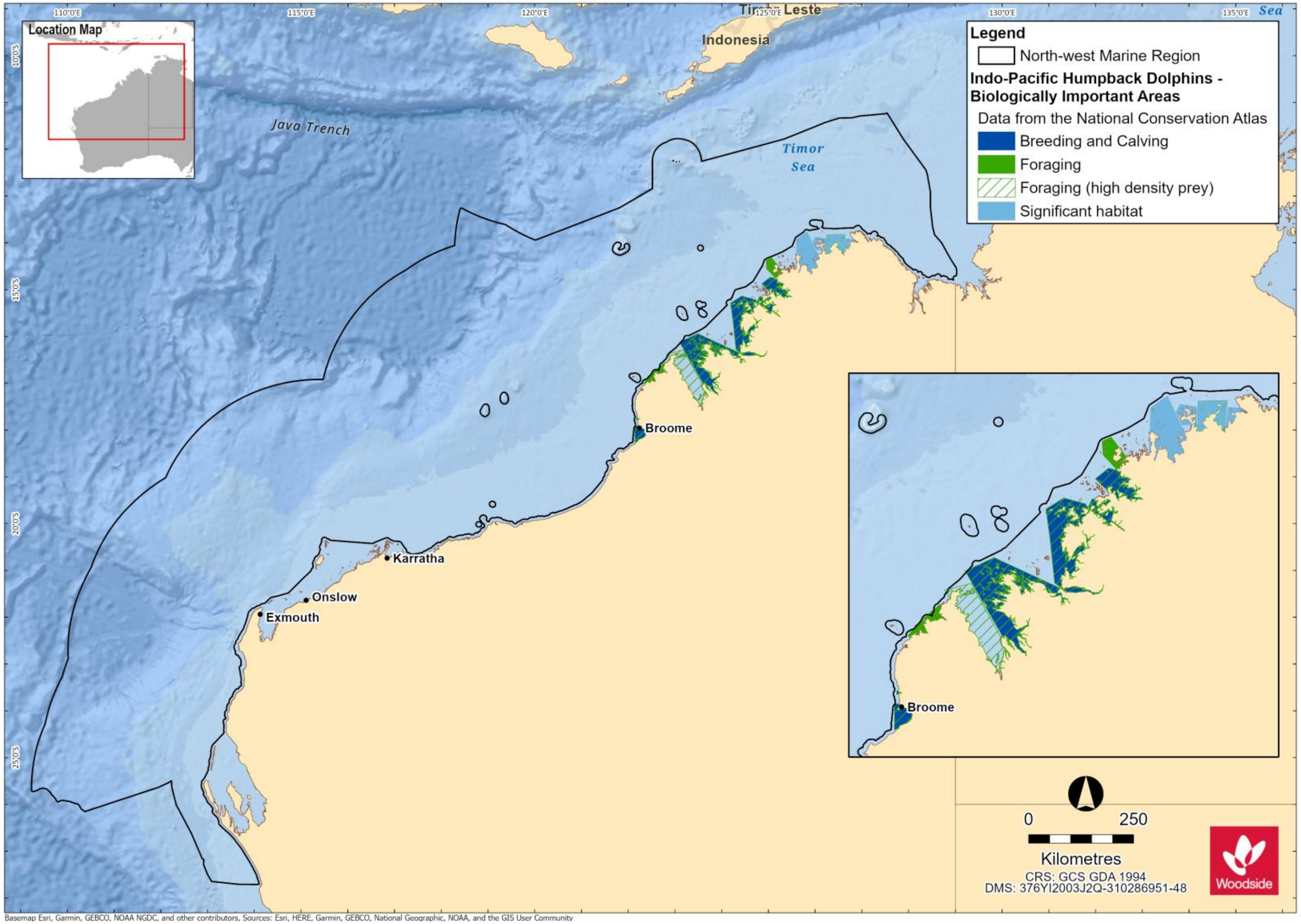

Figure 7-4 Indo-Pacific humpback dolphin BIAs for the NWMR

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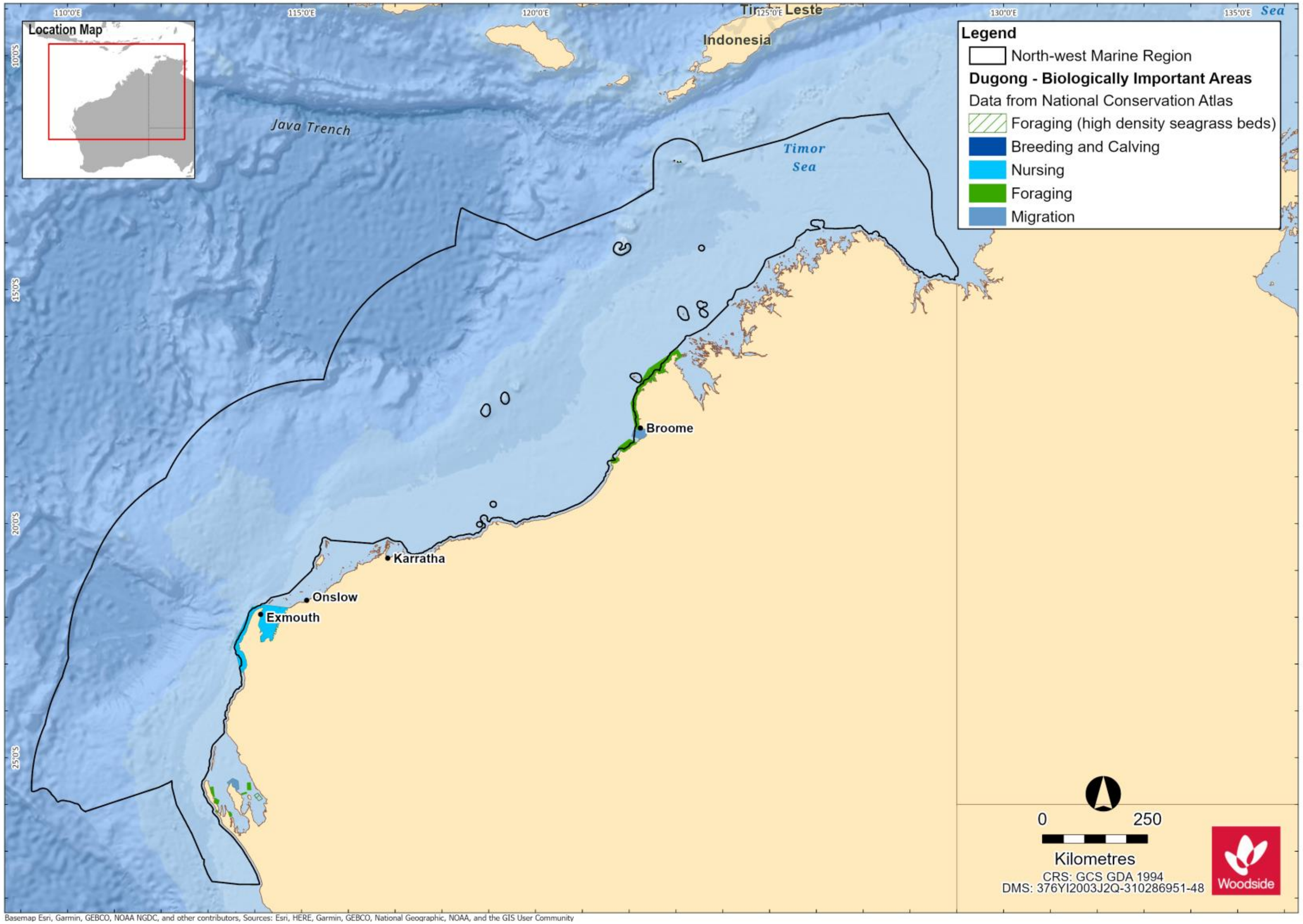

Figure 7-5 Dugong BIAs for the NWMR

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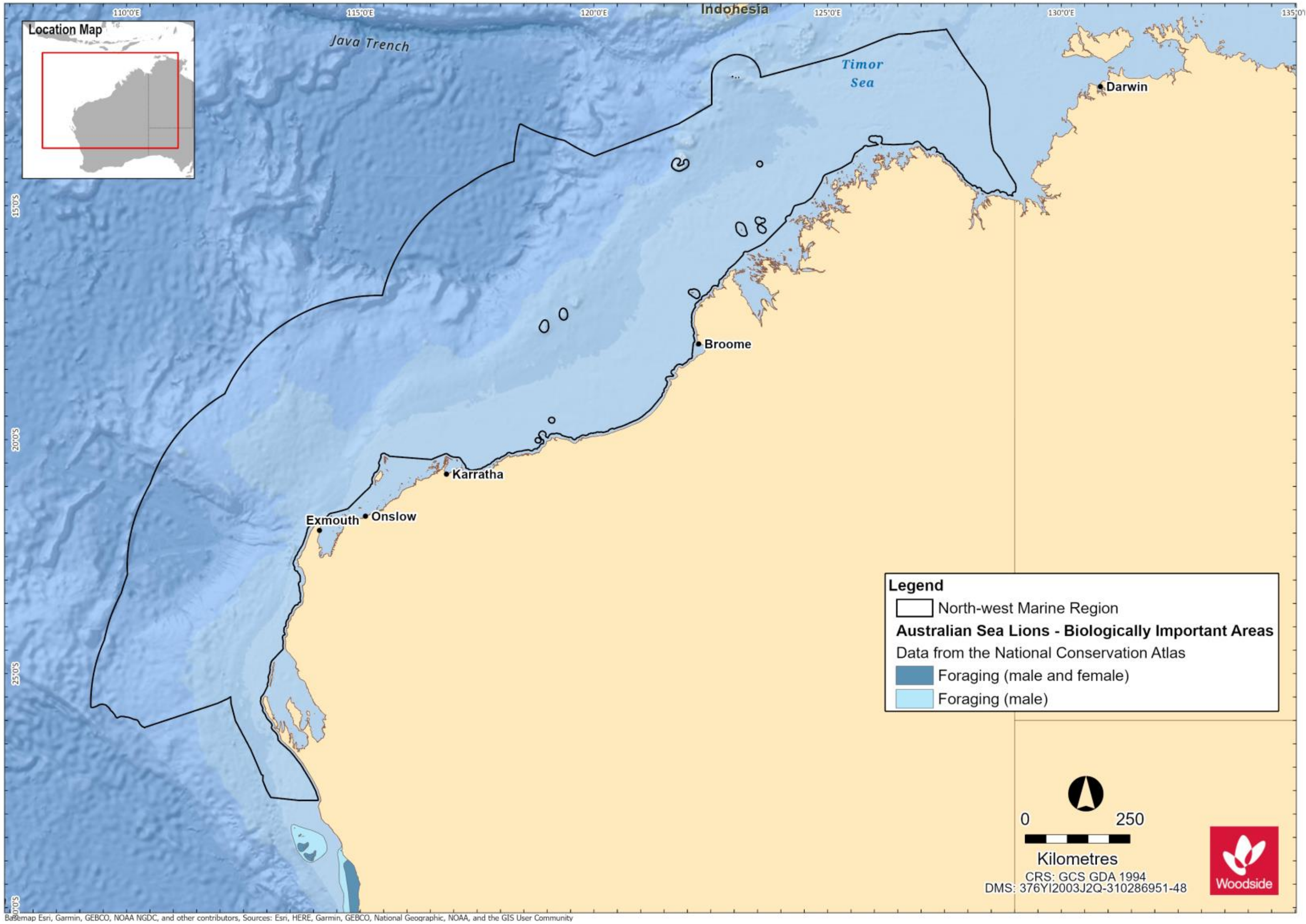

Figure 7-6 Australian sea lion BIAs in the northern extent of the SWMR closest to the NWMR

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7.6 Marine Mammal Summary for the NWMR

7.6.1 Browse

The Browse activity area includes biologically important habitat for five threatened and/or migratory marine mammal species:

- blue whale and pygmy blue whale (foraging and migration areas);
- humpback whale (breeding, calving and migration areas);
- Indo-Pacific humpback dolphin (foraging, breeding and calving areas);
- Australian snubfin dolphin (foraging, breeding and calving areas); and
- dugong (foraging).

BIAs for the marine mammal species are outlined in **Table 7-3**.

7.6.2 North-west Shelf / Scarborough

The NWS / Scarborough activity area includes biologically important habitat for five threatened and/or migratory marine mammal species:

- blue whale and pygmy blue whale (foraging and migration areas);
- humpback whale (resting and migration areas);
- Indo-Pacific humpback dolphin (foraging, breeding and calving areas);
- Australian snubfin dolphin (foraging, breeding and calving areas); and
- dugong (foraging and calving areas).

BIAs for the marine mammal species are outlined in **Table 7-3**.

7.6.3 North-west Cape

The North-west Cape activity area includes biologically important habitat for three threatened and/or migratory marine mammal species:

- blue whale and pygmy blue whale (foraging and migration areas);
- humpback whale (resting and migration areas); and
- dugong (foraging and calving areas).

BIAs for the marine mammal species are outlined in **Table 7-3**.

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8. SEABIRDS AND MIGRATORY SHOREBIRDS OF THE NWMR

8.1 Regional Context

The NWMR supports high numbers and species diversity of seabirds and migratory shorebirds including many that are EPBC Act listed, threatened and migratory. The NWMR marine bioregional plan reported 34 seabird species (listed as threatened, migratory and/or marine) that are known to occur, and 30 of 37 species of migratory shorebird species that regularly occur in Australia, are recorded at Ashmore Reef in the NWMR (DSEWPAC, 2012e). The NWMR marine bioregional plan also noted that Roebuck Bay and Eighty Mile Beach are internationally significant and recognised migratory shorebird locations.

Many migratory seabirds and shorebirds are protected through bilateral agreements between Australia and Japan (JAMBA), China (CAMBA) and the Republic of Korea (ROKAMBA), recognising the migratory route and important stopover and resting habitats of the East Asian-Australasian Flyway (EAAF). Important migratory bird habitats are also recognised as part of protected wetlands of the internationally significance under the Ramsar Convention. Important Bird Areas (IBAs) for the NWMR, which are also recognised as global Key Biodiversity Areas (KBAs) (BirdLife Australia[4]), include:

- Roebuck Bay KBA (and Ramsar site): Internationally significant migratory shorebird species.
- Mandora Marsh and Anna Plains KBA (adjacent to Eighty Mile Beach, Ramsar site): Internationally significant migratory shorebird species.
- Dampier Saltworks KBA: Internationally significant migratory shorebird species.
- Montebello Islands KBA: Shorebird and seabird species.
- Barrow Island KBA: Shorebird and seabird species.
- Exmouth Gulf Mangroves KBA: Internationally significant migratory shorebird species.

Table 8-1 presents a list of the threatened and migratory seabird and shorebird species that occur within the NWMR, with their conservation status and relevant recovery plans and/or conservation advice.

4 https://www.birdlife.org.au/projects/KBA#:~:text=The%20Key%20Biodiversity%20Areas%20(KBAs,of%20advocacy%20for%20protected%20areas. Accessed April, 2021.

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Table 8-1. Bird species (threatened/migratory) identified by the EPBC Act PMST and other sources of information as potentially occurring within the NWMR

Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			WA *Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Seabirds						
Macronectes giganteus	Southern giant petrel	Endangered	Migratory	Marine	Migratory	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPAC, 2011c)
Papasula abbotti	Abbott's booby	Endangered	N/A	Marine	N/A	Conservation Advice for the Abbott's booby - *Papasula abbotti* (Threatened Species Scientific Committee, 2020b)
Pterodroma mollis	Soft-plumaged petrel	Vulnerable	N/A	Marine	N/A	Conservation Advice *Pterodroma mollis* soft-plumaged petrel (Threatened Species Scientific Committee, 2015f)
Sternula nereis nereis	Australian fairy tern	Vulnerable	N/A	N/A	Vulnerable	Conservation Advice for *Sternula nereis nereis* (Fairy Tern) (DSEWPAC, 2011d)
Anous tenuirostris melanops	Australian lesser noddy	Vulnerable	N/A	Marine	Endangered	Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy (Threatened Species Scientific Committee, 2015e)
Thalassarche carteri	Indian yellow-nosed albatross	Vulnerable	Migratory	Marine	Endangered	National recovery plan for threatened albatrosses and giant petrels 2011-2016 (DSEWPAC, 2011c)
Anous stolidus	Common noddy	N/A	Migratory	Marine	Migratory	Draft Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2019)
Fregata ariel	Lesser frigatebird	N/A	Migratory	Marine	Migratory	
Fregata minor	Great frigatebird	N/A	Migratory	Marine	Migratory	
Sula leucogaster	Brown booby	N/A	Migratory	Marine	Migratory	
Sula sula	Red-footed booby	N/A	Migratory	Marine	Migratory	

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Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			WA *Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Onychiprion anaethetus (listed as *Sterna anaethetus)*	Bridled tern	N/A	Migratory	Marine	Migratory	
Thalasseus bergii	Greater crested tern	N/A	Migratory	Marine	Migratory	
Sternula albifrons	Little tern	N/A	Migratory	Marine	Migratory	
Sterna dougallii	Roseate tern	N/A	Migratory	Marine	Migratory	
Onychoprion fuscata	Sooty tern	N/A	N/A	Marine	N/A	
Hydroprogne caspia	Caspian tern	N/A	Migratory	Marine	Migratory	
Ardenna pacifica	Wedge-tailed shearwater	N/A	Migratory	Marine	Migratory	
Puffinus assimillis	Little shearwater	N/A	N/A	Marine	N/A	
Ardenna carneipes	Flesh-footed shearwater	N/A	Migratory	Marine	Vulnerable	
Calonectris leucomelas	Streaked shearwater	N/A	Migratory	Marine	Migratory	
Phaethon lepturus	White-tailed tropicbird	N/A	Migratory	Marine	Migratory	
Chroicocephalus novaehollandiase	Silver gull	N/A	N/A	Marine	N/A	
Migratory shorebirds						
Numenius madagascariensis	Eastern curlew, Far Eastern curlew	Critically endangered	Migratory	Marine	Critically endangered	Conservation Advice *Numenius madagascariensis* eastern curlew (DOE, 2015a)
Calidris ferruginea	Curlew sandpiper	Critically endangered	Migratory	Marine	Critically endangered	Conservation Advice *Calidris ferruginea* curlew sandpiper (DOE, 2015b)
Calidris tenuirostris	Great knot	Critically endangered	Migratory	Marine	Critically endangered	Conservation Advice *Calidris tenuirostris* Great knot (Threatened Species Scientific Committee, 2016a)
Limosa lapponica menzbieri	Bar-tailed godwit (*menzbieri*)	Critically endangered	Migratory	Marine	Critically endangered	Conservation Advice *Limosa lapponica menzbieri* Bar-tailed godwit (northern Siberia). (Threatened Species Scientific Committee, 2016c)

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Species Name	Common Name	*Environment Protection and Biodiversity Conservation Act 1999*			WA *Biodiversity Conservation Act 2016*	EPBC Act Part 13 Statutory Instrument
		Threatened Status	Migratory Status	Listed	Conservation Status	
Calidris canutus	Red knot	Endangered	Migratory	Marine	Endangered	Conservation Advice *Calidris canutus* Red knot (Threatened Species Scientific Committee, 2016b)
Charadrius mongolus	Lesser sand plover	Endangered	Migratory	Marine	Endangered	Conservation Advice *Charadrius mongolus* Lesser sand plover (Threatened Species Scientific Committee, 2016e)
Charadrius leschenaultii	Greater sand plover	Vulnerable	Migratory	Marine	Vulnerable	Conservation Advice *Charadrius leschenaultia* Greater sand plover (Threatened Species Scientific Committee, 2016d)
All migratory shorebird species	Wildlife Conservation Plan for Migratory Shorebirds (Commonwealth of Australia, 2015c).					

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8.2 Seabirds in the NWMR

Seabirds are birds that are adapted to life within the marine environment (oceanic and coastal) and are generally long-lived, have delayed breeding and have fewer young than other bird species (Commonwealth of Australia, 2019). At least 34 seabird species listed as threatened, migratory and/or marine under the EPBC Act are known to occur regularly in the NWMR and include a variety of species of terns, noddies, petrels, shearwaters, frigatebirds, and boobies. Many of these species spend most of their lives at sea (predominately pelagic species), ranging over large distances to forage. These pelagic species only come onshore to breed and raise chicks at natal or high-fidelity breeding colonies on remote, offshore island locations in and adjacent to the NWMR. Many species are ecologically significant to the NWMR, as they are endemic to the region, can be present in large numbers in breeding seasons and non-breeding seasons, and many exhibit extensive annual migrations that include marine areas outside the Australian EEZ (DSEWPAC, 2012e).

The presence of seabirds within the NWMR is influenced by seabird species that migrate and forage in the area during the non-breeding season and this includes many seabird species that breed on the Houtman Abrolhos in the SWMR. Pelagic seabirds have been documented foraging at current boundaries and seasonal upwellings within the NWMR (refer to Sutton *et al*., 2019). The Houtman Abrolhos Islands National Park located in the SWMR, is one of the most significant seabird breeding locations in the eastern Indian Ocean. Sixteen (16) species of seabirds breed there. Eighty percent of common (brown) noddies, 40% of sooty terns and all the lesser noddies found in Australia nest at the Houtman Abrolhos (Surman, 2019). Important seabird areas in the NWMR are as identified by the KBAs (refer to **Section 8.1**) and the information on a select number of seabird species documented for the NWMR (based on the screening criteria presented in **Section 3**), as presented in **Table 8-2**.

Table 8-2 Information on threatened/migratory seabird species of the NWMR

Species	Key Information
Seabirds	
Southern giant petrel	This species is included in the National recovery plan for threatened albatrosses and giant petrels. Habitat critical to survival is defined for breeding and foraging. There are six known breeding localities under Australian jurisdiction (for all species giant petrels) and all are located in the Southern Ocean including islands off Tasmania and within the Australian Antarctic Territory (DSEWPAC, 2011c). Habitat critical to survival identified for foraging is defined as waters south of 25 degrees latitude. The giant petrel species distribution is mainly within the Southern Ocean but this species does migrate into subtropical waters during the winter and its distribution includes the southern extent of the NWMR. No BIAs for this species are located in the NWMR.
Abbott's booby	The Abbott's booby is a large, long-lived seabird known to nest only at Christmas Island. The recovery of this species is strongly dependent on the protection of breeding habitat defined habitat critical to the survival of this species on Christmas Island (Threatened Species Scientific Committee, 2020b). This species spends much of its time at sea and known to forage over large distances offshore when nesting and its range includes off the coast of Java, near the Chagos and in the Banda Sea, and may possibly extend into the north-western extent of the NWMR. No BIAs for this species are located in the NWMR.
Soft-plumaged petrel	This petrel species breeds only at two locations in Australian waters within the Southern Ocean (one off Tasmania and Macquarie Island) (Threatened Species Scientific Committee, 2015f). As a mainly sub-Antarctic species they are usually distributed in cooler seas but distribution extents into subtropical waters and its known distribution includes the southern extent of the NWMR. No BIAs for this species are located in the NWMR.
Australian fairy tern	The Australian fairy tern is listed as Vulnerable for the sub-species only recorded for WA. It has a coastal distribution from Sydney, south to Tasmania and around southern WA up to the Dampier Archipelago and out on the offshore island groups of Barrow, Montebello and the Lowendals (DSEWPAC, 2011d). The Australian fairy tern feeds on small baitfish and roosts and nests on sandy beaches below vegetation. These behaviours, generally, occur in inshore waters of island archipelagos and on the Australian mainland shores and adjacent wetlands. Fairy terns breed from August to February. The Australian fairy tern is unlikely to be present

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Species	Key Information
	within the offshore environment of the NWMR. The largest breeding colony in Western Australia for this species is in the Houtman Abrolhos Islands, SWMR (Surman, 2019). For the description and location of BIAs in the NWMR, refer to **Table 8-3** and **Figure 8-2.**
Australian lesser noddy	The Houtman Abrolhos, WA is an important breeding habitat for the Australian lesser noddy in the eastern Indian Ocean. This species exhibits nesting habitat specialisation (white mangrove stands) and has a limited foraging range during the breeding season. Furthermore, the lesser noddy forages over shelf waters and appears not to disperse over their non-breeding period as they remain largely in the general vicinity or slightly to the south of the colony in the non-breeding season (February to September; Surman *et al*., 2018). No BIAs for this species are located in the NWMR.
Indian yellow-nosed albatross	This species is included in the National recovery plan for threatened albatrosses and giant petrels. Habitat critical to survival is defined for breeding and foraging. There are six known breeding localities under Australian jurisdiction (for all species of albatrosses) and all are located in the Southern Ocean including islands off Tasmania and within the Australian Antarctic Territory (DSEWPAC, 2011c). Habitat critical to survival identified for foraging is defined as waters south of 25 degrees latitude. All albatross species distribution (including the Indian yellow-nose albatross) is mainly within the Southern Ocean but this species does migrate into subtropical waters during the winter and its distribution includes the southern extent of the NWMR. No BIAs for this species are located in the NWMR.
Common noddy	This species is listed as migratory and marine. The common (or brown) noddy is the largest species of noddy found in Australian waters. The species is widespread in tropical and subtropical areas beyond Australia. This seabird species is gregarious and normally occurs in flocks, up to hundreds of individuals, when feeding or roosting. The Houtman Abrolhos, WA is the primary breeding habitat for the common noddy in the Eastern Indian Ocean. This species spends their non-breeding season (March to August) in the NWS area, around 950 km north from the breeding colony (Surman *et al*. 2018). The species occurs within NWMR waters, particularly around offshore islands such as the Montebello Island group. This species is recorded on unmanned oil and gas platforms within the NWS. No BIAs for this species are located in the NWMR.
Lesser frigatebird **Great frigatebird**	Both species of frigatebird are listed as migratory and marine. Within the NWMR, the lesser frigatebird is known to breed on Adele, Bedout and West Lacepede islands, Ashmore Reef and Cartier Island (Commonwealth of Australia, 2019). 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. Breeding/foraging BIAs for the lesser frigatebird are located in the NWMR; refer to **Table 8-3**.
Brown booby	The brown booby is the most common booby, occurring throughout all tropical oceans bounded by latitudes 30º N and 30º S. There are large colonies on offshore islands within the NWMR such as the Lacepede Islands (one of the largest colonies in the world), Ashmore Reef, and other offshore Kimberley islands. This seabird species is a specialised plunge diver, mostly eating fish and some cephalopods (Commonwealth of Australia, 2019). Breeding/foraging BIAs for the brown booby are located in the NWMR; refer to **Table 8-3** and **Figure 8-3**.
Red-footed booby	Within the NWMR, its known breeding sites for this species include Ashmore Reef and Cartier Island. It is a pelagic species and generally occurs away from land. It mainly eats flying fish and squid. Prey abundance is reliant on the high productivity in slope areas off remote islands where the birds breed (Commonwealth of Australia, 2019). Breeding/foraging BIAs for the red-footed booby are located in the NWMR; refer to **Table 8-3** and **Figure 8-3**.
Greater crested tern	The greater crested tern has a widespread distribution recorded on islands and coastlines of tropical and subtropical areas, ranging from the Atlantic coast of South Africa, Indian Ocean and through south-east Asia and Australia. Outside the breeding season it can be found at sea throughout its range, with the exception of the central Indian Ocean (Commonwealth of Australia, 2019). The largest breeding colony in WA for this species is the Houtman Abrolhos Islands, SWMR (Surman, 2019). No BIAs for this species are located in the NWMR.
Little tern	There are three sub-populations of this species in Australia and two of these occur in the NWMR: northern Australian breeding sub-population occurring around Broome and extending across in to the NMR, and an east Asian breeding sub-population, with the terns present from Shark Bay to south-eastern Queensland during the austral summer. Little terns

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Species	Key Information
	usually forage close to breeding colonies in the shallow water of estuaries (Commonwealth of Australia, 2019). For the description and location of BIAs in the NWMR, refer to **Table 8-3** and **Figure 8-2**.
Roseate tern	This species is generally tropical in distribution and there are many breeding populations in the NWMR, including Ashmore Reef, Napier Broome Bay, Bonaparte Archipelago, Lacepede Islands, Dampier Archipelago and the Lowendal Islands. A large number of non-breeding roseate terns have been observed at several remote locations in the Kimberley and there are high numbers also recorded for Eighty Mile Beach Ramsar site. The Kimberley colonies are likely to be another sub-species that breeds in east Asia. Roseate terns predominately eat small pelagic fish (Commonwealth of Australia, 2019). The largest breeding colony in Western Australia for this species is in the Houtman Abrolhos Islands, SWMR (Surman, 2019). For the description and location of BIAs in the NWMR, refer to **Table 8-3** and **Figure 8-2**.
Wedge-tailed shearwater	The wedge-tailed shearwater is a pelagic, marine seabird known from tropical and subtropical waters. Its distribution is widespread across the Indian and Pacific oceans. It is known to breed on the east and west coasts (and offshore islands) of Australia. This species is known to consume fish, cephalopods, and other biota primarily via contact-dipping. Wedge-tailed shearwaters are now understood to undertake extensive foraging trips (over thousands of kilometres over periods of days when chicking and provisioning young) and much longer and extensive pelagic travels over the north-west Indian Ocean during the non-breeding season, targeting current boundaries and upwellings. The species breeds throughout its range, mainly on vegetated islands, atolls and cays and excavates burrows in the ground where chicks are raised (Commonwealth of Australia, 2019). Large breeding colonies of the wedge-tailed shearwater are located on the Houtman Abrolhos islands (SWMR) (Surman *et al*., 2018) and several locations in the NWMR including: Muiron Islands (North-west Cape), Varanus Island and the Dampier Archipelago in the Pilbara where burrow numbers were estimated to several hundred thousand to half a million such as on the Muiron Islands, though it is not known if all burrows are utilised on an annual basis (Birdlife Australia, 2018; Surman *et al.*, 2018). Cannell *et al* (2019) satellite tracked adult wedge-tailed shearwaters during egg incubation and chick rearing on the Muiron Islands in January 2018. For the incubation trips, there was a strong consistency for the birds to travel towards seamounts, typically located north-west of the Muiron Islands, between Australia and Indonesia. One bird however remained south-west of the islands, in the Cape Range Canyon. A similar pattern to utilise areas associated with sea mounts was also observed for the long foraging trips during chick rearing, though some of the foraging was concentrated in deeper waters. A bimodal foraging strategy during chick-rearing was observed, with adults undertaking long foraging trips after a series of shorter foraging trips within the NWMR. Surman *et al*. (2018) reported most wedge-tailed shearwaters from the breeding colonies on the Houtman Abrolhos undertook extensive non-breeding migrations. This seabird species occupied waters adjacent or to the north of their nesting sites or migrated 4200 km north-west into the equatorial central Indian Ocean near the Ninety East Ridge during the non-breeding season (later April to mid-November). For the description and location of BIAs in the NWMR, refer to **Table 8-3** and **Figure 8-1**.
Flesh-footed shearwater	The species mainly occurs in the subtropics, over continental shelves and slopes and occasionally inshore waters, with individual birds pass through the tropics and over deeper waters during migration to the North Pacific and Indian oceans (Commonwealth of Australia, 2019). They are a common visitor to the waters off southern Australia, from south-western WA to south-eastern Queensland. The fleshy-footed shearwater is a trans-equatorial migrant, breeding from late September to May off south-western Australia, and migrating north by early May, across the southern Indian and possibly Indonesia to the northern Pacific Ocean. No BIAs for the flesh-footed shearwater are located in the NWMR.
Streaked shearwater	The streaked shearwater has a broad distribution in the western Pacific Ocean, breeding on the coast and offshore islands of Japan, Russia, China and the Korean Peninsula. During winter months (non-breeding season), the species undertakes trans-equatorial migration to the coasts of Vietnam, New Guinea, the Philippines, Australia, southern India and Sri Lanka. The streaked shearwater feeds mainly on fish and squid that it catches by surface-seizing and shallow plunges (Commonwealth of Australia, 2019). No BIAs for the streaked shearwater are located in the NWMR.
White-tailed tropicbird	Tropicbirds are predominately pelagic species and the white-tailed tropicbird forages in warm waters and over long distances (pan-tropical). The species is most common off north-west Australia. In the NWMR, this species is considered a sub-species and are limited in number and distribution. Nesting sites are known for Clerke Reef (Rowley Shoals) and Ashmore

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Species	Key Information
	Reef. Christmas Island is also a known nesting site and the species can disperse several thousand kilometres during foraging trips. This species feeds mainly on fish and cephalopods, captured by deep plunge diving (Commonwealth of Australia, 2019). There are breeding BIAs at the Rowley Shoals and Ashmore Reef within the NWMR for the white-tailed tropicbird; refer to **Table 8-3**.
Silver gull	The silver gull is typically described as an inshore and coastal foraging seabird and has an Australian-wide distribution including locations within the NWMR. It is noted as it has been recorded on unmanned oil and gas platforms located within the NWS.

8.2.1 Biologically Important Areas in the NWMR

BIAs representing important life cycle stages and behaviours for eight species of seabird in the NWMR are presented in **Table 8-3**.

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Table 8-3 Seabird BIAs within the NWMR

Seabird Species	Woodside Activity Area			BIAs			
	Browse	NWS/S	NWC	Breeding/foraging	Foraging	Breeding	Resting
Australia fairy tern	-	✓	✓	-	No foraging BIAs in the NWMR Foraging in high numbers: the BIA is located in the SWMR including the Houtman Abrolhos Islands	Dampier Archipelago, Montebello, Lowendal and Barrow Island Groups, south Ningaloo and barrier island of Shark Bay	-
Wedge-tailed shearwater	✓	✓	✓	Widespread area of the NWMR offshore and inshore waters	Foraging in high numbers: the BIA is located in the SWMR including the Houtman Abrolhos Islands	-	-
Great frigatebird	✓	-	-	Ashmore Reef, Adele Island	-	-	-
Lesser frigatebird	✓	✓	-	Off Eighty Mile Beach, Lacepedes, Adele Island, North Kimberley and Ashmore Reef	-	-	-
Brown booby	✓	✓	-	Off Eighty Mile Beach, Lacepedes, Adele Island, North Kimberley and Ashmore Reef	-	-	-
Red-footed booby	✓	-	-	Adele Island, Ashmore Reef	-	-	-
Little tern	✓	✓	-	Rowley Shoals, Adele Island	-	-	-
Roseate tern	✓	✓	✓	-	No foraging BIAs in the NWMR Foraging (provisioning young) and foraging BIAs located in the SWMR – Houtman Abrolhos Islands the	Dampier Archipelago, Montebello, Lowendal and Barrow Island Groups, south Ningaloo and barrier island of Shark Bay	Eighty Mile Beach

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Seabird Species	Woodside Activity Area			BIAs			
	Browse	NWS/S	NWC	Breeding/foraging	Foraging	Breeding	Resting
					nearest BIA to the NWMR		
White-tailed tropicbird	✓	-	-			Rowley Shoals Ashmore Reef	

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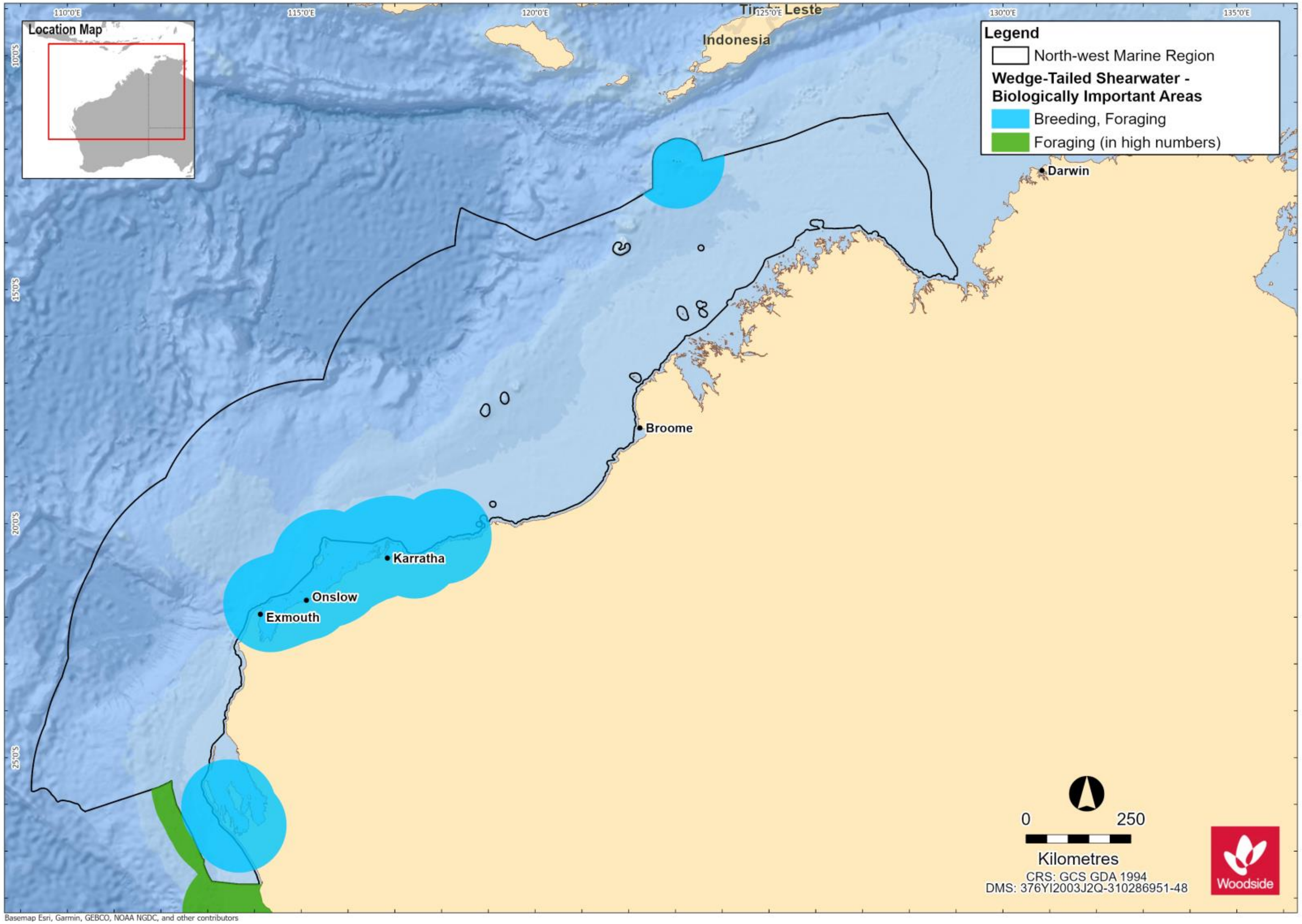

Figure 8-1 Wedge-tailed shearwater BIAs for the NWMR

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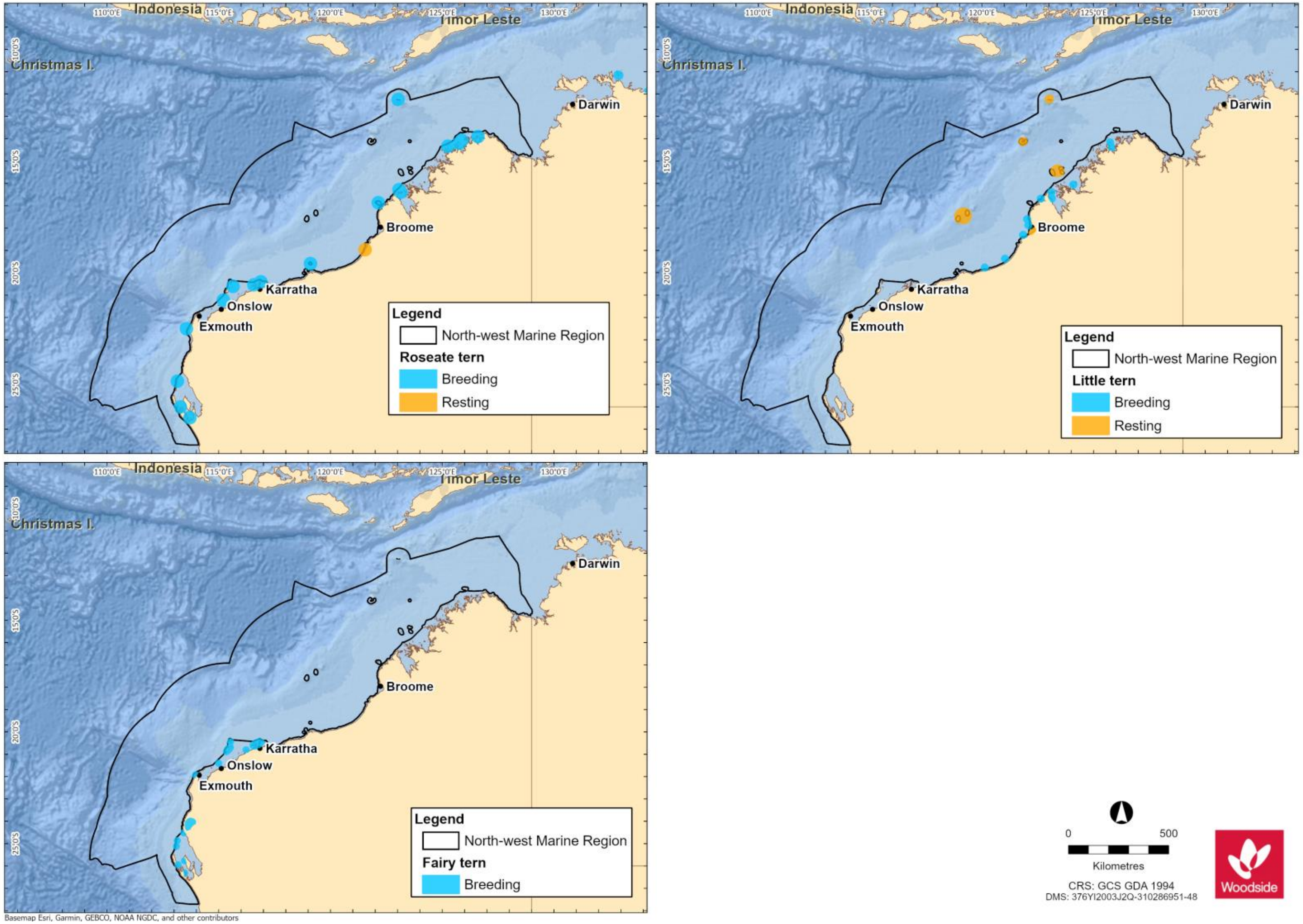

Figure 8-2 Tern species BIAs for the NWMR

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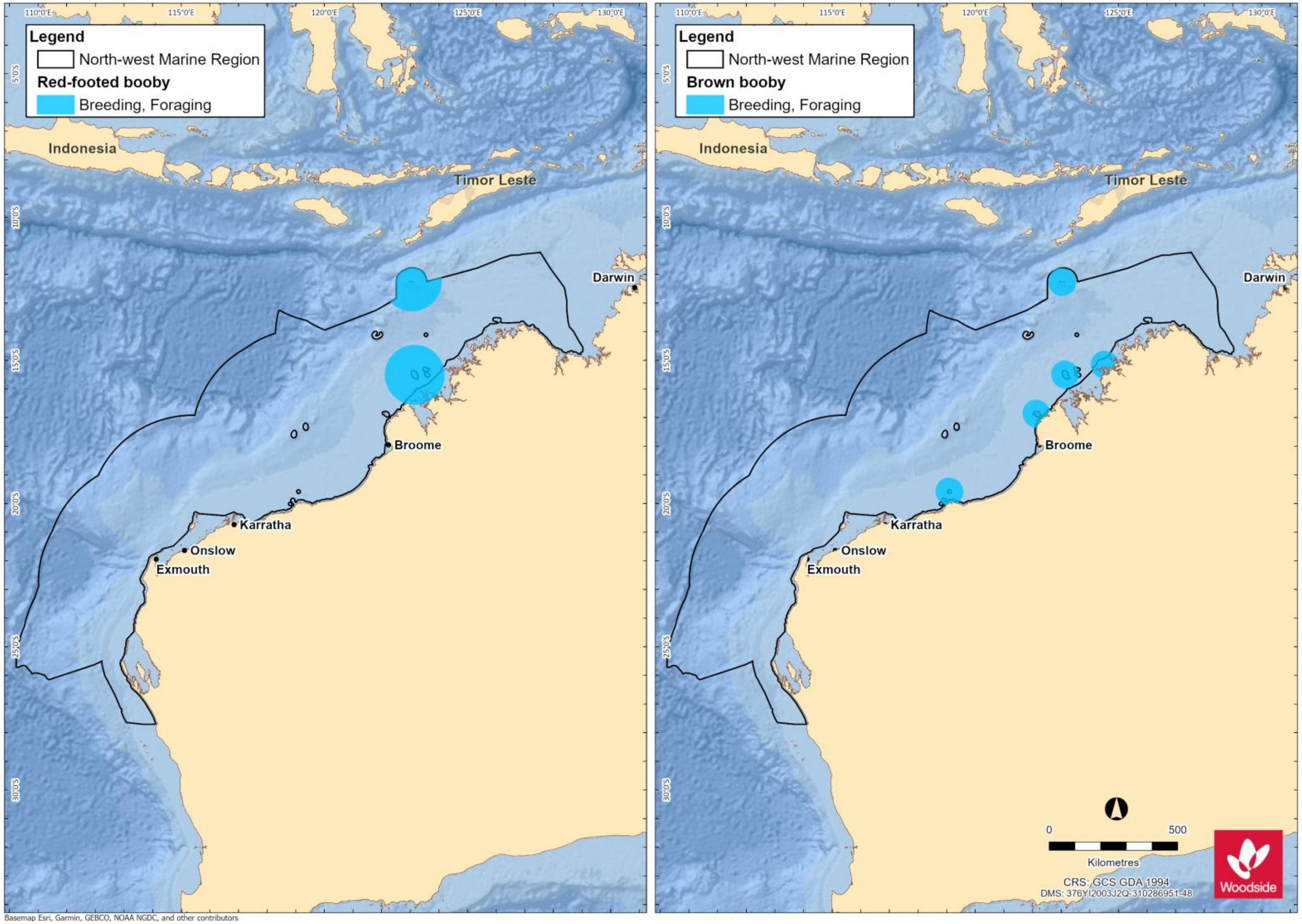

Figure 8-3 Red-footed and brown booby BIAs for the NWMR

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8.2.2 Seabird Summary for NWMR

8.2.2.1 Browse

The Browse activity area includes biologically important habitat for seven threatened and/or migratory seabird species:

- wedge-tailed shearwater (breeding/foraging);
- great and lesser frigatebirds (breeding/foraging);
- brown booby (breeding/foraging);
- red-footed booby (breeding/foraging);
- little tern (breeding/foraging);
- roseate tern (breeding and resting); and,
- white-tailed tropicbird (breeding).

BIAs for the seabird species are outlined in **Table 8-3**.

8.2.2.2 NWS / Scarborough

The NWS / Scarborough activity area includes biologically important habitat for five threatened and/or migratory seabird species:

- wedge-tailed shearwater (breeding/foraging);
- lesser frigatebird (breeding/foraging);
- brown booby (breeding/foraging);
- little tern (breeding/foraging); and
- roseate tern (breeding and resting).

BIAs for the seabird species are outlined in **Table 8-3**.

8.2.2.3 North-west Cape

The North-west Cape activity area includes biologically important habitat for five threatened and/or migratory seabird species:

- Australian fairy tern (breeding);
- wedge-tailed shearwater (breeding/foraging); and
- roseate tern (breeding and resting).

BIAs for the seabird species are outlined in **Table 8-3**.

8.3 Shorebirds

Shorebirds (migratory and resident species) are generally associated with wetland or coastal environments, and the NWMR hosts a large number of many shorebird species, particularly in the Austral summer (refer to **Appendix A** for the EPBC Act PMST reports on listed species of shorebirds). Shorebirds may use coastal environments for feeding, nesting or migratory stopovers. In coastal environments, shorebirds generally feed during low tide on exposed intertidal mud and sand flats, and roost in suitable habitat above the high water mark. Many shorebird species undergo annual migrations, typically breeding at high latitudes of the Northern Hemisphere and migrating south for the non-breeding season and Australia is part of the East Asian-Australasian Flyway (EAAF). The EAAF extends from breeding grounds in the Russian tundra, Mongolia and Alaska

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southwards through east and south-east Asia, to non-breeding areas of Indonesia, Papua New Guinea, Australia and New Zealand (Weller and Lee, 2017). The EAAF is of most relevance to the NWMR. There are 37 species of shorebird which annually migrate to Australia via the EAAF and 36 of these species spend the austral summer (non-breeding season) foraging and roosting in coastal and wetland habitats (Commonwealth of Australia, 2015c; Weller and Lee, 2017).

Ashmore Reef is documented as a BIA for migratory shorebirds in the NWMR (DSEWPAC, 2012a).

Table 8-4. Information on threatened/migratory shorebird species of the NWMR

Species	Key Information
Shorebirds	
Eastern curlew, Far eastern curlew	This species is the largest, migratory shorebird in the world, with a long neck, long legs and a very long downcurved bill and is a long-haul flyer. The eastern curlew is a coastal species with a continuous distribution north from Barrow Island to the Kimberley region. The species is endemic to the EAAF and is a non-breeding visitor to Australia from August to March, primarily foraging on crabs and molluscs in intertidal mudflats. During the non-breeding season in Australia, this species is most associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (DOE, 2015a).
Curlew sandpiper	The curlew sandpiper breeds in northern Siberia but has a non-breeding range that extends from western Africa to Australia, with small numbers reaching New Zealand (Bamford *et al*., 2008). In Australia, curlew sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. Records occur in all states and the NT during the non-breeding period, and also during the breeding season when many non-breeding one-year old birds remain in Australia rather than migrating north along the EAAF. The species preferred habitat for foraging is mudflats and nearby shallow waters in sheltered coastal areas such as estuaries, bay, inlets and lagoons (DOE, 2015b).
Great knot	The great knot breeds in the Northern Hemisphere and undertakes biannual migrations along the EAAF to non-breeding habitat in Australia. The great knot winters in Australia and has been recorded around the entirety of the Australian coast the greatest numbers are found in northern Western Australia (Pilbara (Dampier Archipelago) and Kimberley and the Northern Territory. In Australia, this species prefers sheltered, coastal habitat with large intertidal mudflats or sandflats (inkling inlets, bays, harbours, estuaries and lagoons). High numbers (exceeding several thousand birds are regularly recorded from Roebuck Bay. The great knot feeds on a variety of invertebrates by pecking at or just below the surface of moist mud or sand (Threatened Species Scientific Committee, 2016a).
Bar-tailed godwit (*menzbieri*)	The bar-tailed godwit is a large, migratory shorebird and there are two sub-species in the EAAF (*Limosa lapponica baueri* and *L. l. menzbieri*). The sub-species *L. l. menzbieri* breeds in northern Siberia and spends its non-breeding period mostly in the north of WA but also in South-east Asia. The bar-tailed godwit (*menzbieri*) usually forages near the water in shallow water, mainly in tidal estuaries and harbours with a preference for exposed sandy or soft mud substrates on intertidal flats, banks and beaches (Threatened Species Scientific Committee, 2016c).
Red knot (*piersmai*)	This species is a small to medium migratory shorebird. There are two sub-species that cannot be distinguished from each other in nonbreeding plumage, however, *Calidris canutus piersmai* tend to overwinter almost exclusively in north-west Australia. 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 with migration along the EAAF. Very large numbers are recorded for the north-west Australia and is common in all suitable habitats around the coast, including inland clay pans near Roebuck Bay (where the species roosts). The red knot usually forages in soft substrate along the waters edge on intertidal mudflats, sandflats and sandy beaches of sheltered coasts (Threatened Species Scientific Committee, 2016b).
Lesser sand plover	The lesser sand plover is a small to medium shorebird and one of 36 migratory shorebirds that breed in the Northern Hemisphere during the boreal summer and are known to annually migrate to the non-breeding grounds of Australia along the EAAF for the austral summer. There are five different sub-species and it is most likely the non-breeding ranges of the sub-species *Charadrius m. mongolus* overlaps with the NWMR. This species is widespread in coastal regions, preferring sandy beaches, mudflats of coastal bays and estuaries (Threatened Species Scientific Committee, 2016e).
Greater sand plover	The greater sand plover is a small to medium shorebird and in its non-breeding plumage is difficult to distinguish from the lesser sand plover. This species breeds in the Northern

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Species	Key Information
	Hemisphere and undertakes annual migrations to and from Southern Hemisphere feeding grounds in the austral summer along the EAAF. The species distribution in Australia during the non-breeding season is widespread, in WA the greater sand plover is widespread between Northwest Cape and Roebuck Bay (Threatened Species Scientific Committee, 2016d).

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9. KEY ECOLOGICAL FEATURES

Key ecological features (KEFs) are elements of the Commonwealth marine environment that are considered to be important for a marine region's biodiversity or ecosystem function and integrity. KEFs have been identified by the Australian Government based on 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), or
  - biodiversity and endemism (species which only occur in a specific area),
- a unique seafloor feature, with known or presumed ecological properties of regional significance.

Thirteen KEFs are designated within the NWMR, twelve KEFs within the SWMR and eight KEFs within the NMR. These KEFs have been identified in the Protected Matters search (**Appendix A**) and outlined in **Table 9-1, Table 9-2** and **Table 9-3,** and **Figure 9-1, Figure 9-2** and **Figure 9-3**.

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Table 9-1 Key Ecological Features (KEF) within the NWMR

KEF Name	Woodside Activity Area			Values[1]	Description
	Browse	NWS/S	NW Cape		
Carbonate bank and terrace system of the Sahul Shelf	✓	-	-	Unique seafloor feature with ecological properties of regional significance Regionally important because of their role in enhancing biodiversity and local productivity relative to their surrounds. The carbonate banks and terraces provide areas of hard substrate in an otherwise soft sediment environment which are important for sessile species	The Carbonate banks and terrace system of the Sahul Shelf are located in the western Joseph Bonaparte Gulf and to the north of Cape Bougainville and Cape Londonderry. The carbonate banks and terraces are part of a larger complex of banks and terraces that occurs on the Van Diemen Rise in the adjacent NMR. The bank and terrace system of the Van Diemen Rise covers approximately 31,278 km^2 and forms part of the larger system associated with the Sahul Banks to the north and Londonderry Rise to the east. The feature is characterised by terrace, banks, channels and valleys (DSEWPAC, 2012c). The banks, ridges and terraces of the Van Diemen Rise are raised geomorphic features with relatively high proportions of hard substrate that support sponge and octocoral gardens. These, in turn, provide habitat to other epifauna, by providing structure in an otherwise flat environment (Przeslawski *et al.*, 2011). Plains and valleys are characterised by scattered epifauna and infauna that include polychaetes and ascidians. These epibenthic communities support higher order species such as olive ridley turtles, sea snakes and sharks (DSEWPAC, 2012c)
Pinnacles of the Bonaparte Basin	✓	-	-	Unique seafloor feature with ecological properties of regional significance Provide areas of hard substrate in an otherwise soft sediment environment and so are important for sessile species Recognised as a biodiversity hotspot for sponges The Pinnacles of the Bonaparte Basin KEF is located within both the NWMR and NMR (refer **Table 9-3**)	The Pinnacles of the Bonaparte Basin provide areas of hard substrate in an otherwise relatively featureless environment, the pinnacles are likely to support a high number of species, although a better understanding of the species richness and diversity associated with these structures is required (DSEWPAC, 2012a, 2012c). Covering >520 km^2 within the Bonaparte Basin, this feature contains the largest concentration of pinnacles along the Australian margin. The Pinnacles of the Bonaparte Basin are thought to be the eroded remnants of underlying strata; it is likely that the vertical walls generate local upwelling of nutrient-rich water, leading to phytoplankton productivity that attracts aggregations of planktivorous and predatory fish, seabirds, and foraging turtles (DSEWPAC, 2012a, 2012c).
Ashmore Reef and Cartier Island and surrounding Commonwealth waters	✓	-	-	High productivity, biodiversity and aggregation of marine life that apply to both the benthic and pelagic habitats within the feature	Ashmore Reef is the largest of only three emergent oceanic reefs present in the north-eastern Indian Ocean and is the only oceanic reef in the region with vegetated islands. Ashmore contains a large reef shelf, two large lagoons, several channelled carbonate sand flats, shifting sand cays, an extensive reef flat, three vegetated islands—East, Middle and West islands—and

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KEF Name	Woodside Activity Area			Values[1]	Description
	Browse	NWS/S	NW Cape		
					surrounding waters. Rising from a depth of more than 100 m, the reef platform is at the edge of the NWS and covers an area of 239 km². Ashmore Reef and Cartier Island and the surrounding Commonwealth waters are regionally important for feeding and breeding aggregations of birds and other marine life; they are areas of enhanced primary productivity in an otherwise low-nutrient environment (DSEWPAC, 2012a). Ashmore Reef supports the highest number of coral species of any reef off the WA coast.
Seringapatam Reef and the Commonwealth waters in the Scott Reef complex	✓	-	-	Support diverse aggregations of marine life, have high primary productivity relative to other parts of the region, are relatively pristine and have high species richness, which apply to both the benthic and pelagic habitats within the feature	Seringapatam Reef and the Commonwealth waters in the Scott Reef complex are regionally important in supporting the diverse aggregations of marine life, high primary productivity, and high species richness associated with the reefs themselves. As two of the few offshore reefs in the north-west, they provide an important biophysical environment in the region (DSEWPAC, 2012a).
Continental slope demersal fish communities	✓	✓	✓	High biodiversity of demersal fish assemblages, including high levels of endemism	The diversity of demersal fish assemblages on the continental slope in the Timor Province, the Northwest Transition and the North-west Province is high compared to elsewhere along the Australian continental slope (DSEWPAC, 2012a). The continental slope between North-west Cape and the Montebello Trough has more than 500 fish species, 76 of which are endemic, which makes it the most diverse slope bioregion in Australia (Last *et al.*, 2005). The slope of the Timor Province and the Northwest Transition also contains more than 500 species of demersal fishes of which 64 are considered endemic (Last *et al.*, 2005), making it the second richest area for demersal fishes throughout the whole continental slope. Demersal fish species occupy two distinct demersal biomes associated with the upper slope (225–500 m water depths) and the mid-slope (750–1000 m). Although poorly known, it is suggested that the demersal slope communities rely on bacteria and detritus-based systems comprised of infauna and epifauna, which in turn become prey for a range of teleost fishes, molluscs and crustaceans (Brewer *et al.*, 2007). Higher-order consumers may include carnivorous fishes, deepwater sharks, large squid, and toothed whales (Brewer *et al.*, 2007). Pelagic production is phytoplankton-based, with hot spots around oceanic reefs and islands (Brewer *et al.*, 2007).

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KEF Name	Woodside Activity Area			Values[1]	Description
	Browse	NWS/S	NW Cape		
Ancient coastline at 125 m depth contour	✓	✓	✓	Unique seafloor feature with ecological properties of regional significance Provides areas of hard substrate and therefore may provide sites for higher diversity and enhanced species richness relative to surrounding areas of predominantly soft sediment	Several steps and terraces as a result of Holocene sea level changes occur in the region, with the most prominent of these features occurring as an escarpment along the NWMR and Sahul Shelf at a water depth of 125 m. The Ancient Coastline is not continuous throughout the NWMR and coincides with a well-documented eustatic stillstand at about 130 m worldwide (Falkner *et al.*, 2009). Where the Ancient Coastline 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 Ancient Coastline, represented as rocky escarpment, are considered to provide biologically important habitat in an area predominantly made up of soft sediment. The escarpment type features may also potentially facilitate mixing within the water column due to upwelling, providing a nutrient-rich environment. Although the Ancient Coastline adds additional habitat types to a representative system, the habitat types are not unique to the coastline as they are widespread on the upper shelf (Falkner *et al.*, 2009)
Canyons linking the Argo Abyssal Plain and Scott Plateau	-	✓	-	Facilitates nutrient upwelling, creating enhanced productivity and encouraging diverse aggregations of marine life	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). As a result, aggregations of whale sharks, manta rays, humpback whales, sea snakes, sharks, predatory fishes and seabirds are known to occur in the area due to its enhanced productivity (Sleeman *et al.*, 2007).
Glomar Shoal	-	✓	-	An area of high productivity and aggregations of marine life including commercial and recreational fish species	Glomar Shoal is a submerged littoral feature located about 150 km north of Dampier on the Rowley shelf at depths of 33–77 m (Falkner *et al.*, 2009). Studies by Abdul Wahab *et al.* (2018) found a number of hard coral and sponge species in water depths less than 40 m. One hundred and seventy (170) different species of fishes were detected with greatest species richness and abundance in shallow habitats (Abdul Wahab *et al.*, 2018). Fish species present include a number of commercial and recreational species such as Rankin cod, brown striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish (Falkner *et al.*, 2009; Fletcher and Santoro, 2009). These species have recorded high catch rates associated with Glomar Shoal, indicating that the shoal is likely to be an area of high productivity.

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KEF Name	Woodside Activity Area			Values[1]	Description
	Browse	NWS/S	NW Cape		
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	-	✓	-	Regionally important in supporting high species richness, higher productivity and aggregations of marine life	The Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals KEF and is adjacent to the three nautical mile State waters limit surrounding Clerke and Imperieuse reefs, and include the Mermaid Reef Marine Park as described in **Section 10**. The reefs provide a distinctive biophysical environment in the region. They have steep and distinct reef slopes and associated fish communities. In evolutionary terms, the reefs may play a role in supplying coral and fish larvae to reefs further south via the southward flowing Indonesian Throughflow. Both coral communities and fish assemblages differ from similar habitats in eastern Australia (Done *et al.*, 1994).
Exmouth Plateau	-	✓	✓	Unique seafloor feature with ecological properties of regional significance, which apply to both benthic and pelagic habitats Likely to be an important area of biodiversity as it provides an extended area offshore for communities adapted to depths of approximately 1000 m	The Exmouth Plateau is a large, mid-slope, continental margin plateau that lies off the northwest coast of Australia. It ranges in depth from about 500 to more than 5000 m and is a major structural element of the Carnarvon Basin (Miyazaki and Stagg, 2013). The large size of the Exmouth Plateau and its expansive surface may modify deep water flow and be associated with the generation of internal tides; both of which may subsequently contribute to the upwelling of deeper, nutrient-rich waters closer to the surface (Brewer *et al.*, 2007). Satellite observations suggest that productivity is enhanced along the northern and southern boundaries of the plateau (Brewer *et al.*, 2007). Sediments on the plateau suggest that biological communities include scavengers, benthic filter feeders and epifauna (DSEWPAC, 2012a). Fauna in the pelagic waters above the plateau are likely to include small pelagic species and nekton attracted to seasonal upwellings, as well as larger predators such as billfishes, sharks and dolphins (Brewer *et al.*, 2007). Protected and migratory species are also known to pass through the region, including whale sharks and cetaceans.
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	-	-	✓	Unique seafloor feature with ecological properties of regional significance The feature is an area of moderately enhanced productivity, attracting aggregations of fish and higher-order consumers such as large predatory	The canyons are associated with upwelling as they channel deep water from the Cuvier Abyssal Plain up onto the slope. This nutrient-rich water interacts with the Leeuwin Current at the canyon heads (DSEWPAC, 2012a). Aggregations of whale sharks, manta rays, sea snakes, sharks, large predatory fish, and seabirds are known to occur in this area.

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KEF Name	Woodside Activity Area			Values[1]	Description
	Browse	NWS/S	NW Cape		
				fish, sharks, toothed whales and dolphins Likely to be important due to their historical association with sperm whale aggregations	
Commonwealth waters adjacent to Ningaloo Reef	-	-	✓	High productivity and diverse aggregations of marine life The Commonwealth waters adjacent to Ningaloo Reef and associated canyons and plateau are interconnected and support the high productivity and species richness of Ningaloo Reef, globally significant as the only extensive coral reef in the world that fringes the west coast of a continent	The Leeuwin and Ningaloo currents interact, leading to areas of enhanced productivity in the Commonwealth waters adjacent to Ningaloo Reef. Aggregations of whale sharks, manta rays, humpback whales, sea snakes, sharks, large predatory fish, and seabirds are known to occur in this area (DSEWPAC, 2012a). The spatial boundary of this KEF, as defined in the NCVA, is defined as the waters contained in the existing Ningaloo AMP provided in **Section 10**.
Wallaby Saddle	-	-	✓	High productivity and aggregations of marine life: Representing almost the entire area of this type of geomorphic feature in the NWMR. It is a unique habitat that neither occurs anywhere else nearby (within hundreds of kilometres) nor with as large an area (Falkner *et al.* 2009)	The Wallaby Saddle may be an area of enhanced productivity. Historical whaling records provide evidence of sperm whale aggregations in the area of the Wallaby Saddle, possibly due to the enhanced productivity of the area and aggregations of baitfish (DSEWPAC, 2012a).

[1]. Values description sourced from Marine bioregional plan for the North-west Marine Region (DSEWPAC, 2012a) and the Department of Agriculture, Water and the Environment (DAWE) SPRAT database.

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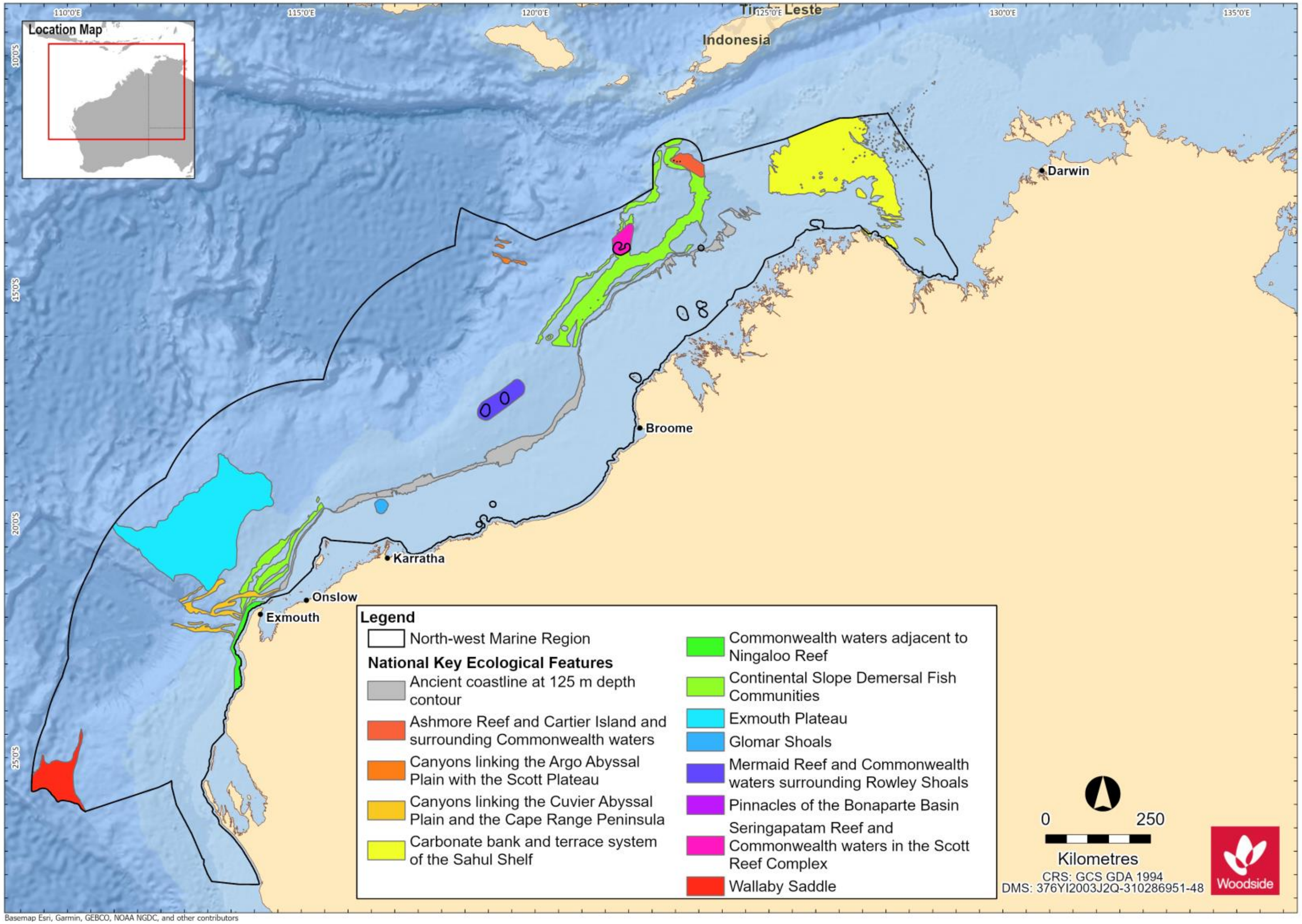

Figure 9-1 Key Ecological Features (KEFs) within the NWMR.

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Table 9-2 Key Ecological Features (KEF) within the SWMR

KEF Name	Values[1]	Description
Albany Canyons group and adjacent shelf break	High productivity and aggregations of marine life, and unique seafloor feature with ecological properties of regional significance Both benthic and demersal habitats within the feature are of conservation value	The Albany Canyons group is thought to be associated with small, periodic subsurface upwelling events, which may drive localised regions of high productivity. The canyons are known to be a feeding area for sperm whale and sites of orange roughy aggregations. Anecdotal evidence also indicates that this area supports fish aggregations that attract large predatory fish and sharks.
Ancient coastline at 90-120 m depth	Relatively high productivity and aggregations of marine life, and high levels of biodiversity and endemism The feature creates topographic complexity, that may facilitate benthic biodiversity and enhanced biological productivity	Benthic biodiversity and productivity occur where the ancient coastline forms a prominent escarpment, such as in the western Great Australian Bight, where the sea floor is dominated by sponge communities of significant biodiversity and structural complexity.
Cape Mentelle upwelling	Facilitates nutrient upwelling, supporting high productivity and diverse aggregations of marine life	The Cape Mentelle upwelling draws relatively nutrient-rich water from the base of the Leeuwin Current, up the continental slope and onto the inner continental shelf, where it results in phytoplankton blooms at the surface. The phytoplankton blooms provide the basis for an extended food chain characterised by feeding aggregations of small pelagic fish, larger predatory fish, seabirds, dolphins and sharks.
Commonwealth marine environment surrounding the Houtman Abrolhos Islands (and adjacent shelf break)	High levels of biodiversity and endemism within benthic and pelagic habitats	The Houtman Abrolhos Islands and surrounding reefs support a unique mix of temperate and tropical species, resulting from the southward transport of species by the Leeuwin Current over thousands of years. The Houtman Abrolhos Islands are the largest seabird breeding station in the eastern Indian Ocean. They support more than one million pairs of breeding seabirds.

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KEF Name	Values[1]	Description
Commonwealth marine environment surrounding the Recherche Archipelago	Aggregations of marine life and high levels of biodiversity and endemism within benthic and demersal communities	The Recherche Archipelago is the most extensive area of reef in the SWMR. Its reef and seagrass habitat supports a high species diversity of warm temperate species, including 263 known species of fish, 347 known species of molluscs, 300 known species of sponges, and 242 known species of macroalgae. The islands also provide haul-out (resting areas) and breeding sites for Australian sea lions and New Zealand fur seals.
Commonwealth marine environment within and adjacent to the west-coast inshore lagoons	High productivity and aggregations of marine life within benthic and pelagic habitats Important for benthic productivity and recruitment for a range of marine species	These lagoons are important for benthic productivity, including macroalgae and seagrass communities, and breeding and nursery aggregations for many temperate and tropical marine species. They are important areas for the recruitment of commercially and recreationally important fish species. Extensive schools of migratory fish visit the area annually, including herring, garfish, tailor and Australian salmon.
Commonwealth marine environment within and adjacent to Geographe Bay	High productivity and aggregations of marine life, and high levels of biodiversity, recruitment within benthic and pelagic communities	Geographe Bay is known for its extensive beds of tropical and temperate seagrass that support a diversity of species, many of them not found anywhere else. The bay provides important nursery habitat for many species. Juvenile dusky whaler sharks use the shallow seagrass habitat as nursery grounds for several years, before ranging out to adult feeding grounds along the shelf break. The seagrass also provides valuable habitat for fish and invertebrates (Carruthers *et al.*, 2007). It is also an important resting area for migratory humpback whales.
Diamantina Fracture Zone	Unique seafloor feature with ecological properties of regional significance which apply to its benthic and demersal habitats	The Diamantina Fracture Zone is a rugged, deep- water environment of seamounts and numerous closely spaced troughs and ridges. Very little is known about the ecology of this remote, deep- water feature, but marine experts suggest that its size and physical complexity mean that it is likely to support deep-water communities characterised by high species diversity, with many species found nowhere else.
Naturaliste Plateau	Unique seafloor feature with ecological properties of regional significance including high species diversity and endemism which apply to its benthic and demersal habitats	The Naturaliste Plateau is Australia's deepest temperate marginal plateau. The combination of its structural complexity, mixed water dynamics and relative isolation indicate that it supports deep- water communities with high species diversity and endemism.
Perth Canyon and adjacent shelf break, and other west-coast canyons	An area of higher productivity that attracts feeding aggregations of deep-diving mammals and large predatory fish. It is also recognised as a unique seafloor feature with ecological properties of regional significance	The Perth Canyon is the largest known undersea canyon in Australian waters. Deep ocean currents rise to the surface, creating a nutrient-rich cold- water habitat attracting feeding aggregations of deep-diving mammals, such as pygmy blue whales and large predatory fish that feed on aggregations of small fish, krill and squid.

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KEF Name	Values[1]	Description
Western demersal slope and associated fish communities of the Central Western Province	Provides important habitat for demersal fish communities and supports species groups that are nationally or regionally important to biodiversity	The western demersal slope provides important habitat for demersal fish communities, with a high level of diversity and endemism. A diverse assemblage of demersal fish species below a depth of 400 m is dominated by relatively small benthic species such as grenadiers, dogfish and cucumber fish. Unlike other slope fish communities in Australia, many of these species display unique physical adaptations to feed on the sea floor (such as a mouth position adapted to bottom feeding), and many do not appear to migrate vertically in their daily feeding habits.
Western rock lobster	A species that plays a regionally important ecological role	This species is the dominant large benthic invertebrate in the region. The lobster plays an important trophic role in many of the inshore ecosystems of the SWMR. Western rock lobsters are an important part of the food web on the inner shelf, particularly as juveniles.

1. Values description sourced from Marine bioregional plan for the South-west Marine Region (DSEWPAC, 2012b) and the Department of Agriculture, Water and the Environment (DAWE) SPRAT database

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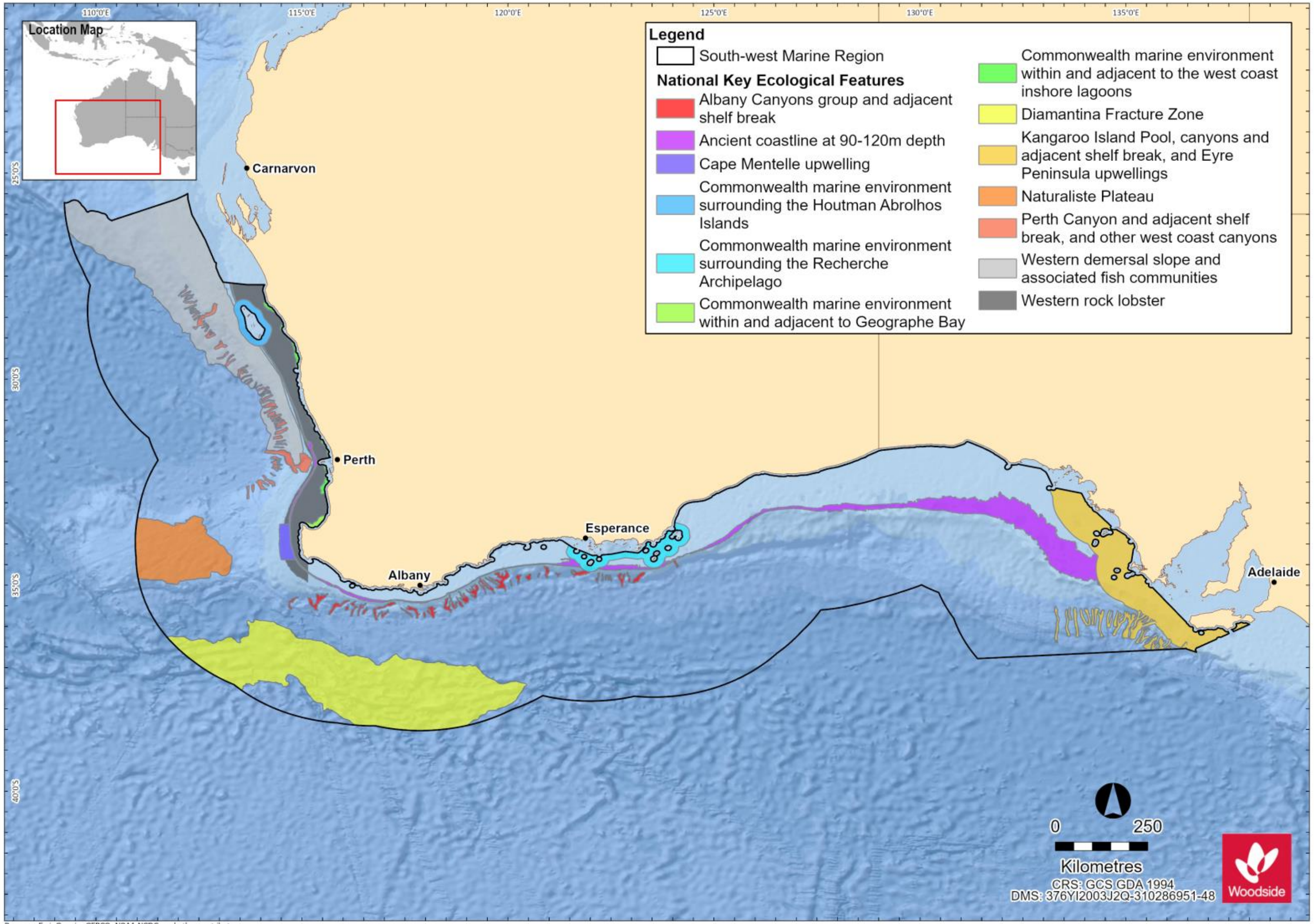

Figure 9-2. Key Ecological Features (KEFs) within the SWMR

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Table 9-3 Key Ecological Features (KEF) within the NMR

KEF Name	Values[1]	Description
Carbonate bank and terrace system of the Van Diemen Rise	Important for its role in enhancing biodiversity and local productivity relative to its surrounds and for supporting relatively high species diversity The feature has been identified as a sponge biodiversity hotspot (Przeslawski *et al.* 2014)	The bank and terrace system of the Van Diemen Rise is part of the larger system associated with the Sahul Banks to the north and Londonderry Rise to the east; it is characterised by terrace, banks, channels and valleys. The variability in water depth and substrate composition may contribute to the presence of unique ecosystems in the channels. Species present include sponges, soft corals and other sessile filter feeders associated with hard substrate sediments of the deep channels; epifauna and infauna include polychaetes and ascidians. Olive ridley turtles, sea snakes and sharks are also found associated with this feature.
Gulf of Carpentaria basin	Regional importance for biodiversity, endemism and aggregations of marine life relevant to benthic and pelagic habitats	The Gulf of Carpentaria basin is one of the few remaining near-pristine marine environments in the world. Primary productivity in the Gulf of Carpentaria basin is mainly driven by cyanobacteria that fix nitrogen but is also strongly influenced by seasonal processes. The soft sediments of the basin are characterised by moderately abundant and diverse communities of infauna and mobile epifauna dominated by polychaetes, crustaceans, molluscs, and echinoderms. The basin also supports assemblages of pelagic fish species including planktivorous and schooling fish, with top predators such as shark, snapper, tuna, and mackerel.
Gulf of Carpentaria coastal zone	High productivity, aggregations of marine life (including several endemic species) and high biodiversity compared to broader region	Nutrient inflow from rivers adjacent to the NMR generates higher productivity and more diverse and abundant biota within the Gulf of Carpentaria coastal zone than elsewhere in the region. The coastal zone is near pristine and supports many protected species such as marine turtles, dugongs, and sawfishes. Ecosystem processes and connectivity remain intact; river flows are mostly uninterrupted by artificial barriers and healthy, diverse estuarine and coastal ecosystems support many species that move between freshwater and saltwater environments.
Pinnacles of the Bonaparte Basin	Unique seafloor feature with ecological properties of regional significance Provide areas of hard substrate in an otherwise soft sediment environment and so are important for sessile species Recognised as a biodiversity hotspot for sponges The Pinnacles of the Bonaparte Basin KEF is located within both the NWMR and NMR (refer **Table 9-1**)	Covering more than 520 km^2 within the Bonaparte Basin, this feature contains the largest concentration of pinnacles along the Australian margin. The Pinnacles of the Bonaparte Basin are thought to be the eroded remnants of underlying strata; it is likely that the vertical walls generate local upwelling of nutrient-rich water, leading to phytoplankton productivity that attracts aggregations of planktivorous and predatory fish, seabirds and foraging turtles.

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KEF Name	Values[1]	Description
Plateaux and saddle north-west of the Wellesley Islands	High species abundance, diversity and endemism of marine life	Abundance and species density are high in the plateaux and saddle as a result of increased biological productivity associated with habitats rather than currents. Submerged reefs support corals that are typical of northern Australia, including corals that have bleach-resistant zooxanthellae; and particular reef fish species that are different to those found elsewhere in the Gulf of Carpentaria. Species present include marine turtles and reef fish such as coral trout, cod, mackerel, and shark. Seabirds frequent the plateaux and saddle, most likely due to the presence of predictable food resources for feeding offspring.
Shelf break and slope of the Arafura Shelf	The Shelf break and slope of the Arafura Shelf is defined as a key ecological feature for its ecological significance associated with productivity emanating from the slope It also forms part of a unique biogeographic province (Last *et al.*, 2005)	The shelf break and slope of the Arafura Shelf is characterised by continental slope and patch reefs and hard substrate pinnacles. The ecosystem processes of the feature are largely unknown in the region; however, the Indonesian Throughflow and surface wind-driven circulation are likely to influence nutrients, pelagic dispersal and species and biological productivity in the region. Biota associated with the feature is largely of Timor–Indonesian Malay affinity.
Submerged coral reefs of the Gulf of Carpentaria	High aggregations of marine life, biodiversity and endemism Twenty per cent of the reefs found in the NMR are situated within this KEF (Harris *et al.*, 2007)	The submerged coral reefs of the Gulf of Carpentaria are characterised by submerged patch, platform and barrier reefs that form a broken margin around the perimeter of the Gulf of Carpentaria basin, rising from the sea floor at depths of 30–50 m. These reefs provide breeding and aggregation areas for many fish species including mackerel and snapper and offer refuges for sea snakes and apex predators such as sharks. Coral trout species that inhabit the submerged reefs are smaller than those found in the Great Barrier Reef and may prove to be an endemic sub-species.
Tributary Canyons of the Arafura Depression	High productivity and high levels of species diversity and endemism of marine life within the benthic and pelagic habitats of the feature	The tributary canyons are approximately 80–100 m deep and 20 km wide. The largest of the canyons extend some 400 km from Cape Wessel into the Arafura Depression, and are the remnants of a drowned river system that existed during the Pleistocene era. Sediments in this feature are mainly calcium-carbonate rich, although sediment type varies from sandy substrate to soft muddy sediments and hard, rocky substrate. Marine turtles, deep sea sponges, barnacles and stalked crinoids have all been identified in the area.

1. Values description sourced from Marine bioregional plan for the North Marine Region (DSEWPAC, 2012c) and Department of Agriculture, Water and the Environment (DAWE) SPRAT database.

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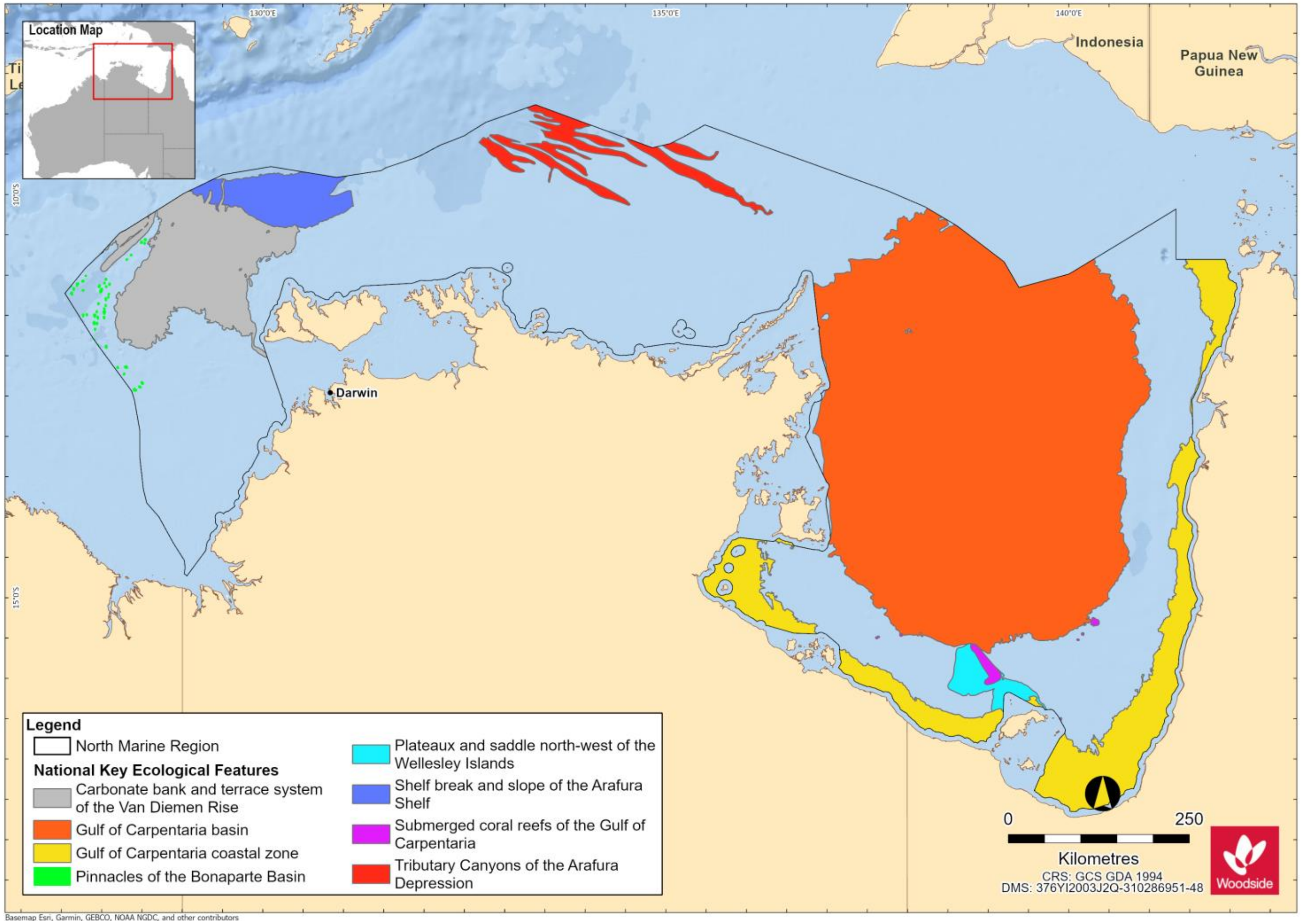

Figure 9-3. Key Ecological Features (KEFs) within the NMR

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10. PROTECTED AREAS

10.1 Regional Context

Protected areas included World Heritage Properties, National Heritage Places, Wetlands of International Importance, Australian Marine Parks, State Marine Parks and Reserves, Threatened Ecological Communities and the Australian Whale Sanctuary. The PMST Reports (**Appendix A**) shows that there are twenty-nine protected areas found in the NWMR, eighteen in the SWMR and nine in the NMR.

Table 10-1, Table 10-2 and **Table 10-3** outline the protected areas of each of the marine regions NWMR, SWMR and NMR, respectively.

10.2 World Heritage Properties

Properties nominated for World Heritage listing are inscribed on the list only after they have been carefully assessed as representing the best examples of the world's cultural and natural heritage. Only World Heritage listings classed as natural are discussed in this section. World Heritage sites classed as cultural are discussed in **Section 11**.

The list of Australia's World Heritage Properties and the PMST Reports (**Appendix A**) show two World Heritage Properties within the NWMR (**Table 10-1**), no World Heritage Properties within the SWMR (**Table 10-2),** and though not reported in the NMR PMST Report, Kakadu National Park and World Heritage Area is included in **Table 10-3**.

10.3 National and Commonwealth Heritage Places - Natural

The National Heritage List is Australia's list of natural, historic, and Indigenous places of outstanding significance to the nation. The National Heritage List Spatial Database describes the place name, class (Indigenous, natural, historic), and status. Commonwealth Heritage Places are a collection of sites recognised for their Indigenous, historical and/or natural values which are owned or controlled by the Australian Government.

Only National and Commonwealth Heritage Places classed as natural are discussed in this section. Heritage Places classed as indigenous or historic are discussed in **Section 11**.

A search of the National Heritage List Spatial Database and the PMST Reports (**Appendix A**) identified three natural National Heritage Places in the NWMR (**Table 10-1**), three in the SWMR (**Table 10-2**) and for the NMR, Kakadu National Park (not included in the PMST report) is included in **Table 10-3**.

A search of the Commonwealth Heritage List identified four natural commonwealth heritage places within the NWMR (**Table 10-1**).

10.4 Wetlands of International Importance (listed under the Ramsar Convention)

Australia has 65 Ramsar wetlands that cover >8.3 million ha. Ramsar wetlands are those that are representative, rare, or unique wetlands, or that are important for conserving biological diversity.

The List of Wetlands of International Importance held under the Ramsar Convention and the PMST Reports (**Appendix A**) identified four Ramsar Sites with coastal features within the NWMR (**Table 10-1**), four in the SWMR (**Table 10-2**) and two for the New Territory, included for the NMR (**Table 10-3**).

10.5 Australian Marine Parks

Australian Marine Parks (AMPs), proclaimed under the EPBC Act in 2007 and 2013, are located in Commonwealth waters that start at the outer edge of State and Territory waters, generally three

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nautical miles (~5.5 km) from the shore, and extend to the outer boundary of Australia's EEZ, 200 nm (~370 km) from the shore.

PMST Reports (**Appendix A**) show sixteen AMPs within the NWMR (**Table 10-1**), ten within the SWMR (**Table 10-2**) and eight within the NMR (**Table 10-3**).

10.6 Threatened Ecological Communities

No Threatened Ecological Communities (TECs) as listed under the EPBC Act are known to occur within the marine waters of the NWMR, SWMR or NMR as indicated by the PMST Reports (**Appendix A**).

10.7 Australian Whale Sanctuary

The Australian Whale Sanctuary has been established to protect all whales and dolphins found in Australian waters. Under the EPBC Act all cetaceans (whales, dolphins and porpoises) are protected in Australian waters.

The Australian Whale Sanctuary includes all Commonwealth waters from the three nautical mile State/Territory waters limit out to the boundary of the EEZ (i.e. out to 200 nm and further in some places). Within the Sanctuary it is an offence to kill, injure or interfere with a cetacean. Severe penalties apply to anyone convicted of such offences.

10.8 State Marine Parks and Reserves

State Marine Parks and Reserves, proclaimed under the *Conservation and Land Management Act 1984* (CALM Act), are located in State waters and vested in the WA Conservation and Parks Commission. State Marine Parks and Reserves of Western Australia have been considered, with 14 occurring in the NWMR (**Table 10-1**) and six occurring in the SWMR (**Table 10-2**).

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10.9 Summary of Protected Areas within the NWMR

Table 10-1 Protected Areas within the NWMR

Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
World Heritage Properties						
Shark Bay World Heritage Property	-	-	✓		The Shark Bay World Heritage Property is adjacent to the Shark Bay AMP and was included on the World Heritage List in 1991.	Universal values of the Shark Bay World Heritage Property include large and diverse seagrass beds, stromatolites and populations of dugong and threatened species. Inscribed under Natural Criteria vii, viii, ix and x.
The Ningaloo Coast World Heritage Property	-	-	✓		The Ningaloo Coast World Heritage Property lies within the Ningaloo AMP and was included on the World Heritage List in 2011.	Universal values of the Ningaloo Coast World Heritage Property include high marine species diversity and abundance; in particular, Ningaloo Reef supports both tropical and temperate marine reptiles and mammals. Inscribed under Natural Criteria vii and x.
National Heritage Places - Natural						
Shark Bay	-	-	✓		The Shark Bay National Heritage Place consists of the same area included in the Shark Bay World Heritage Property (refer above) and was established on the National Heritage List in 2007.	The national heritage place has a number of exceptional natural features, including one of the largest and most diverse seagrass beds in the world, colonies of stromatolites and rich marine life including a large population of dugongs, and also provides a refuge for a number of other globally threatened species. Shark Bay meets the national heritage listing criteria a, b, c, d, e, f, g, h and i.
The Ningaloo Coast	-	-	✓		The Ningaloo Coast National Heritage Place consists of the same area included in the Ningaloo	The Ningaloo Coast contains one of the best developed near-shore reefs in the world, being home to rugged limestone peninsulas, spectacular coral and sponge gardens and the whale shark.

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					Coast World Heritage Property (refer above) and was established on the National Heritage List in 2010.	The Ningaloo Coast meets the national heritage listing criteria a, b, c, d, and f.
The West Kimberley	✓	✓	-		The West Kimberley National Heritage Place covers an area of around 192,000 km^2 located in the north-west of Australia from Broome to Wyndham, and was established on the National Heritage List in 2011.	The Kimberley plateau, north-western coastline and northern rivers of the West Kimberley provide a vital refuge for many native plants and animals that are found nowhere else or which have disappeared from much of the rest of Australia. In addition, Roebuck Bay is internationally recognised as one of Australia's most significant sites for migratory wading birds. The national heritage place also contains a remarkable history of Aboriginal occupation, with many places of indigenous sacred value. The West Kimberley meets the national heritage listing criteria a, b, c, d, e, f, g, h and i.
Commonwealth Heritage Places - Natural						
Mermaid Reef – Rowley Shoals	-	✓	-	N/A	The Mermaid Reef – Rowley Shoals Commonwealth Heritage Place is located within the boundary of the Mermaid Reef Marine National Nature Reserve. The site was listed as a Commonwealth Heritage Place in 2004.	The Mermaid Reef-Rowley Shoals Commonwealth Heritage Place is regionally important for the diversity of its fauna and together with Clerke and Imperieuse reefs, has biogeographical significance due to the presence of species which are at, or close to, the limits of their geographic ranges, including fishes known previously only from Indonesian waters. Rowley Shoals is important for benchmark studies as one of the few places off the north-west coast of Western Australia which have been the site of major biological collection trips by the WA Museum.

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
Ashmore Reef National Nature Reserve	✓	-	-		The Ashmore Reef Commonwealth Heritage Place is located within the boundary of the Ashmore Reef Marine Park (refer AMPs below). The site was listed as a Commonwealth Heritage Place in 2004.	Ashmore Reef has major significance as a staging point for wading birds migrating between Australia and the Northern Hemisphere and supports high concentrations of breeding seabirds, many of which are nomadic and typically breed on small isolated islands. Ashmore Reef is an important scientific reference area for migratory seabirds, sea snakes and marine invertebrates. The Ashmore Reef Commonwealth Heritage Place is significant for its history of human occupation and use. The island is believed to have been visited by Indonesian fisherman since the early eighteenth century. The islands were used both for fishing and as a staging point for voyages to the southern reefs off Australia's coast.
Scott Reef and Surrounds – Commonwealth Area	✓	-	-		Scott Reef and Surrounds Commonwealth Heritage Place is located within the Western Australian Coastal Waters surrounding North and South Scott Reef. The site was listed as a Commonwealth Heritage Place in 2004.	The Scott Reef and Surrounds Commonwealth Heritage Place is regionally important for the diversity of its fauna and has biogeographical significance due to the presence of species which are at, or close to, the limits of their geographic ranges, including fish known previously only from Indonesian waters. Scott Reef is recognised as important for scientific research and benchmark studies due to its age, the extensive documentation of its geophysical and physical environmental characteristics and its use as a site of major biological collection trips and surveys by the WA Museum and the Australian Institute of Marine Science.

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
Ningaloo Marine Area – Commonwealth Waters	-	-	✓		The Ningaloo Marine Area Commonwealth Heritage Place is located within the Commonwealth waters of the Ningaloo Marine Park (refer AMPs below). The site was listed as a Commonwealth Heritage Place in 2004.	The Ningaloo Marine Area Commonwealth Heritage Place provides a migratory pathway for humpback whales and foraging habitat for whale sharks. The place is an important breeding area for billfish and manta ray. The Ningaloo Marine Area provides opportunities for scientific research relating to aspects of the area's unique features including tourism (marine ecology, whales, turtles, whale sharks, fish and oceanography.
Wetlands of International Importance (Ramsar)						
Ashmore Reef National Nature Reserve	✓	-	-	Ramsar	The Ashmore Reef Ramsar site is located within the boundary of the Ashmore Reef Marine Park (refer AMPs below). The site was listed under the Ramsar Convention in 2002.	Ashmore Reef Ramsar site supports internationally significant populations of seabirds and shorebirds, is important for turtles (green, hawksbill and loggerhead) and dugong, and has the highest diversity of hermatypic (reef-building) corals on the WA coast. It is known for its abundance and diversity of sea snakes. However, since 1998 populations of sea snakes at Ashmore Reef have been in decline.
Eighty Mile Beach	-	✓	-	Ramsar	The Eighty Mile Beach Ramsar site covers an area of 1250 km^2, located along a long section of the Western Australian coastline adjacent to the Eighty Mile Beach AMP (refer below).	The Eighty Mile Beach Ramsar site includes saltmarsh and a raised peat bog more than 7000 years old. The site contains the most important wetland for waders in north-western Australia, supporting up to 336,000 birds, and is especially important as a land fall for waders migrating south for the austral summer.
Roebuck Bay	-	✓	-	Ramsar	The Roebuck Bay Ramsar site covers an area of 550	The Roebuck Bay Ramsar site is recognised as one of the most important areas for migratory shorebirds in Australia.

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					km^2, located south of Broome and adjacent to the Roebuck AMP (refer below).	The site regularly supports over 100,000 waterbirds, with numbers being highest in the austral spring when migrant species breeding in the Palearctic stop to feed during migration.
Ord River Floodplain	✓			Ramsar	The Ord River Floodplain Ramsar Site is in the East Kimberley region and encompasses an extensive system of river, seasonal creek, tidal mudflat, and floodplain wetlands. The Ramsar Site is a nursery, feeding and/or breeding ground for migratory birds, waterbirds, fish, crabs, prawns, and crocodiles.	The site represents the best example of wetlands associated with the floodplain and estuary of a tropical river system in the Tanami-Timor Sea Coast Bioregion in the Kimberley. In addition, the False Mouths of the Ord are the most extensive mudflat and tidal waterway complex in Western Australia.
Wetlands of National Importance (DAWE, 2019)						
Ashmore Reef	✓	-	-		Ashmore Reef is a shelf-edge platform reef located among the Sahul Banks of north-western Australia. It covers an area of 583 km^2 and consists of three islets surrounded by intertidal reef and sand flats.	These islets are major seabird nesting sites with 20 breeding species recorded to date. The total bird population has been estimated to exceed 100,000 during the peak breeding season. The marine reserve also has the highest diversity of marine fauna of the reefs on the NWS and differs from other reefs and coastal areas in the region. The area meets criteria 1, 3, 4 and 5 for inclusion on the Directory of Important Wetlands in Australia.
Mermaid Reef	-	✓	-		Mermaid Reef Marine Park covers an area of around 540 km^2, located ~280 km west north-west of Broome, and is the most north-easterly atoll of the Rowley Shoals.	The reefs of the Mermaid Reef Marine Park have biogeographic value due to the presence of species that are at or close to the limit of their distribution. The coral communities are one of the special values of Mermaid Reef. The area meets criteria 1, 2 and 3 for inclusion on the Directory of Important Wetlands in Australia.

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
Exmouth Gulf East	-	-	✓		Exmouth Gulf East covers an area of 800 km^2 and includes wetlands in the eastern part of Exmouth Gulf, from Giralia Bay; to Urala Creek, Locker Point.	The Exmouth Gulf East is an outstanding example of tidal wetland systems of low coast of north-west Australia, with well- developed tidal creeks, extensive mangrove swamps and broad saline coastal flats. The site is one of the major population centres for dugong in WA and its seagrass beds and extensive mangroves provide nursery and feeding areas for marine fishes and crustaceans in the Gulf. The area meets criteria 1, 2 and 3 for inclusion on the Directory of Important Wetlands in Australia.
Hamelin Pool	-	-	✓		Hamelin Pool covers an area of 900 km^2 in the far south-east part of Shark Bay.	Hamelin Pool is an outstanding example of a hypersaline marine embayment and supports extensive microbialite (subtidal stromatolite) formations, which are the most abundant and diverse examples of growing marine microbialites in the world. The area meets criteria 1 and 6 for inclusion on the Directory of Important Wetlands in Australia.
Shark Bay East	-	-	✓		Shark Bay East covers a 250 km area of coastline comprising tidal wetlands, and marine waters less than 6 m deep at low tide, in the east arm of Shark Bay.	The site is an outstanding example of a very large, shallow marine embayment, with particularly extensive occurrence of seagrass beds and substantial areas of intertidal mud/sandflats and mangrove swamp. The site supports what is probably the world's largest discrete population of dugong; it is also a major nursery and/or feeding area for turtles, rays, sharks, other fishes, prawns and other marine fauna; and is a major migration stop-over area for shorebirds. The area meets criteria 1, 2, 3, 4, 5 and 6 for inclusion on the Directory of Important Wetlands in Australia.
Australian Marine Parks (DNP, 2018a)						
Abrolhos Marine Park	-	-	✓	II, IV, VI	Abrolhos Marine Park is located adjacent to the WA Houtman Abrolhos Islands, covering a large offshore	Abrolhos Marine Park is significant because it contains habitats, species and ecological communities associated with four bioregions:

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					area of 88,060 km² extending from the WA State waters boundary to the edge of Australia's EEZ. The Abrolhos Marine Park is located within both the NWMR and SWMR.	• Central Western Province • Central Western Shelf Province • Central Western Transition • South-west Shelf Transition It includes seven KEFs: Commonwealth marine environment surrounding the Houtman Abrolhos Islands; Demersal slope and associated fish communities of the Central Western Province; Mesoscale eddies; Perth Canyon and adjacent shelf break, and other west-coast canyons; Western rock lobster; Ancient coastline at 90-120 m depth; and Wallaby Saddle. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging and breeding habitat for seabirds, foraging habitat for Australian sea lions and white sharks, and a migratory pathway for humpback and pygmy blue whales. The AMP is adjacent to the northernmost Australian sea lion breeding colony in Australia on the Houtman Abrolhos Islands.
Carnarvon Canyon Marine Park	-	-	✓	IV	Carnarvon Canyon Marine Park covers an area of 6177 km², located ~300 km north-west of Carnarvon.	Carnarvon Canyon Marine Park is significant because it contains habitats, species and ecological communities associated with the Central Western Transition bioregion. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. There is limited information about species' use of this AMP.
Shark Bay Marine Park	-	-	✓	VI	Shark Bay Marine Park covers an area of 7443 km² located ~60 km offshore of Carnarvon, adjacent to the Shark Bay World Heritage Property and National Heritage Place.	Shark Bay Marine Park is significant because it contains habitats, species and ecological communities associated with two bioregions: • Central Western Shelf Province • Central Western Transition. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
						the EPBC Act. BIAs within the AMP include breeding habitat for seabirds, internesting habitat for marine turtles, and a migratory pathway for humpback whales.
Gascoyne Marine Park	-	-	✓	II, IV, VI	Gascoyne Marine Park covers an area of 81,766 km², located ~20 km off the west coast of the Cape Range Peninsula, adjacent to the Ningaloo Marine Park.	Gascoyne Marine Park is significant because it contains habitats, species and ecological communities associated with three bioregions: • Central Western Shelf Transition • Central Western Transition • Northwest Province. It includes four KEFs: Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula; Commonwealth waters adjacent to Ningaloo Reef; Continental slope demersal fish communities; and Exmouth Plateau. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding habitat for seabirds, internesting habitat for marine turtles, a migratory pathway for humpback whales, and foraging habitat and migratory pathway for pygmy blue whales.
Ningaloo Marine Park	-	-	✓	II, IV	Ningaloo Marine Park covers an area of 2435 km², stretching ~300 km along the west coast of the Cape Range Peninsula, and is adjacent to the WA Ningaloo Marine Park and Gascoyne Marine Park.	Ningaloo Marine Park is significant because it contains habitats, species and ecological communities associated with four bioregions: • Central Western Shelf Transition • Central Western Transition • Northwest Province • Northwest Shelf Province. It includes three KEFs: Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula; Commonwealth waters adjacent to Ningaloo Reef; and Continental slope demersal fish communities. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
						or foraging habitat for seabirds, internesting habitat for marine turtles, a migratory pathway for humpback whales, foraging habitat and migratory pathway for pygmy blue whales, breeding, calving, foraging and nursing habitat for dugong and foraging habitat for whale sharks.
Montebello Marine Park	-	✓	-	VI	Montebello Marine Park covers an area of 3413 km^2, located offshore of Barrow Island and 80 km west of Dampier extending from the WA State waters boundary, and is adjacent to the WA Barrow Island and Montebello Islands Marine Parks.	Montebello Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province bioregion. It includes one KEF: Ancient coastline at 125 m depth contour. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding habitat for seabirds, internesting, foraging, mating, and nesting habitat for marine turtles, a migratory pathway for humpback whales and foraging habitat for whale sharks.
Dampier Marine Park	-	✓	-	II, IV, VI	Dampier Marine Park covers an area of 1252 km^2, located ~10 km north-east of Cape Lambert and 40 km from Dampier extending from the WA State waters boundary.	Dampier Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province bioregion. The AMP provides protection for offshore shelf habitats adjacent to the Dampier Archipelago, and the area between Dampier and Port Hedland, and is a hotspot for sponge biodiversity. The AMP supports a range of species including those listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and foraging habitat for seabirds, internesting habitat for marine turtles and a migratory pathway for humpback whales.
Eighty Mile Beach Marine Park	-	✓	-	VI	Eighty Mile Beach Marine Park covers an area of 10,785 km^2, located ~74 km north-east of Port Hedland, adjacent to the	Eighty Mile Beach Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province and consists of shallow shelf habitats, including terrace, banks and shoals.

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					WA Eighty Mile Beach Marine Park.	The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding, foraging and resting habitat for seabirds, internesting and nesting habitat for marine turtles, foraging, nursing and pupping habitat for sawfishes and a migratory pathway for humpback whales.
Argo – Rowley Terrace Marine Park	✓	✓	-	II, VI, VI (Trawl)	Argo-Rowley Terrace Marine Park covers an area of 146,003 km^2, located ~270 km north-west of Broome, and extends to the limit of Australia's EEZ. The AMP is adjacent to the Mermaid Reef Marine Park and the WA Rowley Shoals Marine Park.	Argo–Rowley Marine Park is significant because it contains habitats, species and ecological communities associated with two bioregions: • Northwest Transition • Timor Province. It includes two KEFs: Canyons linking the Argo Abyssal Plain with the Scott Plateau; and Mermaid Reef and Commonwealth waters surrounding Rowley Shoals. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include resting and breeding habitat for seabirds and a migratory pathway for the pygmy blue whale.
Mermaid Reef Marine Park	-	✓	-	II	Mermaid Reef Marine Park covers an area of 540 km^2, located ~280 km north-west of Broome, adjacent to the Argo–Rowley Terrace Marine Park and ~13 km from the WA Rowley Shoals Marine Park. Mermaid Reef is one of three reefs forming the Rowley Shoals. The other two are Clerke Reef and Imperieuse Reef, to the	Mermaid Reef Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Transition. It includes one KEF: Mermaid Reef and Commonwealth waters surrounding Rowley Shoals. The Rowley Shoals have been described as the best geological examples of shelf atolls in Australian waters. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding habitat for seabirds and a migratory pathway for the pygmy blue whale.

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					south-west of the AMP, which are included in the WA Rowley Shoals Marine Park.	
Roebuck Marine Park	-	✓	-	VI	Roebuck Marine Park covers an area of 304 km^2, located ~12 km offshore of Broome, and is adjacent to the WA Yawuru Nagulagun/Roebuck Bay Marine Park.	Roebuck Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Province and consists entirely of shallow continental shelf habitat. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and resting habitat for seabirds, foraging and internesting habitat for marine turtles, a migratory pathway for humpback whales and foraging habitat for dugong.
Kimberley Marine Park	✓	✓	-	II, IV, VI	Kimberley Marine Park covers an area of 74,469 km^2, located ~100 km north of Broome, extending from the WA State waters boundary north from the Lacepede Islands to the Holothuria Banks offshore from Cape Bougainville.	Kimberley Marine Park is significant because it includes habitats, species and ecological communities associated with three bioregions: • Northwest Shelf Province • Northwest Shelf Transition • Timor Province. It includes two KEFs: Ancient coastline at 125 m depth contour; and Continental slope demersal fish communities. The AMP supports a range of species, including protected species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and foraging habitat for seabirds, internesting and nesting habitat for marine turtles, breeding, calving and foraging habitat for inshore dolphins, calving, migratory pathway and nursing habitat for humpback whales, migratory pathway for pygmy blue whales, foraging habitat for dugong and foraging habitat for whale sharks.
Ashmore Reef Marine Park	✓	-	-	Ia, IV	Ashmore Reef Marine Park covers an area of 583 km^2, located ~630 km north of	Ashmore Reef Marine Park is significant because it includes habitats, species and ecological communities associated with the Timor Province. It includes two KEFs:

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					Broome and 110 km south of the Indonesian island of Roti. The AMP is located in Australia's External Territory of Ashmore and Cartier Islands and is within an area subject to a Memorandum of Understanding (MoU) between Indonesia and Australia, known as the MoU Box.	Ashmore Reef and Cartier Island and surrounding Commonwealth waters; and Continental slope demersal fish communities. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding, foraging and resting habitat for seabirds, resting and foraging habitat for migratory shorebirds, foraging, mating, nesting and internesting habitat for marine turtles, foraging habitat for dugong, and a migratory pathway for pygmy blue whales.
Cartier Island Marine Park	✓	-	-	Ia	Cartier Island Marine Park covers an area of 172 km^2, located ~45 km south-east of Ashmore Reef Marine Park and 610 km north of Broome. It is also located in Australia's External Territory of Ashmore and Cartier Islands and within an area subject to an MoU between Indonesia and Australia, known as the MoU Box.	Cartier Island Marine Park is significant because it includes habitats, species and ecological communities associated with the Timor Province. It includes two key ecological features: Ashmore Reef and Cartier Island and surrounding Commonwealth waters and continental slope demersal fish communities. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and foraging habitat for seabirds, internesting, nesting and foraging habitat for marine turtles and foraging habitat for whale sharks. The AMP is also internationally significant for its abundance and diversity of sea snakes, some of which are listed species under the EPBC Act.
Joseph Bonaparte Gulf Marine Park	✓	-	-	VI	Joseph Bonaparte Gulf Marine Park covers an area of 8597 km^2 and is located ~15 km west of Wadeye, NT, and ~90 km north of Wyndham, WA, in the Joseph Bonaparte Gulf.	Joseph Bonaparte Gulf Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Transition bioregion. It includes one KEF: Carbonate bank and terrace system of the Sahul Shelf. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					It is adjacent to the WA North Kimberley Marine Park. The Joseph Bonaparte Gulf Marine Park is located within both the NWMR and NMR.	the EPBC Act. BIAs within the AMP include foraging habitat for marine turtles and the Australian snubfin dolphin.
Oceanic Shoals Marine Park	✓	-	-	II, IV, VI	Oceanic Shoals Marine Park covers an area of 71,743 km^2 and is located west of the Tiwi Islands, ~155 km north-west of Darwin, NT and 305 km north of Wyndham, WA. The Oceanic Shoals Marine Park is located within both the NWMR and NMR.	Oceanic Shoals Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Transition bioregion. It contains four KEFs: Carbonate bank and terrace systems of the Van Diemen Rise; Carbonate bank and terrace systems of the Sahul Shelf; Pinnacles of the Bonaparte Basin; and Shelf break and slope of the Arafura Shelf. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging and internesting habitat for marine turtles.
State Marine Parks and Reserves						
North Kimberley Marine Park	✓	-	-	Sanctuary, Special Purpose and General Use Zones	The North Kimberley Marine Park covers approx. 18,450 km^2 with its south-western boundary located ~270 km north-east of Derby.	The coral reefs of the north Kimberley have the greatest diversity in Western Australia and are some of the most pristine and remarkable reefs in the world. The park surrounds more than 1000 islands and is home to listed species such as dugongs, marine turtles, and sawfishes (DPAW, 2016a).
Lalang-garram / Horizontal Falls Marine Park and North Lalang-garram Marine Park (jointly managed)	✓	-	-	Sanctuary, Special Purpose and General Use Zones	The Lalang-garram / Horizontal Falls Marine Park covers ~3530 km^2 from Talbot Bay in the west and Glenelg River in the east. The North Lalang-garram Marine Park covers ~1100	The Lalang-garram / Horizontal Falls Marine Park's most celebrated attraction is created by massive tides of up to 10 m and narrow gaps in two parallel tongues of land meaning the tide falls faster than the water can escape, producing 'horizontal falls'. There are also islands with fringing coral reefs and mangrove-lined creeks and bays. The North Lalang-garram Marine Park has a number of islands fringed with coral reef and has been identified as an

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
					km^2 between Camden Sound and North Kimberley Marine Parks.	ecological hotspot and supports more than 1% of the world's population of brown boobies, with up to 2000 breeding pairs. About 500 pairs of crested terns also nest on the island (DPAW, 2016b).
Lalang-garram / Camden Sound Marine Park	✓	-	-	Sanctuary, Special Purpose and General Use Zones	Lalang-garram / Camden Sound Marine Park covers 7050 km^2 located about 150 km north of Derby.	The Lalang-garram / Camden Sound Marine Park is the most important humpback whale nursery in the Southern Hemisphere. It also features the spectacular coastal Montgomery Reef. The marine park is home to six species of threatened marine turtle. Australian snubfin and Indo-Pacific humpback dolphins, dugongs, saltwater crocodiles, and several species of sawfish (DPAW, 2013).
Rowley Shoals Marine Park	-	✓	-	Sanctuary, Recreation and General Use Zones	The Rowley Shoals comprise of three reef systems, Mermaid Reef, Clerke Reef and Imperieuse Reef, all 30-40 km apart. These reef systems are located ~300 km west north-west of Broome.	The three coral atolls of the Rowley Shoals Marine Park comprise of shallow lagoons inhabited by diverse corals and abundant marine life, each covering around 80 km^2 at the edge of Australia's continental shelf. Further offshore, the seafloor slopes away to the abyssal plain, some 6000 m below. Undersea canyons slice the slope; these features are commonly associated with diverse communities of deep-water corals and sponges and create localised upwellings that aggregate pelagic species like tunas and billfish (DEC, 2007a).
Yawuru Nagulagun / Roebuck Bay Marine Park	-	✓	-	Special Purpose Zone	Yawuru Nagulagun / Roebuck Bay Marine Park is a series of intertidal flats lying on the coast to the south-east of Broome.	Roebuck Bay is an internationally significant wetland and one of the most important feeding grounds for migratory shorebirds in Australia. Australian snubfin and Australian humpback dolphins frequent the waters and humpback whales pass through on their annual migration. Flatback turtles nest on the shores and are found in the bay's waters with other sea turtle species. Seagrass and macroalgae communities provide food for protected species such as the dugong and flatback turtle (DPAW, 2016c).
Eighty Mile Beach Marine Park	-	✓	-	Sanctuary, Recreation, Special	Eighty Mile Beach Marine Park covers ~2000 km^2 stretching across 220km of	Eighty Mile Beach Marine Park is one of the world's most important feeding grounds for small wading birds that migrate to the area each summer, travelling from countries

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
				Purpose and General Use Zones	coastline between Port Hedland and Broome.	thousands of kilometres away. The marine park is a major nesting area for flatback turtles which are found only in northern Australia. Sawfishes, dugongs, dolphins and millions of invertebrates inhabit the sand and mud flats, seagrass meadows, coral reefs and mangroves (DPAW, 2014).
Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area (jointly managed)	-	✓	-	Sanctuary, Recreation, General Use and Special Purpose Zones	The Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area are located off the north-west coast of WA, ~1600 km north of Perth, and cover areas of ~583 km^2, 42 km^2 and 1,147 km^2, respectively.	The Montebello/Barrow islands marine conservation reserves have very complex seabed and island topography, resulting in a myriad of different habitats subtidal coral reefs, macroalgal and seagrass communities, subtidal soft-bottom communities, rocky shores and intertidal reef platforms, which support a rich diversity of invertebrates and finfish. The reserves are important breeding areas for several species of marine turtles and seabirds, which use the undisturbed sandy beaches for nesting. Humpback whales migrate through the reserves and dugongs occur in the shallow warm waters (DEC, 2007b).
Ningaloo Marine Park and Muiron Islands Marine Management Area (jointly managed)	-	-	✓	Sanctuary, Recreation, General Use and Special Purpose Zones	The Ningaloo Marine Park and Muiron Islands Marine Management Area are located off the North-west Cape of WA, ~1200 km north of Perth, and cover areas of ~2633 km^2 and 286 km^2, respectively.	Ningaloo Reef is the largest fringing coral reef in Australia. Temperate and tropical currents converge in the Ningaloo region resulting in highly diverse marine life including spectacular coral reefs, abundant fishes and species with special conservation significance such as turtles, whale sharks, dugongs, whales and dolphins. The region has diverse marine communities including mangroves, algae and filter-feeding communities and has high water quality. These values contribute to the Ningaloo Marine Park being regarded as the State's premier marine conservation icon. The Muiron Islands Marine Management Area is also important, containing a very diverse marine environment, with coral reefs, filter-feeding communities and macroalgal beds. In addition, the Islands are important seabird and green turtle nesting areas. (CALM, 2005a).

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Protected Area	Woodside Activity Area			IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
	Browse	NWS/S	NW Cape			
Shark Bay Marine Park and Hamelin Pool Marine Nature Reserve (jointly managed)	-	-	✓	Sanctuary, Recreation, General Use and Special Purpose Zones	The Shark Bay Marine Park and Hamelin Pool Marine Nature Reserves are located 400 km north of Geraldton, covering areas of ~7487 km^2 and 1270 km^2, respectively.	Seagrass covers over 4000 km^2 of the Shark Bay Marine Park, with 12 different species making it one of the most diverse seagrass assemblages in the world. Dugongs regularly use this habitat, with the bay containing one of the largest dugong populations in the world. Humpback whales also use the bay as a staging post in their migration along the coast. Green and loggerhead turtles occur in the bay with Dirk Hartog Island providing the most important nesting site for loggerheads in Western Australia. Hamelin Pool contains the most diverse and abundant examples of stromatolites found in the world. These are living representatives of stromatolites that existed some 3500 million years ago (CALM, 1996).

**Conservation objectives for IUCN categories include:*

Ia: Strict Nature Reserve

Ib: Wilderness Area

II: national Park

III: Natural Monument or Feature

IV: Habitat/Species Management Area

V: Protected Landscape

VI: Protected area with sustainable use of natural resources – allow human use but prohibits large scale development.

IUCN categories for the marine park are provided and, in brackets, the IUCN categories for specific zones within each Marine Park as assigned under the North-west Marine Parks Network Management Plan 2018 (DNP, 2018a)

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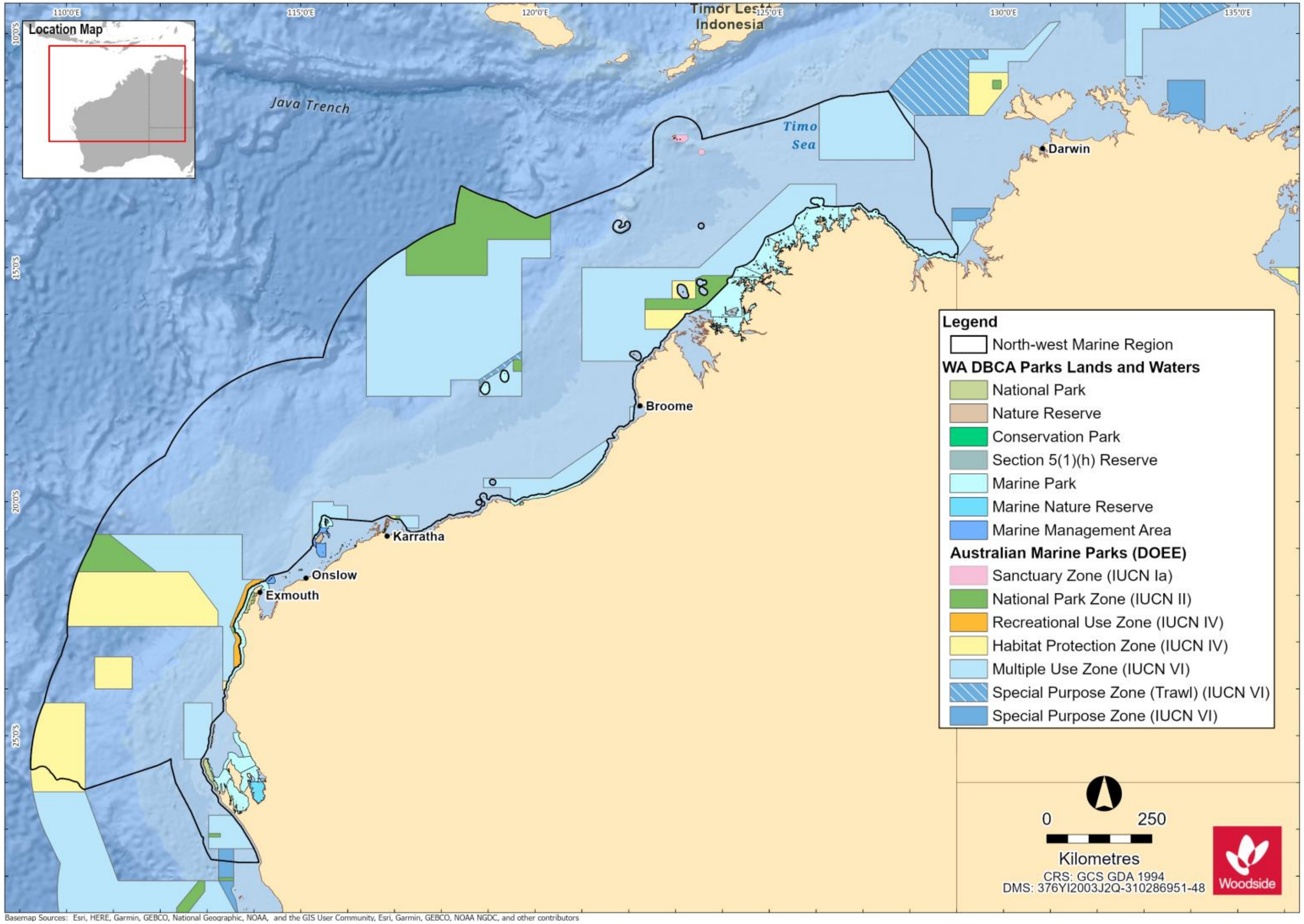

Figure 10-1 Commonwealth and State Marine Protected Areas for the NWMR

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10.10 Summary of Protected Areas within the SWMR

Table 10-2 Protected Areas within the SWMR

Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
World Heritage Properties			
N/A			
National Heritage Places - Natural			
N/A			
Commonwealth Heritage Places - Natural			
N/A			
Wetlands of International Importance (Ramsar)			
Beecher Point Wetlands	Ramsar	Beecher Point Wetlands is a system of about sixty small wetlands located near Rockingham in south-west WA, covering an area of around 7 km^2. The site was listed under the Ramsar Convention in 2001.	The wetlands support sedgelands, herblands, grasslands, open-shrublands and low open-forests. The sedgelands that occur within the linear wetland depressions of the Ramsar site are a nationally listed TEC. At least four species of amphibians and twenty-one (21) species of reptiles have been recorded on the site. The site also supports the southern brown bandicoot. The site meets criteria 1 and 2 of the Ramsar Convention.
Forrestdale and Thomsons Lakes	Ramsar	Forrestdale Lake is located in the City of Armadale and Thomsons Lake is located in the City of Cockburn both of which lie within the southern Perth metropolitan area, in Western Australia. The site was listed under the Ramsar Convention in 1990.	The lakes are surrounded by medium density urban development and some agricultural land. The sediments of Thomsons Lake are between 30,000 and 40,000 years old, which are the oldest lake sediments discovered in WA to date. These lakes are the best remaining examples of brackish, seasonal lakes with extensive fringing sedgeland, typical of the Swan Coastal Plain. The site meets criteria 1, 3, 5 and 6 of the Ramsar Convention.
Peel-Yalgorup System	Ramsar	Peel-Yalgorup System, located adjacent to the City of Mandurah in	Peel-Yalgorup System Ramsar site is the most important area for waterbirds in south-western Australia. It supports a large number of waterbirds, and a

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Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
		WA, is a large and diverse system of shallow estuaries, coastal saline lakes and freshwater marshes. The site was listed under the Ramsar Convention in 1990.	wide variety of waterbird species. It also supports a wide variety of invertebrates, and estuarine and marine fish. The site meets criteria 1, 3, 5 and 6 of the Ramsar Convention.
Vasse-wonnerup system	Ramsar	Vasse-Wonnerup System Ramsar wetland is situated in the Perth Basin, south-western WA. The site was listed under the Ramsar Convention in 1990.	Vasse-Wonnerup System is an extensive, shallow, nutrient-enriched wetland system of highly varied salinities. Large areas of the wetland dry out in late summer. Vasse-Wonnerup System supports tens of thousands of resident and migrant waterbirds of a wide variety of species. More than 80 species of waterbird have been recorded in the System such as red-necked avocets and black-winged stilts, wood sandpiper, sharp-tailed sandpiper, long-toed stint, curlew sandpiper and common greenshank. Thirteen waterbird species are also known to breed at the Ramsar site, including the largest regular breeding colony of black swans in south-western Australia. The site meets criteria 5 and 6 of the Ramsar Convention.
Wetlands of National Importance (DAWE, 2019)			
Rottnest Island Lakes		The Rottnest Island Lakes site is the cluster of 18 lakes and swamps on the north-east part of Rottnest Island.	An outstanding example of a series of lakes/swamps of varied depth and salinity located on an offshore island; the only island among 200 plus in WA exceeding 10 ha in area, that has a salt-lake complex; the only known example of seasonally meromictic lakes in Australia. The area meets criteria 1, 2, 3 and 6 for inclusion on the Directory of Important Wetlands in Australia.
Australian Marine Parks (DNP, 2018b)			
Abrolhos Marine Park	II, IV, VI	The Abrolhos Marine Park is located within both the NWMR and SWMR. Refer **Table 10-1** for description and conservation values.	
Bremer Marine Park	II, VI	Bremer Marine Park covers an area of 4472 km^2 and is located approximately half-way between Albany and Esperance, offshore from the Fitzgerald River National Park, extending from the WA State waters boundary.	Bremer Marine Park is significant because it contains habitats, species and ecological communities associated with two bioregions: • Southern Province • South-west Shelf Province. It includes two KEFs: Albany Canyon group and adjacent shelf break; and Ancient coastline at 90-120 m depth.

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Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
			The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Australian sea lions, and white sharks, a migratory pathway for humpback whales, and a significant calving area for southern right whales. The AMP includes canyons—important aggregation areas for killer whales.
Eastern Recherche Marine Park	II, VI	Eastern Recherche Marine Park covers an area of 20,575 km^2 and is located ~135 km east of Esperance, adjacent to the Recherche Archipelago, close to the WA Cape Arid National Park.	Eastern Recherche Marine Park is significant because it contains habitats, species and ecological communities associated with three bioregions: • South-west Shelf Province • Southern Province • Great Australian Bight Shelf Transition. It includes three KEFs: Mesoscale eddies; Ancient coastline at 90-120 m depth; and Commonwealth marine environment surrounding the Recherche Archipelago. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Australian sea lions and white sharks, and a calving buffer area for southern right whales.
Geographe Marine Park	II, IV, VI	Geographe Marine Park covers an area of 977 km^2 and is located in Geographe Bay, ~8 km west of Bunbury and 8 km north of Busselton, adjacent to the WA Ngari Capes Marine Park.	Geographe Marine Park is significant because it contains habitats, species and ecological communities associated with the South-west Shelf Province bioregion. It includes two KEFs: Commonwealth marine environment within and adjacent to Geographe Bay; and Western rock lobster. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, a migratory pathway for humpback and pygmy blue whales, and a calving buffer area for southern right whales.
Great Australian Bight Marine Park	II, VI	Great Australian Bight Marine Park covers an area of 45,822 km^2 and is located ~12 km south-east of Eucla and 174 km west of Ceduna, adjacent to the SA Far West Coast and Nuyts Archipelago Marine Parks.	Great Australian Bight Marine Park is significant because it contains habitats, species and ecological communities associated with two bioregions: • Great Australian Bight Shelf Transition • Southern Province. It includes three KEFs: Ancient coastline at 90-120 m depth; Benthic invertebrate communities of the eastern Great Australian Bight; and Small pelagic fish of the South-west Marine Region. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Australian sea lions, white sharks and

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Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
			pygmy blue and sperm whales, and a calving area, migratory pathway and large aggregation area for southern right whales.
Jurien Marine Park	II, VI	Jurien Marine Park covers an area of 1851 km^2 and is located ~148 km north of Perth and 155 km south of Geraldton, adjacent to the WA Jurien Bay Marine Park.	Jurien Marine Park is significant because it includes habitats, species and ecological communities associated with two bioregions: • South-west Shelf Transition • Central Western Province. It includes three KEFs: Ancient coastline at 90-120 m depth; Demersal slope and associated fish communities of the Central Western Province; and Western rock lobster The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Australian sea lions and white sharks, and a migratory pathway for humpback and pygmy blue whales.
Perth Canyon Marine Park	II, IV, VI	Perth Canyon Marine Park covers an area of 7409 km^2 and is located ~52 km west of Perth and ~19 km west of Rottnest Island.	Perth Canyon Marine Park is significant because it includes habitats, species and ecological communities associated with four bioregions: • Central Western Province • South-west Shelf Province • Southwest Transition • South-west Shelf Transition. It includes four KEFs: Perth Canyon and adjacent shelf break, and other west-coast canyons; Demersal slope and associated fish communities of the Central Western Province; Western rock lobster; and Mesoscale eddies. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Antarctic blue, pygmy blue and sperm whales, a migratory pathway for humpback, Antarctic blue and pygmy blue whales, and a calving buffer area for southern right whales.
South-west Corner Marine Park	II, IV, VI	South-west Corner Marine Park covers an area of 271,833 km^2 and is located adjacent to the WA Ngari Capes Marine Park. It covers an extensive offshore area that is closest to WA State waters ~48 km west of Esperance, 73 km west of Albany and 68 km west of Bunbury.	South-west Corner Marine Park is significant because it contains habitats, species and ecological communities associated with three bioregions: • Southern Province • South-west Transition • South-west Shelf Province. It includes six KEFs: Albany Canyon group and adjacent shelf break; Cape Mentelle upwelling; Diamantina Fracture Zone; Naturaliste Plateau; Western rock lobster; and Ancient coastline at 90 m-120 m depth.

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Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
			The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Australian sea lions, white sharks and sperm whales, a migratory pathway for Antarctic blue, pygmy blue and humpback whales, and a calving buffer area for southern right whales.
Twilight Marine Park	II, VI	Twilight Marine Park covers an area of 4641 km^2 and is located ~245 km south-west of Eucla and 373 km north-east of Esperance, adjacent to the WA State waters boundary.	Twilight Marine Park is significant because it contains habitats, species and ecological communities associated with the Great Australian Bight Shelf Transition bioregion. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds, Australian sea lions and white sharks, and a calving buffer area for southern right whales.
Two Rocks Marine Park	II, VI	Two Rocks Marine Park covers an area of 882 km^2 and is located ~25 km north-west of Perth, to the north-west of the WA Marmion Marine Park.	Two Rocks Marine Park is significant because it includes habitats, species and ecological communities associated with the South-west Shelf Transition bioregion. It includes three KEFs: Commonwealth marine environment within and adjacent to the west-coast inshore lagoons; Western rock lobster; and Ancient coastline at 90-120 m depth. The AMP supports a range of species including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat for seabirds and Australian sea lions, a migratory pathway for humpback and pygmy blue whales, and a calving buffer area for southern right whales.
State Marine Parks and Reserves			
Jurien Bay Marine Park	Sanctuary, Special Purpose and General Use Zones.	The Jurien Bay Marine Park is located on the central west coast of WA ~200 km north of Perth and covers an area of 824 km^2.	An extensive limestone reef system parallel to the shore has created a huge shallow lagoon that provides perfect habitat for Australian sea lions, dolphins and a myriad of juvenile fish. Extensive seagrass meadows inside the reef shelter many marine animals such as western rock lobsters, octopus and cuttlefish that make up the diet of young sea lions. The marine park also surrounds dozens of ecologically important islands that contain rare and endangered animals found nowhere else in the world (CALM, 2005b).
Marmion Marine Park	Sanctuary, Recreation and Special Use Zones.	The Marmion Marine Park lies within State waters between Trigg Island and Burns Beach and encompasses a coastal area of ~95 km^2. Marmion	The marine park has a number of sanctuary zones including Little Island, The Lumps and the Boyinaboat Reef protecting a variety of habitats from limestone reefs, seagrass beds and clear shallow lagoons that support a diversity of marine life. In addition, to a general use zone and the Waterman Recreation Area. The marine park contains important habitat for the endemic Australian

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Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
		Marine Park was the State's first marine park, declared in 1987.	sea lion, an array of seabird species migratory whales are regular visitors (CALM, 1992; DPAW, 2016d).
Swan Estuary Marine Park	Special Purpose and Nature Reserve Zones.	Three biologically important areas of Perth's Swan River make up the Swan Estuary Marine Park, including Alfred Cove, Pelican Point and Crawley. These three sites cover a total area of 3.4 km^2.	The sand flats, mud flats and beaches at the three locations of the Swan Estuary Marine Park provide the only remaining significant feeding and resting areas in the Swan Estuary, for trans-equatorial migratory wading and waterbirds. The Park and adjacent reserves also provide habitat for a diverse assemblage of aquatic and terrestrial flora and fauna (CALM, 1999).
Shoalwater Islands Marine Park	Sanctuary, Special Purpose and General Use Zones.	The Shoalwater Islands Maine Park is located adjacent to Rockingham on the south-west coast of WA, ~50 km south of Perth and covers an area of ~66 km^2.	The Shoalwater Islands Marine Park consists of a complex seabed and coastal topography consisting of islands, limestone ridges and reef platforms, protected inshore areas and deeper basins, sandbars and beaches, and is home to five species of cetacean and 14 species of sea and shore bird. The waters of the marine park are also used to access feeding grounds for the little penguin (*Eudyptula minor*) colony on Penguin Island, which is close to the northernmost limit of the species' range and is the largest known breeding colony in Western Australia (DEC, 2007c).
Ngari Capes Marine Park	Sanctuary, Special Purpose and Recreation Zones.	The Ngari Capes Marine Park is located off the south-west coast of WA, ~250 km south of Perth, covering ~1238 km^2.	The Ngari Capes Marine Park consists of a complex arrangement of sandy bays, high energy limestone and granite reefs bordered by headlands and cliffs and two weathered capes. Coral communities consist of both tropical and temperate species. Cetaceans and pinnipeds are resident in and/or transient through the marine park as well as a diverse range of seabirds and shorebirds (DEC, 2013).
Walpole and Nornalup Inlets Marine Park	Recreation Zone.	The Walpole and Nornalup Inlets Marine Park is located adjacent to the towns of Walpole and Nornalup on the south coast of WA, ~120 km west of Albany, and covers ~14 km^2.	The Walpole and Nornalup Inlets Marine Park consists of a geologically complex lagoonal estuarine system comprising three significant rivers and two connected inlets that are permanently open to the ocean. Approximately 40 marine and estuarine finfish species commonly inhabit the inlet system, as well as a variety of shark and ray species and numerous seabirds and shorebirds. The sandy beaches and shoreline vegetation of the inlet system are of high ecological and social importance to the marine park (DEC, 2009).

**Conservation objectives for IUCN categories include:*

Ia: Strict Nature Reserve

Ib: Wilderness Area

II: national Park

III: Natural Monument or Feature

IV: Habitat/Species Management Area

V: Protected Landscape

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VI: Protected area with sustainable use of natural resources – allow human use but prohibits large scale development.

IUCN categories for the marine park are provided and, in brackets, the IUCN categories for specific zones within each Marine Park as assigned under the South-west Marine Parks Network Management Plan 2018 (DNP, 2018b)

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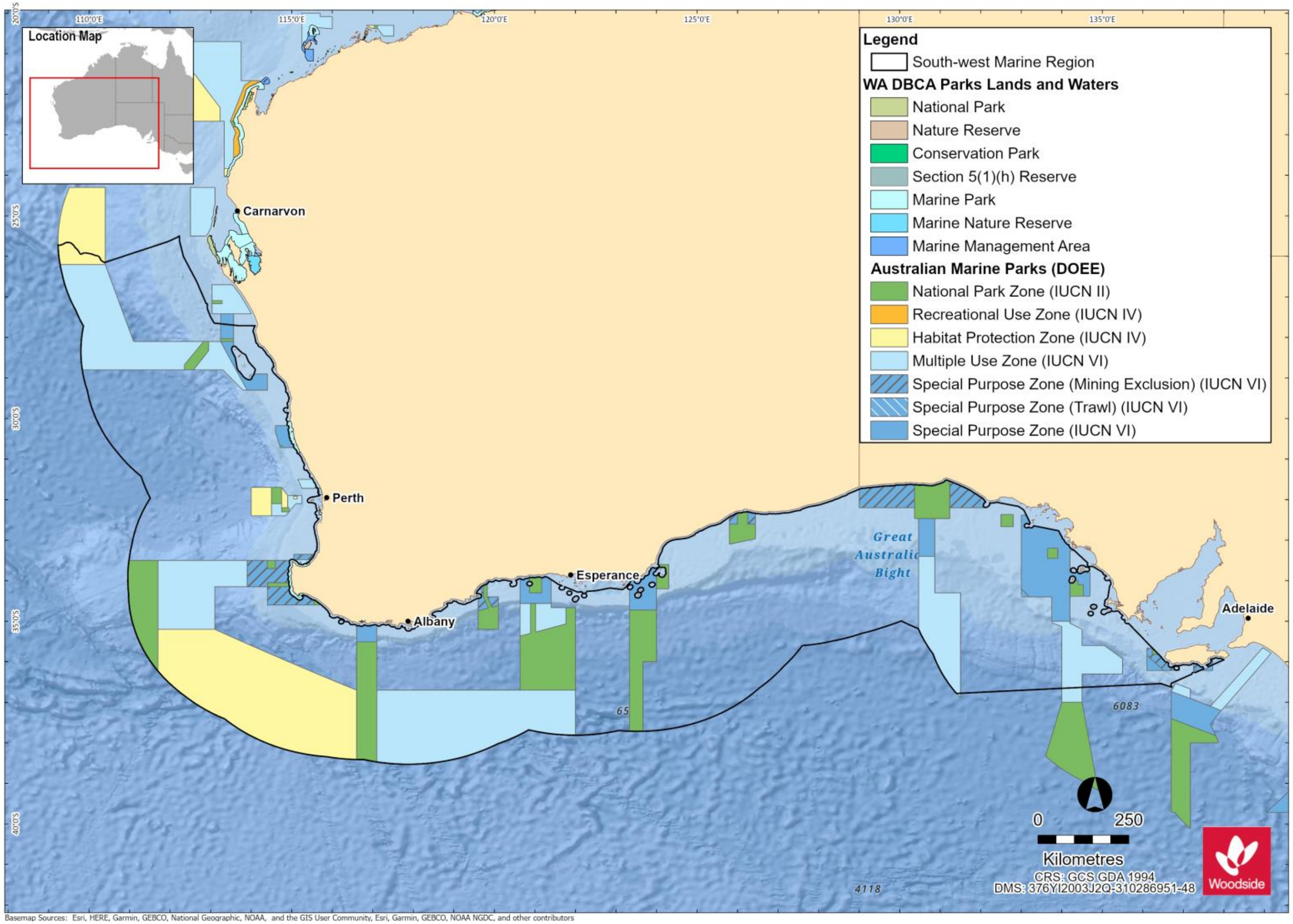

Figure 10-2. Commonwealth and State Marine Protected Areas for the SWMR

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10.11 Summary of Protected Areas within the NMR

Table 10-3 Protected Areas within the NMR

Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
World Heritage Properties			
Kakadu National Park		Kakadu National Park is a living landscape with exceptional natural and cultural values. It is the largest National Park in Australia and preserves the greatest variety of ecosystems on the Australian continent including extensive areas of floodplains, mangroves, tidal mudflats, coastal areas and monsoon forests. The park was inscribed the World Heritage list in three stages over 11 years. It is located in tropical north Australia covering a total area of 19,804 square kilometres.	The conservation values reflect the WHA Criterion: (i), (vi), (vii) and (ix): Natural features relate to Criterion (vii) – the remarkable contrast between the internationally recognised Ramsar-listed wetlands and the spectacular rocky escarpment and its outliers and Criterion (ix) – four major river systems of tropical Australia and floodplains that are dynamic environments, shaped by changing sea levels and big floods every wet season. These floodplains illustrate the ecological and geomorphological effects that have accompanied Holocene climate change and sea level rise. Kakadu National Park contains important and significant habitats supporting a diverse range of flora and fauna.
National Heritage Places - Natural			
Kakadu National Park		Refer to World Heritage property description above.	Refer to World Heritage property conservation values above
Commonwealth Heritage Places - Natural			
N/A			
Wetlands of International Importance (Ramsar)			
Kakadu National Park		Australian Ramsar site number 2. The stage 1 and 2 Ramsar sites, established in 1980, 1985 and 1989, respectfully were combined into a single Ramsar site in 2010.	The Kakadu National Park Ramsar site straddles the western edge of the Arnhem Land Plateau encompassing a range of landforms and extensive floodplains. It is a mosaic of contiguous wetlands comprising the catchments of two large river systems, the East and South Alligator rivers and encompasses extensive tidal mudflat areas. It is an internationally important site for migratory shorebirds as part of the EAAF.

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Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
Cobourg Peninsula		Australian Ramsar site number 1 established in 1974. This Ramsar site includes freshwater and extensive intertidal areas but excludes subtidal areas. It is in a remote location and there has been minimal human impact on the site.	The wetlands encompassed in the Ramsar site are some of the better protected and near-natural wetlands in the bioregion and there is a diverse array of wetland in a confined area. The site supports important turtle nesting habitat and habitat for coastal dolphin species and is an internationally significant migratory shorebird habitat as part of the EAAF and an important location for seabird breeding colonies.
Wetlands of National Importance (DAWE, 2019)			
Southern Gulf Aggregation		The site is a complex continuous wetland aggregation in the Gulf of Carpentaria, covering an area of ~5460 km^2 located 58 km east of Burketown, Queensland.	The Southern Gulf Aggregation is the largest continuous estuarine wetland aggregation of its type in northern Australia. It is one of the three most important areas for shorebirds in Australia. The area meets criteria 1, 2, 3, 4, 5 and 6 for inclusion on the Directory of Important Wetlands in Australia.
Australian Marine Parks (DNP, 2018c)			
Arafura Marine Park	VI	Arafura Marine Park covers an area of 22,924 km^2 is located ~256 km north-east of Darwin and 8 km offshore of Croker Island, NT. It extends from NT waters to the limit of Australia's EEZ.	The AMP is significant because it contains habitats, species and ecological communities associated with two bioregions: • Northern Shelf Province • Timor Transition. It includes one KEF: Tributary canyons of the Arafura Depression. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include internesting habitat for marine turtles and important foraging and breeding habitat for seabirds.
Arnhem Marine Park	VI	Arnhem Marine Park covers an area of 7125 km^2 and is located ~100 km south-east of Croker Island and 60 km south-east of the Arafura Marine Park. It extends from NT waters surrounding the Goulburn Islands, to the waters north of Maningrida.	Arnhem Marine Park is significant because it contains habitats, species and ecological communities associated with the Northern Shelf Province bioregion. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include foraging habitat and a migratory pathway for marine turtles and seabirds.
Gulf of Carpentaria Marine Park	II, VI	Gulf of Carpentaria Marine Park covers an area of 23,771 km^2 and is located ~90 km north-west of Karumba, Queensland and is adjacent to the Wellesley Islands in	Gulf of Carpentaria Marine Park is significant because it contains habitats, species and ecological communities associated with the Northern Shelf Province bioregion.

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Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
		the south of the Gulf of Carpentaria basin.	It includes four KEFs: Gulf of Carpentaria basin; Gulf of Carpentaria coastal zone; Plateaux and saddle north-west of the Wellesley Islands; and Submerged coral reefs of the Gulf of Carpentaria. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and foraging areas for seabirds and internesting and foraging areas for turtles.
Joseph Bonaparte Gulf Marine Park	VI	The Joseph Bonaparte Gulf Marine Park is located within both the NWMR and NMR. Refer **Table 10-1** for description and conservation values.	
Limmen Marine Park	IV	Limmen Marine Park covers an area of 1399 km^2 and is located ~315 km south-west of Nhulunbuy, NT, in the south-west of the Gulf of Carpentaria. It extends from NT waters, between the Sir Edward Pellew Group of Islands and Maria Island in the Limmen Bight, adjacent to the NT Limmen Bight Marine Park.	Limmen Marine Park is significant because it contains habitats, species and ecological communities associated with the Northern Shelf bioregion. It includes one KEF: Gulf of Carpentaria coastal zone. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include internesting and foraging habitat for marine turtles.
Oceanic Shoals Marine Park	II, IV, VI	The Oceanic Shoals Marine Park is located within both the NWMR and NMR. Refer **Table 10-1** for description and conservation values.	
Wessel Marine Park	IV, VI	Wessel Marine Park covers an area of 5908 km^2 and is located ~22 km east of Nhulunbuy, NT. It extends from NT waters adjacent to the tip of the Wessel Islands to NT waters adjacent to Cape Arnhem.	Wessel Marine Park is significant because it contains habitats, species and ecological communities associated with the Northern Shelf bioregion. It includes one KEF: Gulf of Carpentaria basin. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding habitat for seabirds and internesting and foraging habitat for marine turtles.
West Cape York Marine Park	II, IV, VI	West Cape York Marine Park covers an area of 16,012 km^2 and is located adjacent to the northern end	West Cape York Marine Park is significant because it contains species and ecological communities associated with two bioregions: • Northeast Shelf Transition

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Protected Area	IUCN Protected Area Category* or Relevant Park Zone	Description	Conservation Values
		of Cape York Peninsula ~25 km south-west of Thursday Island and 40 km north-west of Weipa, Queensland.	• Northern Shelf Province. It includes two KEFs: Gulf of Carpentaria basin; and Gulf of Carpentaria coastal zone. The AMP supports a range of species, including species listed as threatened, migratory, marine or cetacean under the EPBC Act. BIAs within the AMP include breeding and foraging habitat for seabirds, internesting and foraging habitat for marine turtles and dugong, and foraging, breeding and calving habitat for dolphins.
Territory Marine Parks and Reserves			
Cobourg Marine Park	II, IV, VI	Cobourg Marine Park covers an area of 2,290 km^2 and is located in the waters surrounding the Cobourg Peninsula ~220 km north-east of Darwin. The Marine Park is part of the larger Garig Gunak Barlu National Park. Garig Gunak Barlu National Park includes both the Marine Park and the Cobourg Sanctuary.	Cobourg Marine Park is located in the Cobourg and Van Diemen Gulf marine bioregions with the northern portion of the Park covered by the Cobourg marine bioregion and the southern portion covered by the Van Diemen Gulf marine bioregion. The Marine Park is characterised by a number of deeply incised bays and estuaries on its northern shores. These bays are ancient river valleys that were drowned during periods of sea level rise and provide a varied environment and habitat that is quite distinct from the open water areas of the Park. The areas of the Park that have been studied and where extensive collections have been made indicates that the Park supports rich and diverse marine life including live coral reefs, seagrass, diverse reef and pelagic fish populations, marine turtles and dugong.

**Conservation objectives for IUCN categories include:*

Ia: Strict Nature Reserve

Ib: Wilderness Area

II: National Park

III: Natural Monument or Feature

IV: Habitat/Species Management Area

V: Protected Landscape

VI: Protected area with sustainable use of natural resources – allow human use but prohibits large scale development.

IUCN categories for the marine park are provided and, in brackets, the IUCN categories for specific zones within each Marine Park as assigned under the North Marine Parks Network Management Plan 2018 (DNP, 2018c)

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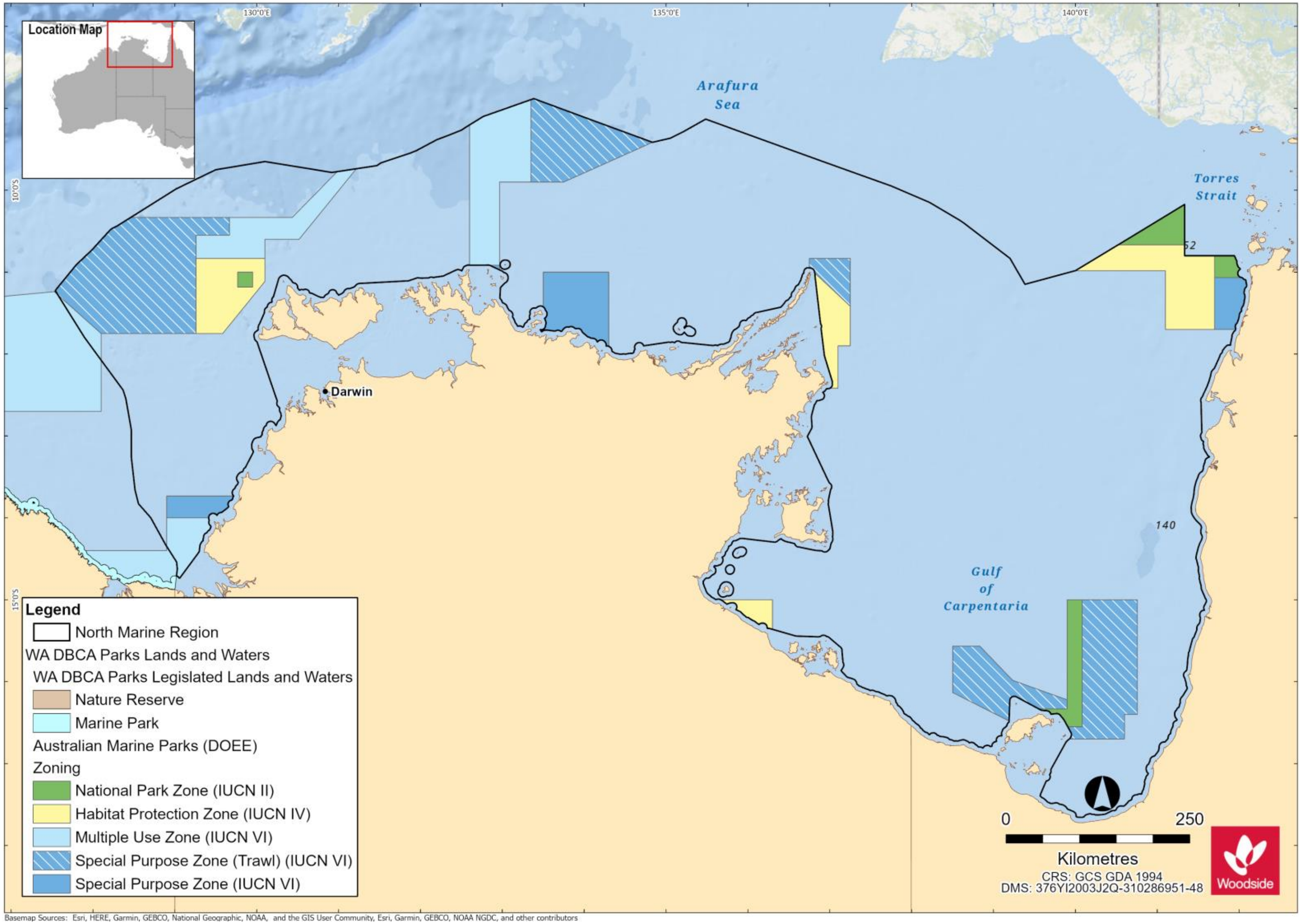

Figure 10-3. Commonwealth and State Marine Protected Areas within the NMR

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11. SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

This section summarises the information relating to the socio-economic and cultural environment of the regions offshore Western Australia, with a focus on the NWMR and to a lesser extent the SWMR and NWR.

The cultural environment includes Indigenous and European heritage values, including underwater values such as historic shipwrecks. Socio-economic values include commercial and traditional fishing, tourism and recreation, shipping, oil and gas activities and defence activities.

11.1 Cultural Heritage

11.1.1 Indigenous Sites of Significance

Murujuga (the Burrup Peninsula) has a very high density of significant Indigenous heritage sites and places with tangible and intangible heritage values. The area has one of the largest, densest, and most diverse collections of rock art in the world. It is estimated that the peninsula and surrounding islands contain over a million petroglyphs (rock engravings) covering a broad range of styles and subjects. The landscape also contains quarries, middens, fish traps, rock shelters, ceremonial sites, artefact scatters, grinding patches and stone arrangements that evidence tens of thousands of years of human occupation. These places are linked to Aboriginal cosmology, Dreaming stories and songs through the stories, knowledge and customs that are still held by traditional custodians.

In 2007 the Dampier Archipelago (including the Burrup Peninsula) was included on the National Heritage List due to outstanding heritage values relating to Australia's cultural history contained in the large number, density, diversity, distribution and fine execution of rock art. Within the National Heritage Place, the Murujuga National Park covers 4913 ha and is co-managed by the Murujuga Aboriginal Corporation and the Department of Biodiversity, Conservation and Attractions. The Murujuga Cultural Landscape was also added to Australia's Tentative World Heritage List in 2020, with full World Heritage Listing anticipated in 2024.

Woodside also recognises the potential for heritage to survive in submerged landscapes. Sea-level rises since the last ice age mean that areas now under the sea were once exposed, that many of today's islands would have been connected to the mainland, and that Aboriginal people are highly likely to have inhabited these places. Woodside works with traditional custodians, academics and heritage professionals to identify tangible and intangible heritage values in the submerged landscape to avoid disturbing heritage where possible and to minimise impacts where heritage cannot be avoided.

It is an offence to excavate, destroy, damage, conceal or alter Indigenous heritage onshore or in state waters under section 17 of the *Aboriginal Heritage Act 1972 (WA) (AHA)* without ministerial authorisation. Where there is a risk of injury or desecration to a significant Aboriginal area, even where permitted under the AHA, any Aboriginal person may apply to the federal Environment Minister for a declaration under sections 9 or 10 of the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cth)* for the protection and preservation of that area.

The Department of Planning, Lands and Heritage maintains a register of registered sites and heritage places including middens, burial, ceremonial [sites], artefacts, rock shelters, mythological [sites] and engraving sites. There are over 1600 registered sites on Murujuga and the Dampier Archipelago with around 1100 other heritage places. This register is not comprehensive and will be complemented by heritage surveys where necessary. Protection of National and World Heritage values is also legislated through various provisions of the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*. Murujuga National Park is managed under the *Conservation and Land Management Act 1984 (WA)*.

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11.1.2 European Sites of Significance

European sites of significance and heritage value are found along adjacent foreshores of the SWMR, NWMR and NWR. Heritage values are protected in Western Australia under the *Heritage Act 2018*.

11.1.3 Underwater Cultural Heritage

Places of historic cultural significance are protected under Commonwealth, State and local regimes. Places inscribed on the National or World Heritage list are protected through various provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). Historic places may also be protected under the *Heritage Act 2018* (WA); under section 129 the prohibited alteration, demolition, damage, despoilment or removal of objects from a registered place may result in a fine of A$1 million. Protection of heritage by local government typically emanates from local planning schemes produced under Part 5 of the *Planning and Development Act 2005* (WA).

The remains of vessels and aircraft in Commonwealth waters, along with any associated article, are automatically protected under the *Underwater Cultural Heritage Act 2018* (Cth) after 75 years. Remains and relics of any ship lost, wrecked or abandoned in Western Australian waters before 1900 are protected by the *Maritime Archaeology Act 1973* (WA).

The Australian National Shipwreck Database and the WA Maritime Museum Shipwreck Database list these protected wrecks.

11.1.4 National and Commonwealth Listed Heritage Places

Australia's National Heritage Sites are those of outstanding natural, historic and/or Indigenous significance to Australia. National Heritage places classed as natural are discussed in **Section 10.3**. Historic and/or Indigenous National Heritage Listed Places of the NWMR include:

- Dampier Archipelago (including Burrup Peninsula)
- Dirk Hartog Landing Site/Cape Inscription
- HMAS Sydney II and the HSK Kormoran Shipwreck Sites
- Batavia Shipwreck Site and Survivor Camps Area 1629 – Houtman Abrolhos

Commonwealth Heritage Places are a collection of sites recognised for their Indigenous, historical and/or natural values, which are owned or controlled by the Australian Government. A number of these sites are owned or controlled by the Department of Defence, as well as Government agencies relating to maritime safety, customs and communication. Commonwealth Heritage places classed as natural are discussed in **Section 10.3**. Listed Heritage Places in the NWMR include:

- Mermaid Reef – Rowley Shoals (refer **Section 10.3**)
- Ashmore Reef National Nature Reserve (refer **Section 10.3**)
- Scott Reef and Surrounds – Commonwealth Area (refer **Section 10.3**)
- Ningaloo Marine Area (refer **Section 10.3**)

World Heritage Properties are those sites that hold universal value which transcends any value they may be held by any one nation. These sites and their qualities are detailed in the Convention concerning the Protection of the World Cultural and Natural Heritage (the World Heritage Convention), to which Australia is a founding member. The Protected Matters Search Report (**Appendix A**) lists two natural World Heritage Properties in the NWMR (refer **Section 10.2**). There are no cultural heritage listings located within the NWMR.

Summary tables of heritage places for NWMR, SWMR and NMR are presented in **Table 11-1,Table 11-2** and **Table 11-3**.

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11.2 Summary of Heritage Places within the NWMR

Table 11-1 Heritage Places (Indigenous and Historic) within the NWMR

Heritage Places	Woodside Activity Area			Class	Description	Conservation Values
	Browse	NWS/S	NW Cape			
National Heritage Properties						
Dampier Archipelago (including Burrup Peninsula)	-	✓	-	Indigenous	The Dampier Archipelago (including the Burrup Peninsula) contains one of the densest concentrations of rock engravings in Australia with some sites containing thousands or tens of thousands of images.	The rock engravings comprise images of avian, marine and terrestrial fauna, schematised human figures, figures with mixed human and animal characteristics and geometric designs. At a national level it has an exceptionally diverse and dynamic range of schematised human figures some of which are arranged in complex scenes. The fine execution and dynamic nature of the engravings, particularly some of the composite panels, exhibit a degree of creativity that is unusual in Australian rock engravings.
Dirk Hartog Landing Site 1616 – Cape Inscription Area	-	-	✓	Historic	Cape Inscription is the site of the oldest known landings of Europeans on the WA coastline.	The Cape Inscription area displays uncommon aspects of Australia's cultural history because of the cumulative effect its association with these explorers and surveyors had on growing knowledge of the great southern continent in Europe. The association of the site with these early navigators stimulated the development of the European view of the great southern continent at a time when they began to look at the world with a modern scientific outlook.
Commonwealth Heritage Properties						
N/A						

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11.3 Summary of Heritage Places within the NMR

Table 11-2 Heritage Places (Indigenous and Historic) within the NMR

Heritage Places	Class	Description	Conservation Values
National Heritage Properties			
None			
Commonwealth Heritage Properties			
None			

11.4 Summary of Heritage Places within the SWMR

Table 11-3 Heritage Places (Indigenous and Historic) within the SWMR

Heritage Places	Class	Description	Conservation Values
National Heritage Properties			
Cheetup Rock Shelter	Indigenous	Cheetup meaning “place of the birds” is the name of a spacious rock shelter located in Cape Le Grand National Park, about 55 km east of Esperance in WA. Aboriginal people associated with the place identify themselves as Nyungar/Noongar, Ngadju (shortened from Ngadjunmaia) or Mirning.	Cheetup rock shelter provides outstanding evidence for the antiquity of processing and use of cycad seeds by Aboriginal people. The seeds of the cycad are extremely toxic and can cause speedy death if eaten fresh without proper preparation to remove the toxins. The presence of *Macrozamia riedlei* seeds in a pit lined with Xanthorrhoea (grass tree) leaf bases indicates that the Aboriginal people in the Esperance region had the knowledge to remove the toxins of this important source of carbohydrate and protein at least 13,200 years ago.

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Heritage Places	Class	Description	Conservation Values
Batavia Shipwreck Site and Survivor Camps Area 1629 – Houtman Abrolhos	Historic	The Batavia and its associated sites hold an important place in the discovery and delineation of the WA coastline. The wreck of the Batavia, and other Dutch ships like her, convinced the VOC (Dutch East India Company) of the necessity of more accurate charts of the coastline and resulted in the commissioning of Vlamingh's 1696 voyage.	Because of its relatively undisturbed nature the archaeological investigation of the wreck itself has revealed a range of objects of considerable value as well as to artefact specialists and historians.
HMAS Sydney II and HSK Kormoran Shipwreck Sites	Historic	The naval battle fought between the Australian warship HMAS Sydney II and the German commerce raider HSK Kormoran off the WA coast during World War II was a defining event in Australia's cultural history. HMAS Sydney II was Australia's most famous warship of the time and this battle has forever linked the stories of these warships to each other. The loss of HMAS Sydney II along with its entire crew of 645 following the battle with HSK Kormoran, remains as Australia's worst naval disaster.	The shipwreck sites of HMAS Sydney II and HSK Kormoran have outstanding heritage value to the nation because of their importance in a defining event in Australia's cultural history and for their part in development of the process of the defence of Australia.
Commonwealth Heritage Properties			
Cliff Point Historic Sites	Historic	Cliff Head is a limestone bluff on the east coast of Garden Island. Evidence of occupation has been reported from the beach just north of the head, the immediate hinterland, the ridge above and on the south face of the ridge.	The Cliff Point Historic Site, individually significant within the area of Garden Island is important as the first site inhabited by Governor Stirling's party in 1829 when founding the colony of WA, and as WA's first official non-convict settlement. The site was occupied in the first instance by Captain Charles Fremantle before the arrival of Captain Stirling. The party occupied the site for two months before a move was made to the Swan River settlement on the mainland.
HMAS Sydney II and HSK Kormoran Shipwreck Sites	Historic	As above	As above
J Gun Battery	Historic	J Battery comprised two 155 mm long range guns, the other similar battery being at Cape Peron on the mainland at the entrance to Cockburn Sound. Located in the dune systems at the north western	J Gun Battery (1942) is individually significant within the area of Garden Island (Register No. 019544) and is historically important as the first gun battery constructed on Garden Island and as one of two long range gun batteries which played a

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Heritage Places	Class	Description	Conservation Values
		corner of Garden Island elements of the J Battery complex are now covered in part by sand.	strategic role in the coastal defences of Cockburn Sound and Fremantle following the entry of Japan into the Second World War (1939-45).

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11.5 Fisheries - Commercial

11.5.1 Commonwealth and State Fisheries

The diverse range of habitats and species offshore WA has allowed for various fisheries to develop and operate throughout the region.

The Australian Fisheries Management Authority (AFMA) manages fisheries on behalf of the Commonwealth Government and is bound by objectives under the Commonwealth *Fisheries Management Act 1991*.

WA State commercial fisheries are managed by the WA Department of Primary Industries and Regional Development (WA DPIRD) under the WA *Fish Resources Management Act 1994* (FRMA), Fisheries Resources Management Regulations 1995, relevant gazetted notices and licence conditions, and applicable Fishery Management Plans.

Commonwealth and State managed fisheries that operate within the NWMR and in areas beyond this region are summarised in the **Table 11-4**.

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Table 11-4 Commonwealth and State managed fisheries

<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th rowspan="2" colspan="3">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td colspan="7">Commonwealth Managed Fisheries</td></tr>
<tr><td rowspan="5">Southern Bluefin Tuna Fishery</td><td rowspan="5">✓</td><td rowspan="5">✓</td><td rowspan="5">✓</td><td>Management area</td><td colspan="2">The Southern Bluefin Tuna Fishery (SBTF) covers the entire EEZ around Australia, out to 200 nm from the coast. They do not fish in the Woodside activity area.</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>Southern bluefin tuna (Thunnus maccoyii)</td><td>Longline and purse seine fishing.</td><td>Southern bluefin tuna is a pelagic species which can be found to depths of 500 m (AFMA, 2021a)</td></tr>
<tr><td>Fishing effort</td><td colspan="2">Most of the Australian fishing effort is by purse-seine vessels in the Great Australian Bight and waters off South Australia during summer months, and by longline off the New South Wales coastline during winter months (Patterson et al., 2020).
SBTF is a fishery that is shared amongst many countries. Australia currently has a 35% share of the total global allowable catch, and while wild capture fishing in Australia to sell directly to market can occur anywhere throughout the SBTF's range, currently the vast majority of that quota is value-added through ranching (on-growing the wild captured fish for extra 5-6 months). Ranching requires significant infrastructure, a resident labour force, plus proximity to a fishery able to supply a large quantity of natural feed/sardines (40,000+ tonnes) (for example as available in Port Lincoln). North-west WA is critically important regardless of how the quota is fished because of the proximity to the single spawning ground of this global roaming species.
The stock remains classified as overfished.</td></tr>
<tr><td>Active licences/vessels</td><td colspan="2">Seven purse seine vessels, 20 longline vessels (Patterson et al., 2020).</td></tr>
<tr><td>Western Skipjack Tuna Fishery</td><td>✓</td><td>✓</td><td>✓</td><td>Management area</td><td colspan="2">The combined western and eastern skipjack tuna (Katsuwonus pelamis) fisheries (STF) encompass the entire Australian EEZ. The Western Skipjack Tuna Fishery (WSTF) extends westward from the SA/Victorian border across the Great Australian Bight and around the west coast of WA to the Cape York Peninsula.</td></tr>
</table>

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Fishery	Woodside Activity Area			Description			
	Browse	NWS/S	NW Cape				
				Species targeted		**Fishing methods**	**Fishing depth**
				Western skipjack tuna (*Katsuwonus pelamis*)		Fishers use purse seine gear (about 98% of catch) and sometimes pole and line when fishing for skipjack tuna.	Western skipjack tuna is a pelagic species that can be found to depths of 260 m (AFMA, 2021b).
				Fishing effort:	The Skipjack Tuna Fishery (STF) has not been actively fished since the 2008-2009 fishing season (Patterson *et al*., 2020). The management arrangements for this fishery will be reviewed if active boats re-enter the fishery.		
				Active licences/vessels:	No active vessels operating since 2009.		
Western Tuna and Billfish Fishery	✓	✓	✓	**Management area**	The Western Tuna and Billfish Fishery (WTBF) extends to the Australian EEZ boundary in the Indian Ocean.		
				Species targeted		**Fishing methods**	**Fishing depth**
				Bigeye tuna (*Thunnus obesus*) Yellowfin tuna (*Thunnus albacares*) Swordfish (*Xiphias gladius*) Albacore (*Thunnus alalonga*) Striped marlin (*Kajikia audax*)		Fishers mainly use pelagic longline fishing gear to catch the targeted species. Minor line (including handline, troll, rod and reel) can also be used.	Species have a broad depth distribution, with tuna occurring at 150 – 300 m, striped marlin at 150 m and swordfish at up to 600 m (BRS, 2007).
				Fishing effort:	The WTBF operates in Australia's EEZ and high seas of the Indian Ocean. Fishing effort in recent years has been concentrated off south-west WA, with occasional activity off SA.		
				Active licences/vessels:	Two pelagic longline vessels and two minor longline vessels (Patterson *et al*., 2020).		
Western Deepwater Trawl Fishery			✓	**Management area**	The Western Deepwater Trawl Fishery (WDTF) is located in deep water off WA, from the line approximating the 200 m isobath to the edge of the Australian Fishing Zone (AFZ).		

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Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
				Species targeted	**Fishing methods**	**Fishing depth**
				More than 50 species, historically dominated by six commercial finfish species or species groups: Orange roughy (*Hoplostethus atlanticus*) Oreos (Oreosomatidae) Boarfish (Pentacerotidae) Eteline snapper (Lutjanidae: Etelinae) Apsiline snapper (Lutjanidae: Apsilinae) Sea bream (Lethrinidae)	Demersal trawl.	Water deeper than 200 m, stakeholder consultation has indicated that this may be to depths of 800 m.
				Fishing effort:	The number of vessels active in the fishery and total hours trawled have fluctuated from year to year. Notably, total hours trawled were relatively high for a brief period during the early 2000s when fishers targeted ruby snapper and deepwater bugs (Patterson *et al*., 2020). Total fishing effort has been variable but relatively low since then. Effort in 2018-2019 (492 trawl hours) was less than half that of 2017-2018 (1108 trawl hours) (Patterson *et al*., 2020).	
				Active licences/vessels:	One active vessel in 2018-2019 (Patterson *et al.*, 2020).	
North-west Slope Trawl Fishery	✓	✓		**Management area**	The North-west Slope Trawl Fishery (NWSTF) extends, from 114 °E to 125 °E, from the 200 m isobath to the outer limit of the AFZ (200 nm from the coastline, which is the boundary of the Australian EEZ).	
				Species targeted	**Fishing methods**	**Fishing depth**
				Australian scampi (*Metanephrops australiensis*) and smaller quantities of velvet and Boschma's scampi (*M. velutinus* and *M. boschmai*) Mixed snappers have historically been an important component of the catch.	Demersal trawl.	Typically at depths of 350 to 600 m (Patterson *et al*., 2017), however stakeholder consultation has indicated that this may be to depths of 800 m.

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<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th colspan="3" rowspan="2">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td>Fishing effort:</td><td colspan="2">The NWSTF commenced in 1985 and the number of active vessels peaked at 21 in the 1986-1987 season and declined through the 1990s before increasing to 10 vessels in 2000-2001 and 2002-2002 seasons. Four vessels operated in the 2017-2018 and 2018-2019 seasons (Patterson et. al. 2020).
Fishing for scampi occurs over soft, muddy sediments or sandy habitats, using demersal trawl gear on the continental slope (Patterson et al., 2017).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="2">Four vessels (Patterson et. al., 2020).</td></tr>
<tr><td colspan="7">State Managed Fisheries</td></tr>
<tr><td rowspan="4">Pilbara Fish Trawl (Interim) Managed Fishery</td><td rowspan="4"></td><td rowspan="4">✓</td><td rowspan="4"></td><td>Management area</td><td colspan="2">The Pilbara Trawl (Interim) Managed Fishery is of high intensity and is divided into two zones and an area governed by Schedule 5 (prohibited to trawling). In addition to the Prohibited Trawl Fishing area, no fish trawl units are allocated for use in Zone 1 or Areas 3 and 6 of Zone 2 (which comprises six management areas) (Newman et al., 2020a). No fish trawl units have been allocated for use in Area 6 of Zone 2 since the management plan commenced operation in 1998.</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>The Pilbara Fish Trawl (Interim) Managed Fishery (PFTIMF) targets more than 50 scalefish species.
The five main demersal scalefish species landed by the fisheries in the Pilbara region are blue-spotted emperor, crimson snapper, rosy threadfin bream, red emperor and goldband snapper in 2018 (Newman et al., 2020a).</td><td>Demersal trawl.</td><td>The Pilbara Fish Trawl Fishery lands the largest component of the catch and operates in waters between 50 and 200 m water depth (Allen et al., 2014, Newman et al. 2015). Stakeholders have advised that trawling can occur in depths of up to approximately 800 m.</td></tr>
<tr><td>Fishing effort:</td><td colspan="2">Based on State of the Fisheries annual reports provided by DPIRD, catch trends are seen to be increasing over the past reporting years:</td></tr>
</table>

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Fishery	Woodside Activity Area			Description			
	Browse	NWS/S	NW Cape				
					Pilbara Trawl (Interim) Managed Fishery caught 1996 t in 2018-19, 1780 t in 2017-18, 1529 t in 2016-17, 1172 t in 2015-16, 1105 t in 2014-15.		
				Active licences/vessels:	Two Pilbara Trawl (Interim) Managed Fishery vessels in 2017 (Newman *et al*., 2020a). Active vessels data are confidential as there were fewer than three vessels in the Pilbara Fish Trawl Interim Managed Fishery (Newman *et al*., 2020a).		
Pilbara Trap Managed Fishery		✓	✓	**Management area**	The Pilbara Trap Fishery 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 using input controls in the form of individual transferable effort allocations monitored with a satellite-based vessel management system. The fishery includes six licences allocated to three vessels, operating principally from Onslow.		
				Species targeted		**Fishing methods**	**Fishing depths**
				Pilbara Trap Managed Fishery catch is made up of around 45-50 different fish species. The four main species landed by the fisheries in the Pilbara region are blue-spotted emperor, red emperor, goldband snapper and Rankin cod.		Demersal fish traps.	Greatest effort in waters less than 50 m depth targeting high value species such as red emperor and goldband snapper.
				Fishing effort	Based on State of the Fisheries annual reports provided by DPIRD, catch trends are seen to be increasing over the past reporting years: Pilbara Trap Managed Fishery caught 563 t in 2018-19, 573 t in 2017-18, 495 t in 2016-17, 510 t in 2015-16, 268 t in 2014-15. In 2018, the total catch for the Pilbara Trap Managed Fishery was 563 t, making up 21% of the total catch by the Pilbara Demersal Scale Fishery (Newman *et al*., 2019).		

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Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
				Active licences/vessels	In the 2019 season, there were six licences in the Pilbara Trap Managed Fishery, (Newman *et al*., 2020a). Active vessels data are confidential as there were fewer than three vessels in the Pilbara Trap Managed Fishery (Newman *et al*., 2019).	
Pilbara Line Managed Fishery		✓	✓	**Management area**	The Pilbara Line Managed Fishery boat licences are permitted to operate anywhere within "Pilbara waters", bounded by a line commencing at the intersection of 21°56'S latitude and the high water mark on the western side of the North-west Cape on the mainland of WA; west along the parallel to the intersection of 21°56'S latitude and the boundary of the AFZ and north to longitude 120°E.	
				Species targeted	**Fishing method**	**Fishing depths**
				The Pilbara Line Managed Fishery catch is made up around 45-50 different fish species. The Pilbara Line Managed Fishery targets similar demersal species to the Pilbara Trap and Trawl fisheries, as well as some deeper offshore species such as ruby snapper and eightbar grouper The Pilbara Line Managed Fishery operates on an exemption basis that enables licence holders to fish for any nominated five-month block during the year.	Demersal long line.	Pilbara Line Fishing Depth: Operates up to a depth of 600 m.
				Fishing effort	Based on State of the Fisheries annual reports provided by DPIRD, catch trends are seen to be increasing over the past reporting years: Pilbara Line Managed Fishery caught 93 t in 2018-19, 143 t in 2017-18, 126 t in 2016-17, 97 t in 2015-16, 40 t in 2014-15. The total catch in 2018 for the Pilbara Line Managed Fishery was 93 t, making up 3% of the total catch by the Pilbara Demersal Scalefish Fishery (Newman *et al*., 2019).	

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<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th colspan="3" rowspan="2">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td></td><td></td><td></td><td></td><td>Active licences/vessels</td><td colspan="2">In the 2018 season there are nine individual licences in the Pilbara Line Fishery, held by seven operators.
Active vessels data is confidential as there were fewer than three vessels in the Pilbara Line Fishery (Newman et al., 2018).</td></tr>
<tr><td rowspan="5">Mackerel Managed Fishery</td><td rowspan="5">✓</td><td rowspan="5">✓</td><td rowspan="5">✓</td><td>Management area</td><td colspan="2">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 Coast (Area 3).</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>Spanish mackerel (Scomberomorus commerson)
Grey mackerel (S. semifasciatus)
Other species from the genus Scomberomorus</td><td>Near-surface trawling gear.
Jig fishing.</td><td>Previous engagement with WAFIC suggests that the depth of fisheries may extend to 70 m.</td></tr>
<tr><td>Fishing effort:</td><td colspan="2">Most of the catch is taken from waters off the Kimberley coasts (Lewis and Brand-Gardner, 2018), reflecting the tropical distribution of mackerel species (Molony et al., 2015). Most 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 before spawning (Mackie et al., 2003).
Based on State of the Fisheries annual reports provided by DPIRD, catch trends are as follows:
213 t in 2018-19 (the lowest on record (Lewis et al., 2020), 283 t in 2017-18, 276 t in 2016-17, 302 t in 2015-16, 322 t in 2014-15.</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="2">Fifteen boats fished in 2018, with approximately 35-40 people directly employed in the Mackerel Managed Fishery, primarily from May-November (Lewis et al., 2020).</td></tr>
<tr><td rowspan="2">Marine Aquarium Managed Fishery</td><td rowspan="2">✓</td><td rowspan="2">✓</td><td rowspan="2">✓</td><td>Management area</td><td colspan="2">The Marine Aquarium Managed Fishery is able to operate in all State waters. The fishery is typically more active in waters south of Broome and higher levels of effort around the Capes region, Perth, Geraldton, Exmouth, Dampier and Broome (Newman et al., 2020b).</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
</table>

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Fishery	Woodside Activity Area: Browse	Woodside Activity Area: NWS/S	Woodside Activity Area: NW Cape	Description			
				Finfish, hard coral, soft coral, tridacnid clams, syngnathids (seahorses and pipefish), other invertebrates (including molluscs, crustaceans, echinoderms etc.), algae, seagrasses and 'live rock'.		The fishery is diver-based, which typically restricts effort to safe diving depths (less than 30 m).	Less than 30 m, as advised by WAFIC.
				Fishing effort:	Total catch for the Marine Aquarium Managed Fishery in 2018 was 156,188 fishes, 32.025 t of coral, live rock and living sand and 176.02 L of marine plants and live feed.		
				Active licences/vessels:	Eleven licences were active in 2019 (Newman *et al.*, 2020b).		
Beche-de-mer Fishery	✓	✓	✓	**Management area**	Fishing occurs in the northern half of WA from Exmouth Gulf to the NT border and is managed under Ministerial Exemptions.		
				Species targeted		**Fishing methods**	**Fishing depth**
				The sea cucumber fishery targets two main species: sandfish (*Holothuria scabra*) and redfish (*Actinopyga echinites*).		Diving	The targeted species typically inhabit nearshore in shallow depths.
				Fishing effort	Based on State of the Fisheries annual reports provided by DPRID, catch trends are as follows: 62t in 2018 (Gaughan and Santoro, 2020), 135t in 2017, 93t in 2016, 38t in 2015		
				Active licences/vessels	Six active licences in 2019 (Hart *et al*., 2019). Active vessels data is confidential as there were fewer than three vessels.		
Onslow Prawn Managed Fishery		✓		**Management area**	The Onslow Prawn Managed Fishery encompasses a portion of the continental shelf off the Pilbara.		
				Species targeted		**Fishing methods**	**Fishing depth**

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Fishery	Woodside Activity Area: Browse	Woodside Activity Area: NWS/S	Woodside Activity Area: NW Cape	Description		
				The fishery targets: Western king prawns (*Penaeus esculentus*) Brown tiger prawns (*Penaeus esculentus*) Blue endeavour prawns (*Metapenaeus endeavouri*	Low opening, otter prawn trawl systems.	Prawn trawling takes place in water depths of approximately 30 metres and less (licence holder feedback). Fishery and or fishing activity overlaps the Beadon Creek dredging scope (Sporer *et al*., 2015).
				Fishing effort:	The total landings for the Onslow Prawn Managed Fishery in 2018 were less than 60 t below the target catch range (Kangas *et al*., 2020a).	
				Active licences/vessels:	One vessel (Kangas *et al*., 2020a).	
Pearl Oyster Managed Fishery	✓	✓	✓	**Management area**	Located in shallow coastal waters with the pearl oyster managed fishery designated by four zones extending from Exmouth to Kununurra and the seaward boundary demarcated by the 200 nm EEZ.	
				Species targeted	**Fishing methods**	**Fishing depth**
				Pearl oysters (*Pinctada maxima*).	Drift diving.	Fishing effort is mostly focussed in shallow coastal waters (10-15 m depth), with a maximum depth of 35 m (Lulofs *et al.* 2002).
				Fishing effort:	In 2018, catch was taken from Zones 2 and 3 with no fishing in Zone 1. The number of pearl oysters caught for 2018-19 was 614,002. Total effort was 15,637 dive hours, this was an increase from 2017 effort of 12,845 hours. No fishing occurred in Zone 1 in 2017 and 2018 (Gaughan and Santoro, 2020).	
				Active licences/vessels:	15,637 diver hours (Hart *et al.*, 2020a).	
		✓	✓	**Management area**	The Pilbara Crab Managed Fishery comprises WA waters off the north-western coast of WA north of 23° 34′ south latitude and west of 120° 00′ east longitude. Areas of the fishery north and east of Exmouth and	

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Fishery	Woodside Activity Area			Description			
	Browse	NWS/S	NW Cape				
Pilbara Crab Managed Fishery					nearshore are currently closed as per Schedule 2 of the Draft Management Plan for the Pilbara Crab Managed Fishery.		
				Species targeted		**Fishing methods**	**Fishing depth**
				Crabs of the Family Portunidae, excluding crabs of the genus *Scylla*.		Traps.	Up to 50 m deep.
				Fishing effort:	The capacity of the fishery is 600 traps.		
				Active licences/vessels:	No information available at this time.		
South-west Coast Salmon Managed Fishery	✓	✓	✓	**Management area**	The South-west Coast Salmon Managed Fishery operates on various beaches south of the metropolitan area and includes all WA waters north of Cape Beaufort except Geographe Bay.		
				Species targeted		**Fishing methods**	**Fishing depth**
				Western Australian salmon (*Arripis truttaceus*)		Beach seine nets.	Information not available however, species generally found in shallow waters (up to 30 m).
				Fishing effort:	No fishing occurs north of the Perth metropolitan area, despite the managed fishery boundary extending to Cape Beaufort (WA/Northern Territory border), as advised by WAFIC. The 2018 commercial catch was 191 t, with 72% taken by the South West Coast Salmon Managed Fishery, 25% by the South Coast Salmon Managed Fishery and 3% by other fisheries (Duffy and Blay, 2020a).		
				Active licences/vessels:	Six licences.		
	✓	✓	✓	**Management area**	The Specimen Shell Managed Fishery (SSMF) encompasses the entire WA coastline, but effort is concentrated in areas adjacent to the population centres such as Broome, Exmouth, Shark Bay,		

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Fishery	Woodside Activity Area			Description			
	Browse	NWS/S	NW Cape				
Specimen Shell Managed Fishery					Geraldton, Perth, Mandurah, the Capes area and Albany (Hart *et al.*, 2020b). There are a number of closed areas where the SSMF is not permitted to operate. These include various marine parks and aquatic reserves, such as Ningaloo Marine Park.		
				Species targeted		**Fishing methods**	**Fishing depth**
				The Specimen Shell Managed Fishery targets the collection of specimen shells for display, collection, cataloguing and sale.		Collection is predominantly by hand when diving to wading in shallow, coastal waters, though in deeper water collection may be conducted by remotely operated vehicles (limited to one per licence).	For collection by hand, (diver-based) this typically restricts effort to safe diving depths (less than 30 m). ROV collection could enable depths up to 300 m (Hart *et al.*, 2017). In the past there has been one licence holder in the Specimen Shell Managed Fishery who has trialled ROV means of shell collection, WAFIC have provided advice that this fishery is no longer active.
				Fishing effort:	Information not available.		
				Active licences/vessels:	In 2018 there were 31 licences with only two divers allowed in the water per licences at one time (Hart *et al.*, 2018). The number of people employed regularly in the fishery is likely to be about 21 (Hart *et al.*, 2018).		
West Australian Abalone Fishery	✓	✓	✓	**Management area**	The Western Australian Abalone Fishery includes all coastal waters from the WA and SA border to the WA and NT border. The fishery is concentrated on the south coast and the west coast.		
				Species targeted		**Fishing methods**	**Fishing depth**
				Greenlip abalone (*Haliotis laevigata*) Brownlip abalone (*Haliotis conicopora*) Roe's abalone (*Haliotis roei*)		Divers.	Distribution to 5 m depth for Roe's abalone and 40 m depth for greenlip / brownlip abalone (DOF, 2011).

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<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td>Fishing effort:</td><td colspan="2">In 2018, the total commercial catch was 48 t, 1 t less than the catch in each of the last two seasons. No commercial fishing for abalone north of Moore River (Zone 8 of the managed fishery) has occurred since 2011–2012 (Strain et al., 2018).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="2">26 vessels active in Roe's abalone fishery (WAFIC[5]).</td></tr>
<tr><td rowspan="5">West Coast Deep Sea Crustacean Managed Fishery</td><td rowspan="5">✓</td><td rowspan="5">✓</td><td rowspan="5">✓</td><td>Management area</td><td colspan="2">The West Coast Deep Sea Crustacean Managed Fishery extends north from Cape Leeuwin to the WA/NT border in water depths greater than 150 m within the AFZ.</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>The fishery targets deepwater crustaceans. Catches were dominated by crystal crabs of which 99% of their Total Allowable Catch (TAC) was landed (How and Orme, 2020a).
Crystal (snow) crab (Chaceon albus)
Giant (king) crab (Pseudocarcinus gigas)
Champagne (spiny) crabs (Hypothalassia acerba)</td><td>Baited pots, or traps, are operated in long-lines which have between 80 and 180 pots attached to a main line marked by a float at each end.</td><td>Deeper than 150 m (and mostly at depths of between 500 m – 800 m). Most of the commercial Crystal crab catch is taken in depths of 500 m – 800 m (WAFIC[6]).</td></tr>
<tr><td>Fishing effort:</td><td colspan="2">The total landings in 2018 was 168. t. Two vessels operated in the fishery in 2017, using baited pots operated in a longline formation in the shelf edge waters, mostly in depths between 500 and 800 m (How and Orme, 2020a). Fishing effort was concentrated between Fremantle and Carnarvon.</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="2">There were four active vessels in 2018 (How and Orme, 2020a).</td></tr>
</table>

[5] https://www.wafic.org.au/fishery/roes-abalone-fishery/
[6] https://www.wafic.org.au/fishery/west-coast-deep-sea-crustacean-fishery/

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<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="6">Abrolhos Islands and Mid-West Trawl Fishery</td><td rowspan="6"></td><td rowspan="6"></td><td rowspan="6">✓</td><td>Management area</td><td colspan="3">The Abrolhos Islands and Mid-West Trawl Fishery (AIMWTMF) operates around the Abrolhos Islands within the SWMR.</td></tr>
<tr><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td colspan="2">Saucer scallops (Ylistrum balloti, formerly Amusium balloti)</td><td>Trawl.</td><td>Information not available, however, the species occurs at depth of around 30-60 m and therefore fishing effort would likely be at these depths (Himmelman et al., 2009).</td></tr>
<tr><td>Fishing effort:</td><td colspan="3">The scallop landings in the AIMWTMF were 31.0 t meat weight (154.8 t whole weight). Between 2011 and 2015, the annual pre-season surveys showed very low recruitment (1-year old), as a result of the 2011 extreme marine heatwave and subsequent poor pawning stock (Kangas et al., 2020b). The fishery was closed between 2011 and 2016.</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="3">Information about licences or vessels is not available but the Department of Primary Industry and Regional Development reported 774 t of catch from this fishery in the 2019 annual report (DPIRD, 2019).</td></tr>
<tr style="display:none"></tr>
<tr><td rowspan="4">Broome Prawn Managed Fishery</td><td rowspan="4">✓</td><td rowspan="4"></td><td rowspan="4"></td><td>Management area</td><td colspan="3">The Broome Prawn Managed Fishery (BPMF) operates off Broome and forms part of the North Coast Prawn Fishery.</td></tr>
<tr><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td colspan="2">Western king prawn (Penaeus latisulcatus)
Coral prawn</td><td>Trawl.</td><td>Trawling is generally in waters between 30 and 60 m deep, however can occur down to 100 m (DOEH, 2004).</td></tr>
<tr><td>Fishing effort:</td><td colspan="3">BPMF recorded extremely low fishing effort in 2018. Only two vessels undertook trial fishing to investigate whether the catch rates were sufficient for commercial fishing. This resulted in negligible landings of Western king prawn (Kangas et al., 2020a).</td></tr>
</table>

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Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
				Active licences/vessels:	Two vessels conducting fishing trial operated in 2018 (Kangas *et al*., 2020a).	
Exmouth Gulf Prawn Managed Fishery			✓	**Management area**	The estimated employment in the fishery in 2017 was 18 people including skippers and other crew (Kangas *et al*., 2018). The fishery occupies a total area of 4000 km², with only half of this area being trawled (Fletcher and Santoro, 2015).	
				Species targeted	**Fishing methods**	**Fishing depth**
				Western king prawn (*Penaeus latisulcatus*) Brown tiger prawn (*Penaeus esculentus*) Blue endeavour prawn (*Metapenaeus endeavouri*) Banana prawn (*Penaeus merguinensis*)	Trawl.	Information not available.
				Fishing effort:	The total landings of prawns in 2018 were 880 t (Kangas *et al*., 2020a). In the 2016 season, a fishing effort of about 23,000 hours resulted in a catch of 822 t.	
				Active licences/vessels:	The precise number of vessels is unreported. Eighteen people were said to be employed in this fishery in 2018 (Kangas *et al.*, 2019); however, in 2013 it was reported that 18 skippers as well as other crew and support staff were employed (WAFIC[7]).	
Gascoyne Demersal Scalefish Managed Fishery			✓	**Management area**	The Gascoyne Demersal Scalefish Fishery (GDSF) is located between the southern Ningaloo Coast to south of Shark Bay (23°07.30'S to 26°.30'S) with a closure area at Point Maud to Tantabiddi (21°56.30'S) (WAFIC[8]).	
				Species targeted	**Fishing methods**	**Fishing depth**

[7] https://www.wafic.org.au/fishery/exmouth-gulf-prawn-fishery/

[8] https://www.wafic.org.au/fishery/gascoyne-demersal-scalefish-fishery/

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Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
				Pink snapper (*Chrysophrys auratus*) Goldband snapper (*Pristipomoides multidens*) Red emperor (*Lutjanus sebae*) Cods (*Gadus morhua*) Emperors (*Lethrinus miniatus)*	Mechanised handlines.	Information not available.
				Fishing effort:	The GDSF reported a total commercial catch of 210 t in 2017-18.	
				Active licences/vessels:	In 2018, 13 vessels fished during the season, in the 2017 season there were 16 vessels (Gaughan and Santoro, 2018).	
Kimberley Developing Mud Crab Fishery	✓			**Management area**	The Kimberley Developing Mud Crab Fishery is one of two small trap-based crab fisheries that exist in the North Coast Bioregion between Cambridge Gulf and Broome (Gaughan and Santoro, 2018).	
				Species targeted	**Fishing methods**	**Fishing depth**
				Brown mud crab (*Scylla olivacea*) Green mud crab (*Scylla serrata*)	Trap.	Information not available.
				Fishing effort:	The catch landed represents all commercially caught mud crabs landed in WA for 2018. A nominal catch rate of 0.66 kg/traplift was recorded for 2018, which is a 28% decrease from 2017 but remains above the harvest strategy threshold (Johnston *et al*., 2020).	
				Active licences/vessels:	There are currently three licences issued to commercial operators (600 trap limit), and three exemptions issued to Indigenous groups (total of 210 traps currently allocated of a maximum 600 traps) (Johnston *et al*., 2020).	
Nickol Bay Prawn Managed Fishery		✓		**Management area**	The Nickol Bay Prawn Managed Fishery operates in nearshore and offshore waters of the Pilbara region along the NWS.	
				Species targeted	**Fishing methods**	**Fishing depth**

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<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td colspan="2">Banana prawn (Penaeus merguiensis)
Western king prawn (Penaeus latisulcatus)
Brown tiger prawn (Penaeus esculentus)
Blue endeavour prawn (Metapenaeus endeavouri)</td><td>Trawl.</td><td>Information not available.</td></tr>
<tr><td>Fishing effort:</td><td colspan="3">Trawling has been reported to occur at several locations along the Pilbara coast to the east of the Burrup Peninsula, including within the waters of Nickol Bay (Fletcher and Santoro, 2015). The total landings for the 2018 season were 81 t. Fishing effort was less than half at 138 days, compared to 281 boat days in 2017 (Kangas et al., 2020a).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="3">The precise number of vessels is unreported, though low effort produced a catch of 17 t in 2016 (Kangas et al., 2018).</td></tr>
<tr><td rowspan="3">Northern Demersal Scalefish Managed Fishery</td><td rowspan="3">✓</td><td rowspan="3"></td><td rowspan="3"></td><td>Management area</td><td colspan="3">The fishery is divided into two fishing areas: an inshore sector (Area 1) and an offshore sector (Area 2) (Newman et al., 2018). Area 1 permits line fishing only, between the high water mark and the 30 m isobath. Area 2 permits handline, dropline and fish trap fishing methods and is further divided into zones. Zone A is an inshore area, Zone B comprises the area with most historical fishing activity, and Zone C is an offshore deep slope area representing waters deeper than 200 m (Fletcher et al., 2017).</td></tr>
<tr><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td colspan="2">Goldband snapper (Pristipomoides multidens)
Blue-spotted emperor (Lethrinus punctulantus)
Red emperor (Lutjanus sebae)
Rankin cod (Epinephelus multinotatus)</td><td>Line fishing, handline, dropline and fish trap fishing.</td><td>Information not available.</td></tr>
</table>

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Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
				Fishing effort:	In 2018, the fishery reported a total catch of 1297 t. Most of the catch is landed from Zone B, with a catch of 1106 t in 2018. The level of catch in Zone B is the highest reported since zoning was implemented in 2006 (Newman *et al.*, 2019).	
				Active licences/vessels:	Six vessels fished in the 2018 season and at least 20 people were directly employed (Gaughan and Santoro, 2018).	
Octopus Interim Management Fishery				**Management area**	The developing Octopus Fishery operates from Kalbarri Cliffs in the north to Esperance in the south.	
				Species targeted	**Fishing methods**	**Fishing depth**
				Octopus sp. cf. tetricus	Passive shelter pots and active traps.	In inshore waters to a depth of 70 m (DPIRD, 2018).
				Fishing effort:	In 2019, the total commercial octopus catch was 314 t, which was 22% higher than the 2017 catch of 257 t. In 2016, about 200 vessels reported a total catch of 252 t (Hart *et al.*, 2020c).	
				Active licences/vessels:	About 21 vessels fish within the octopus specific fisheries, and about 200 vessels from the West Coast Rock Lobster Fishery catch octopus as bycatch (Gaughan and Santoro, 2018).	
Shark Bay Beach Seine and Mesh Net Managed Fishery				**Management area**	The Shark Bay Beach Seine and Mesh Net Managed Fishery operates from Denham.	
				Species targeted	**Fishing methods**	**Fishing depth**
				Whiting (yellowfin *Sillago schomburgkii* and goldenline *S. analis*) Sea mullet (*Mugil cephalus*) Tailor (*Pomatomus saltatrix*) Western yellowfin bream (*Acanthopagrus australis*)	Beach seine and mesh net.	Information not available.

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<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td></td><td></td><td></td><td></td><td>Fishing effort:</td><td colspan="2">In 2018, the total catch was 176 t (Gaughan and Santoro, 2020). The fishery currently employs about 14 fishers based on the seven fishery licences in operation (WAFIC[9]).</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Active licences/vessels:</td><td colspan="2">Six vessels operated employing around 12 fishers (Gaughan and Santoro, 2018).</td></tr>
<tr><td>Shark Bay Crab Managed Fishery</td><td></td><td></td><td></td><td>Management area</td><td colspan="2">The Shark Bay Crab Managed Fishery operates within the NWMR.</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Blue swimmer crab (Portunus armatus)</td><td>Trap and trawl.</td><td>Information not available.</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Fishing effort:</td><td colspan="2">Commercial fishing for blue swimmer crabs in Shark Bay was voluntarily halted by industry in 2012 to facilitate stock rebuilding. The stock is still in a recovery phase; however, the fishery has resumed and reported a total commercial catch of 518 t in the 2017/18 season. The average commercial trap catch rate was 1.5 kg/traplift during 2017/18 (Chandrapavan et al., 2017).</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Active licences/vessels:</td><td colspan="2">The precise number of vessels in the Shark Bay Blue Swimmer Crab Fishery is unreported. There are five crab trap permits. These permits are consolidated onto three active vessels (WAFIC[10]).</td></tr>
<tr><td>Shark Bay Prawn and Scallop Managed Fishery</td><td></td><td></td><td></td><td>Management area</td><td colspan="2">The Shark Bay Prawn Managed Fishery is the highest producing WA fishery for prawns.</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Western king prawn (Penaeus latisulcatus)
Brown tiger prawn (Penaeus esculentus)</td><td>Low-opening otter trawls.</td><td>Information not available.</td></tr>
</table>

[9] https://www.wafic.org.au/fishery/inner-shark-bay-scalefish-fishery/
[10] https://www.wafic.org.au/fishery/shark-bay-prawn-and-scallop-managed-fisheries/

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Fishery	Woodside Activity Area			Description		
	Browse	NWS/S	NW Cape			
				Endeavour prawns (*Metapenaeus endeavouri*) Coral prawns (*Metapenaeopsis sp.*) Saucer scallop (*Amusium balloti*)		
				Fishing effort:	The Shark Bay Scallop Managed Fishery is currently in a recovery phase due to the results from the pre-season survey of stock abundance (Fletcher and Santoro, 2015; Kangas *et al.*, 2018).	
				Active licences/vessels:	The precise number of vessels in the Shark Bay Prawn Managed Fishery is unreported; however, about 100 people are employed in this fishery (Gaughan and Santoro, 2018). About 20 skippers and crew are employed in scallop fishing in the Shark Bay and South Coast fisheries across 18 vessels in 2015 (Sporer *et al.*, 2015).	
South Coast Crustacean Managed Fishery	-	-	-	**Management area**	The South Coast Crustacean Managed Fishery comprises four fisheries: the Windy Harbour/Augusta Rock Lobster Managed Fishery, the Esperance Rock Lobster Managed Fishery, the Southern Rock Lobster Pot Regulation Fishery and the South Coast Deep-Sea Crab Fishery.	
				Species targeted	**Fishing methods**	**Fishing depth**
				Southern rock lobster (*Jasus edwardsii*) Western rock lobster (*Panulirus cygnus*) Giant crab (*Pseudocarcinus gigas*) Crystal crab (*Chaceon albus*) Champagne crab (*Hypothalassia acerba*)	Pots.	Information not available.
				Fishing effort:	The South Coast Crustacean Managed Fishery reported a total catch of 101.2 t in 2018 season and the value of the fishery for 2017/2018 was about $5.9 million (Howe and Orme, 2020b).	
				Active licences/vessels:	The number of vessels is unknown; however, a total of 1977 pots are licensed to be used.	
	-	-	-	**Management area**	The fishery is active in coastal waters between Cape Leeuwin and the South Australia border. Landings are primarily at Albany, Bremer Bay and Esperance (Norriss and Blazeski, 2020).	

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<tr><td rowspan="4">South Coast Purse Seine Managed Fishery</td><td rowspan="4"></td><td rowspan="4"></td><td rowspan="4"></td><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>Small pelagic finfish such as pilchards and yellowtail scad using purse seine nets from vessels.
Sandy sprat (Hyperlophus vittatus)
Blue sprat (Spratelloides robustus)</td><td>Purse seine.</td><td>Information not available.</td></tr>
<tr><td>Fishing effort:</td><td colspan="2">In the 2017/18 season the total catch effort was 2,168 t (Norriss and Blazeski, 2020).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="2">Nine active vessels in 2017/18 (Norriss and Blazeski, 2020).</td></tr>
<tr><td rowspan="5">South-west Trawl Managed Fishery</td><td rowspan="5">-</td><td rowspan="5">-</td><td rowspan="5">-</td><td>Management area</td><td colspan="2">The South-west Trawl Managed Fishery is a multi-species fishery and includes two of WA’s smaller scallop fishing grounds at Fremantle and north of Geographe Bay (Fairclough and Walters, 2018).</td></tr>
<tr><td>Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td>Scallops (Ylistrum balloti, formerly Amusium balloti) and associated by-products
Western king prawn (Penaeus latisulcatus)
In years of low scallop catches licencees may use other trawl gear to target fin-fish species.</td><td>Trawl.</td><td>Information not available.</td></tr>
<tr><td>Fishing effort:</td><td colspan="2">Effort in the fishery is highly variable and typically fluctuates in response to recruitment variability in saucer scallops and prawns. The fishery was not active in 2015 or 2016 (Fairclough and Walters, 2018).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="2">Only one boat fished in 2018 for a total of 5 boat days for minimal catch (Fairclough and Walters, 2018).</td></tr>
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<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="5">The South Coast Salmon Managed Fishery</td><td rowspan="5">-</td><td rowspan="5">-</td><td rowspan="5">-</td><td>Management area</td><td colspan="3">The South Coast Salmon Managed Fishery is one of two fisheries operating in the South Coast Bioregion that target nearshore and estuarine finfish.</td></tr>
<tr><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td colspan="2">Western Australian salmon (Arripis truttaceus)
Southern school whiting (Sillago bassensis)
Australian herring (Arripis georgianus)
King George whiting (Sillaginodes punctatus)
Sea mullet (Mugil cephalus)
Estuary cobbler (Cnidoglanis macrocephalus)
Black bream (Acanthopagrus butcheri)</td><td>Beach seines, haul nets and gill nets.</td><td>Information not available.</td></tr>
<tr><td>Fishing effort:</td><td colspan="3">The total catch for 2018 was 243 t (Duffy and Blay, 2020b).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="3">Number of vessels is unknown; however, 12 commercial fishers were employed in 2018 (Duffy and Blay, 2020b).</td></tr>
<tr><td rowspan="4">West Coast Beach Bait Managed Fishery</td><td rowspan="4">-</td><td rowspan="4">-</td><td rowspan="4">-</td><td>Management area</td><td colspan="3">Primarily active in the Bunbury areas in the SWMR.</td></tr>
<tr><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td colspan="2">Whitebait</td><td>Beach-based haul nets.</td><td>Information not available.</td></tr>
<tr><td>Fishing effort:</td><td colspan="3">In recent years the fishery is primarily active in the Bunbury area. Total catch of whitebait in 2015 was 40.2 t (Duffy and Blay, 2020c).</td></tr>
</table>

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Fishery	Woodside Activity Area: Browse	Woodside Activity Area: NWS/S	Woodside Activity Area: NW Cape	Description			
				Active licences/vessels:	Number of vessels is unknown; however, only one license was issued (DPIRD, 2019).		
West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery	-	-	-	**Management area**	The West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery (WCDGDLF) is part of the Temperate Demersal Gillnet and Demersal Longline Fishery (TDGDLF), which operates between 26° and 33° S, and the Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery (JASDGDLF), which operates from 33° S to the WA/SA border (Braccini and Blay, 2020).		
				Species targeted		**Fishing methods**	**Fishing depth**
				Gummy shark (*Mustelus antarcticus*) Dusky shark (*Carcharhinus obscurus*) Whiskery shark (*Furgaleus macki*) Sandbar shark (*C. plumbeus*)		Gillnet and longline.	Information not available.
				Fishing effort:	Catch estimated annual value of the fishery was $0.2 million for 2017 to 2018 (Braccini and Blay, 2020).		
				Active licences/vessels:	Vessel numbers are unknown; however, 17 interim managed fishery permits were held in 2019 (DPIRD, 2019) and between 18 and 21 skippers and crew were employed between 2016 and 2017.		
West Coast Demersal Scalefish Fishery	-	-	-	**Management area**	These fisheries include the West Coast Demersal Scalefish (Interim) Managed Fishery (51 boats), the West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery and the temperate Demersal Gillnet and Demersal Longline Fisheries. The West Coast Demersal Scalefish Managed Fishery is the main commercial fishery that targets demersal species in the West Coast Bioregion. It encompasses the waters from just south of Shark Bay down to just east of Augusta and extends seaward to the 200 nm boundary. The fishery is divided into four inshore management areas and one offshore management area.		
				Species targeted		**Fishing methods**	**Fishing depth**
				Baldchin groper (*Choerodon rubescens*) Dhufish (*Glaucosoma hebraicum*) Pink snapper (*Pagrus auratus*)		Lines.	Inshore species – 20 to 250 m water depth.

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Fishery	Woodside Activity Area			Description			
	Browse	NWS/S	NW Cape				
							Offshore species – more than 250 m water depth.
				Fishing effort:	In 2016, the West Coast Demersal Scalefish (interim) Managed Fishery reported a total catch of 256 t.		
				Active licences/vessels:	The precise number of vessels in the West Coast Demersal Scalefish Fisheries is unreported; however, it is restricted to 60 interim managed fishery permit holders.		
West Coast Purse Seine Managed Fishery	-	-	-	**Management area**	Located in waters from Cape Bouvard extending to Lancelin.		
				Species targeted		**Fishing methods**	**Fishing depth**
				Small pelagic finfish such as: Scaly mackerel (*Sardinella lemuru*) Pilchards (*Sardinops sagax*) Australian anchovy (*Engraulis australis*) Yellowtail scad (*Trachurus novaezelandiae*) Maray (*Etrumeus teres*)		Purse seine.	Information not available.
				Fishing effort:	Information not available		
				Active licences/vessels:	Seven vessels in 2017 (Gaughan and Santoro, 2018).		
West Coast Rock Lobster Managed Fishery			✓	**Management area**	The West Coast Rock Lobster Fishery operates from Shark Bay south to Cape Leeuwin. The fishery is managed using zones, seasons and total allowable catch. The recreational fishery targets the western rock lobsters using baited pots and by diving between North-west Cape and Augusta.		

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<table>
<tr><th rowspan="2">Fishery</th><th colspan="3">Woodside Activity Area</th><th colspan="4" rowspan="2">Description</th></tr>
<tr><th>Browse</th><th>NWS/S</th><th>NW Cape</th></tr>
<tr><td rowspan="4"></td><td rowspan="4"></td><td rowspan="4"></td><td rowspan="4"></td><td colspan="2">Species targeted</td><td>Fishing methods</td><td>Fishing depth</td></tr>
<tr><td colspan="2">Western rock lobster (Panulirus cygnus)</td><td>Baited pots.</td><td>Less than 20 m.</td></tr>
<tr><td>Fishing effort:</td><td colspan="3">In 2018, 234 vessels reported a total catch of 6400 t in 2017 (de Lestang et al., 2018). In 2016, 226 vessels reported a total catch of 6,086 t (Gaughan and Santoro, 2018).</td></tr>
<tr><td>Active licences/vessels:</td><td colspan="3">234 vessels operated in 2017 and 233 vessels operated in 2018 (Gaughan and Santoro, 2018).</td></tr>
</table>

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11.5.2 Aquaculture

Aquaculture operations in the northwest are typically restricted to inland and shallow coastal waters.

West Coast Bioregion

Aquaculture activities in the West Coast bioregion, defined by the Department of Primary Industries and Regional Development (DPIRD) (as the government body responsible management of primary industries in WA) are focused on blue mussels and edible oysters (mainly in Cockburn Sound) and marine algae for production of beta-carotene, used as a food additive and as a nutritional supplement. Offshore marine finfish production is also being developed, initially focusing on yellowtail kingfish.

There is also an emerging black pearl industry (from the *Pinctada margaritifera* oyster) in the Abrolhos Islands. As well as expansion in the production of Akoya pearls (small white pearls from *Pinctada fucata martensi*), *Pinctada albina* (small, yellow pearls) and *Pteria penguin*, which are often used to produce half (mabe) pearls in pink and bluish shades.

Aquaculture licences for producing coral and live rock (pieces of old coral reefs colonised by marine life, such as beneficial bacteria, for aquariums) at the Abrolhos Islands have also been issued and other applications are being assessed.

Gascoyne Coast Bioregion

In the Gascoyne Coast bioregion, aquaculture activities are focused on the blacklip oyster (*Pinctada margaritifera*) and Akoya pearl oyster (*Pinctada imbricata*) (Gaughan and Santoro, 2020). Several hatcheries supply *P. margaritifera* juveniles to the region's developing black pearl farms.

Other aquaculture developments in the Gascoyne Coast bioregion include emerging producers of coral and live rock species for aquariums.

North Coast Bioregion

Aquaculture activities in the North Coast bioregion is dominated by the production of pearls. A large number of pearl oysters for seeding are obtained from wild stocks and supplemented by hatchery produced oysters, with major hatcheries operating at Broome and around the Dampier Peninsula (Gaughan and Santoro, 2018). Primary spawning of the pearl oyster occurs from mid-October to December. A smaller secondary spawning occurs in February and March (Gaughan and Santoro, 2020).

Other aquaculture developments in the North Coast include emerging producers of coral and live rock species for aquariums as well as barramundi (*Lates calcarifer)* farms and microalgae culturing for Omega-3, biofuels and protein biomass (Gaughan and Santoro, 2020).

11.6 Fisheries – Traditional

Traditional or customary fisheries are typically restricted to shallow coastal waters and/or areas with structures such as reef.

Dugong, fish and marine turtles that move between coastal and Commonwealth waters are important components of the Aboriginal people's culture and diet. Aboriginal people continue to actively manage their sea country in coastal waters of WA in order to protect and manage the marine environment, its resources and cultural values.

Indonesian fishers can fish within designated areas under the Australia-Indonesia Memorandum of Understanding regarding the Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974 (MoU 74). Traditional fishing is allowed within the MoU Box (**Figure 11-1)**, which encompasses: Ashmore Reef (Pulau Pasir), Cartier Island (Pulau Baru), Seringapatam Reef (Afringan), Scott Reef (Pulau Dato) and Browse Island (Berselan). Restrictions have since been introduced around Ashmore Reef and Cartier Island following their

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designation as Nature Reserves under the Commonwealth's *National Parks and Wildlife Conservation Act 1975* in 1983 and 2000, respectively.

The MoU allows Indonesian fishers to fish in designated areas using traditional methods only. These methods include reef gleaning, free-diving, hand lining and other non-mechanised methods. Scott Reef is currently the principal reef in the MoU 74 Box and is utilised seasonally by Indonesian fishers to harvest trepang, trochus shells and other reef species. The peak season is July to October due to more favourable wind conditions, and to allow fishers to sun dry their catch on their boat decks (ERM, 2009). Browse Island is also frequently visited by shark fishers who mostly fish along the eastern margin of the MoU 74 Box.

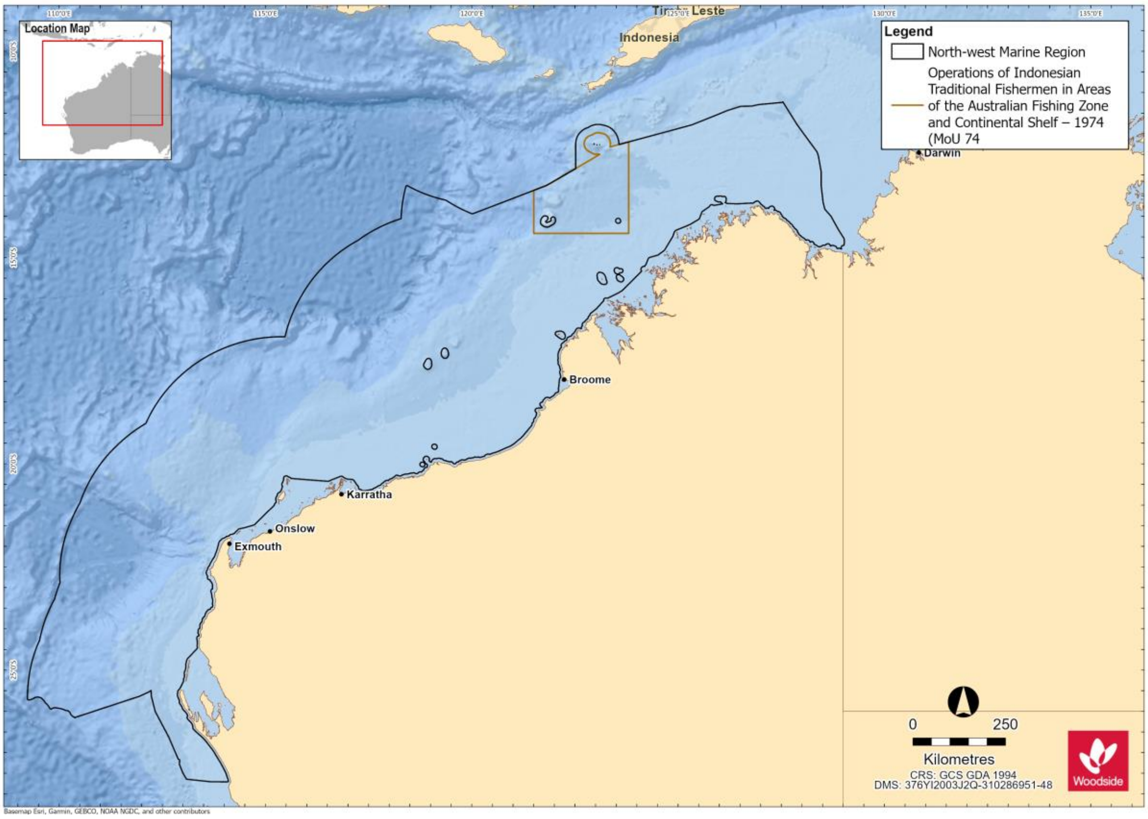

Figure 11-1 MOU 74 Box. Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974

11.7 Tourism and Recreation

There are growing tourism and recreational sectors in WA. The Kimberley, Pilbara and Gascoyne regions are popular visitor destinations for Australian and international tourists. Tourism is concentrated in the vicinity of population centres including Broome, Dampier, Exmouth, Coral Bay and Shark Bay.

Recreational and tourism activities include: charter fishing, other recreational fishing, diving, snorkelling, marine fauna watching, and yachting.

11.7.1 Gascoyne Region

Outside the petroleum industry, tourism is the largest revenue earner of all the major industries of the Gascoyne region. It contributes significantly to the local economy in terms of both income and

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employment. In 2018 there was an average of 337,400 visitors with a visitor spend of $359 million (Gascoyne Development Commission[11]).

In 2018-19, the Ningaloo region (Ningaloo Reef and the surrounding coastal region Exmouth Gulf, communities of Exmouth and Coral Bay, and adjacent proposed southern coastal reserves and pastoral leases) contributed an estimated $110 million in value added to the WA economy (DCBA, 2020). Ningaloo's economic contribution to WA is attributed to four key types of economic activity, tourism expenditure by international, interstate and WA visitors to the Ningaloo region, commercial fishing in the Exmouth Gulf, recreation activity involving the Reef by residents of the Ningaloo region and management and research relating to the Reef (DCBA, 2020). More than 90% of this value added is attributed to the domestic and international tourists who visit Ningaloo each year (DCBA, 2020). The main marine nature-based tourist activities are concentrated around and within the Ningaloo WHA.

11.7.2 Pilbara region

Recreation and tourism activities within the Pilbara are of high social value. Tourism is a key economic driver for the Pilbara with more than 1 million visitors to the region every year, generating $413 million in gross revenue annually (Pilbara Development Commission[12]).

Recreational fishing within the Pilbara region tends to be concentrated in State waters adjacent to population centres. Recreational fishing is known to occur around the Dampier Archipelago with boats launched from boat ramps around Dampier and Karratha (Williamson *et al.*, 2006). Once at sea, charter vessels may also frequent the waters surrounding the Montebello Islands.

11.7.3 Kimberley Region

Recreation and tourism activities in the Kimberley region occur predominantly in WA State waters (extending offshore 3 nm from the mainland), adjacent to coastal population centres (e.g. Broome), with a peak in activity during the winter months (dry season). These activities include recreational fishing, diving, snorkelling, wildlife watching and boating.

Primary dive locations in the Kimberley region include the Rowley Shoals, including Mermaid Reef AMP, Scott Reef, Seringapatam Reef, Ashmore Reef AMP and Cartier Island.

11.8 Shipping

Commercial shipping traffic is high within the NWMR with vessel activities including commercial fisheries, tourism such as cruises, international shipping and oil and gas operations. There are 12 ports adjacent to the NWMR, including the major ports of Dampier, Port Hedland and Broome, which are operated by their respective port authorities. These ports handle large tonnages of iron ore and petroleum exports in addition to salt, manganese, feldspar chromite and copper (DEWHA, 2008).

Heavy vessel traffic exists within the Pilbara Port Authority management area which recorded 10,064 vessel movements in Port of Dampier 2019/20 annual reporting period (PPA, 2020). Twenty-six designated anchorages for bulk carriers, petroleum and gas tankers, drilling rigs, offshore platforms, and pipelay vessels are located offshore of Rosemary Island.

In 2012, AMSA established a network of shipping fairways off the northwest coast of Australia. The shipping fairways, while not mandatory, aim to reduce the risk of collision between transiting vessels and offshore infrastructure. The fairways are intended to direct large vessels such as bulk carriers and LNG ships trading to the major ports into pre-defined routes to keep them clear of existing and planned offshore infrastructure (AMSA, 2013).

[11] https://www.gdc.wa.gov.au/industry-profiles/tourism/

[12] https://www.pdc.wa.gov.au/our-focus/strategicinitiatives/tourism

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11.9 Oil and Gas Infrastructure

The NWMR supports a number of industries including petroleum exploration and production.

Within the NWMR there are seven sedimentary petroleum basins: Northern and Southern Carnarvon basins, Perth, Browse, Roebuck, Offshore Canning and Bonaparte basins. Of these, the Northern Carnarvon, Browse and Bonaparte basins hold large quantities of gas and comprise most of Australia's reserves of natural gas (DEWHA, 2008), which is reflected by the level of development in the area. In addition to existing facilities, there are proposed developments in the region. This includes proposals to develop gas and condensate from a number of fields within the NWMR.

In addition to the oil and gas industry, other land-based industries depend upon the marine environment in the nearshore area. These include ports, salt mines such as Karratha and Onslow, LNG onshore processing facilities such as Burrup Hub, Thevenard Island, Barrow Island, Varanus Island, and small-scale desalination plants at Barrow Island, Burrup, Cape Preston, and Onslow.

11.10 Defence

Key Australian Department of Defence (DoD) operational areas and facilities areas of the NWMR for training and operational activities, include:

- An operating logistics base has been established in Dampier to support vessels patrolling the waters around offshore oil and gas facilities. A dedicated navy administrative support facility is also being constructed at the nearby township of Karratha.
- The Royal Australian Air Force currently maintains two 'bare bases' in remote areas of WA that are used for military exercises. One of these is the Royal Australian Air Force Base in Learmonth. The Royal Australian Air Force maintains the Commonwealth Heritage listed Learmonth Air Weapons Range Facility, which is located between Ningaloo Station and the Cape Range National Park. The air training area associated with the Learmonth base extends over the offshore region.
- The Royal Australian Air Force Base Curtin is located on the north coast of WA, south-east of Derby and 170 km east of Broome. It provides support for land, air and sea operations aimed to support Australia's northern approaches.
- The Naval Communications Station Harold E. Holt is located ~6 km north of Exmouth. The main role of the station is to communicate at very low frequencies (19.8 kHz) with Australian and United States submarines and ships in the eastern Indian Ocean and the western Pacific Ocean.

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12. REFERENCES

[AFMA] Australian Fisheries Management Authority 2021a. Southern Blue Fin Tuna. Accessed 3 June 2021 www.afma.gov.au/fisheries-management/species/southern-bluefin-tuna

[AFMA] Australian Fisheries Management Authority 2021b. Western Skipjack Tuna. Accessed 3 June 2021 www.afma.gov.au/fisheries-management/species/skipjack-tuna

[ALA] Atlas of Living Australia 2020. *Eubalaena australis* (Desmoulins, 1822). Available at: https://bie.ala.org.au/species/urn:lsid:biodiversity.org.au:afd.taxon:99e19958-7c6e-4f22-ad50-44027af1e418

[AMSA] Australian Maritime Safety Authority 2013. Australian Government Maritime Safety Authority Annual Report 2012/13. Available at: https://www.amsa.gov.au/sites/default/files/amsa191-annual-report-2012-13.pdf

[BOM] Bureau of Meteorology 2021a. Climatology of tropical cyclones in Western Australia. http://www.bom.gov.au/cyclone/climatology/wa.shtml [Accessed 05 May 2021].

[BOM] Bureau of Meteorology 2021b. Climate statistics for Troughton Island, monthly mean maximum air temperatures. http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=36andp_display_type=dataFileandp_startYear=andp_c=andp_stn_num=001007 [Accessed 05 June 2021].

[BOM] Bureau of Meteorology 2021c. Climate Statistics for Troughton Island, monthly mean rainfall. http://www.bom.gov.au/climate/averages/tables/cw_001007.shtml [Accessed 05 June 2021).

[BRS] Bureau of Rural Sciences 2007. Fishery Status Reports 2007. Status of Fish Stocks Managed by the Australian Government. Australian Government Department of Agriculture, Fisheries and Forestry, Bureau of Rural Sciences. 304 pp.

[CALM] Department of Conservation and Land Management 1992. Marmion Marine Park Management Plan 1992-2002, Management Plan No 23. Department of Conservation and Land Management.

[CALM] Department of Conservation and Land Management 1996. Shark Bay Marine Reserves Management Plan 1996-2006. Department of Conservation and Land Management.

[CALM] Department of Conservation and Land Management 1999. Swan Estuary Marine Park and Adjacent Nature Reserves Management Plan 1999-2009, Management Plan No 41. Department of Conservation and Land Management.

[CALM] Department of Conservation and Land Management 2005a. Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005 – 2015. Department of Conservation and Land Management.

[CALM] Department of Conservation and Land Management 2005b. Jurien Bay Marine Park Management Plan 2005-2015, Management Plan No 49. Department of Conservation and Land Management.

[DAWE] Department of Agriculture, Water and the Environment 2019. Directory of Important Wetlands. https://www.environment.gov.au/cgi-bin/wetlands/search.pl?smode=DOIW

[DAWE] Department of Agriculture, Water and the Environment 2020. National Conservation Values Atlas. Available at: https://www.environment.gov.au/marine/marine-bioregional-plans/conservation-values-atlas

[DBCA] Department of Biodiversity Conservation and Attractions 2020. Economic contribution of Ningaloo: one of Australia's best kept secrets. Deloitte Access Economics. June 2020. 58 pp.

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights are reserved.

[DEC] Department of Environment and Conservation 2007a. Rowley Shoals Marine Park Management 2007-2017 Management Plan No. 56. Department of Environment and Conservation, Perth, Western Australia.

[DEC] Department of Environment and Conservation 2007b. Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007-2017. Management Plan No 55. Department of Environment and Conservation, Perth, Western Australia.

[DEC] Department of Environment and Conservation 2007c. Shoalwater Islands Marine Park Management Plan 2007-2017, Management Plan No 58. Department of Environment and Conservation, Perth, Western Australia.

[DEC] Department of Environment and Conservation 2009. Walpole and Nornalup Inlets Marine Park Management Plan 2009–2019, Management Plan No 62. Department of Environment and Conservation, Perth, Western Australia.

[DEC] Department of Environment and Conservation 2013. Ngari Capes Marine Park management plan 2013– 2023, Management plan number 74. Department of Environment and Conservation,

[DEWHA] Department of Environment, Water, Heritage and the Arts 2007a. A characterisation of the marine environment of the North-west Marine Region. A summary of an expert workshop convened in Perth, Western Australia, 5-6 September 2007. Prepared by the North-west Marine Bioregional Planning section, Marine and Biodiversity Division, Department of the Environment, Water, Heritage and the Arts. 47 pp.

[DEWHA] Department of Environment, Water, Heritage and the Arts 2007b. Characterisation of the marine environment of the North Marine Region. Outcomes of an Expert Workshop, Darwin, Northern Territory, 2-3 April 2007. Prepared by the North Marine Bioregional Planning Section, Marine Division, Department of the Environment, Water, Heritage and the Arts. 37 pp.

[DEWHA] Department of Environment, Water, Heritage and the Arts 2008. The North-west Marine Bioregional Plan, Bioregional Profile. A Description of the Ecosystems, Conservation Values and Uses of the North-west Marine Region. Prepared by the Marine Bioregional Planning – North-west, Marine and Biodiversity Division. Department of the Environment, Water, Heritage and the Arts. 288 pp.

[DEWR] Department of the Environment and Water Resources 2007. A characterisation of the marine environment of the South-west Marine Region: A summary of an expert workshop convened in Perth, Western Australia, September 2006. 40 pp.

[DNP] Director of National Parks 2018a. North-west Marine Parks Network Management Plan 2018, Director of National Parks, Canberra.

[DNP] Director of National Parks 2018b. South-west Marine Parks Network Management Plan 2018, Director of National Parks, Canberra.

[DNP] Director of National Parks 2018c. North Marine Parks Network Management Plan 2018, Director of National Parks, Canberra.

[DOE] Department of the Environment 2014. Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*). Canberra, ACT: Department of the Environment. Available from: http://www.environment.gov.au/resource/recovery-plan-grey-nurse-shark-carcharias-taurus

[DOE] Department of the Environment 2015a. Conservation Advice *Numenius madagascariensis* eastern curlew. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/847-conservation-advice.pdf

[DOE] Department of the Environment 2015b. Conservation Advice *Calidris ferruginea* curlew sandpiper. Canberra: Department of the Environment. Available from:

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http://www.environment.gov.au/biodiversity/threatened/species/pubs/856-conservation-advice.pdf

[DOEH] Department of Environment and Heritage 2004. Assessment of the Onslow and Nickol Bay Prawn Managed Fisheries, November 2004. 24 pp.

[DOF] Department of Fisheries 2011. State of the Fisheries and Aquatic Resources Report 2010/11. Fletcher, W.J. and Santoro, K. (eds), Department of Fisheries, Perth, Western Australia.

[DPAW] Department of Parks and Wildlife 2013. Lalang-garram / Camden Sound Marine Park management plan 73 2013–2023, Department of Parks and Wildlife, Perth.

[DPAW] Department of Parks and Wildlife 2014. Eighty Mile Beach Marine Park Management Plan 2014-2024. Management Plan No. 80. Department of Parks and Wildlife, Perth, Western Australia.

[DPAW] Department of Parks and Wildlife 2016a. North Kimberley Marine Park Joint Management Plan 2016 Uunguu, Balanggarra, Miriuwung Gajerrong and Wilinggin management areas, Number Plan 89. Department of Parks and Wildlife, Perth.

[DPAW] Department of Parks and Wildlife 2016b. Lalang-garram / Horizontal Falls and North Lalang-garram Marine Parks joint management plan 2016, Management Plan 88. Department of Parks and Wildlife, Perth

[DPAW] Department of Parks and Wildlife 2016c. Yawuru Nagulagun / Roebuck Bay Marine Park joint management plan 2016. Department of Parks and Wildlife, Perth.

[DPAW] Department of Parks and Wildlife 2016d. Marmion Marine Park. Visitor Guide.

[DPIRD] Department of Primary Industries and Regional Development 2018. Western Australian Marine Stewardship Council Report Series No. 14. Resource Assessment Report Western Australian Octopus Resource.

[DPIRD] Department of Primary Industries and Regional Development 2019. Annual Report. Western Australia.

[DSEWPAC] Department of Sustainability, Environment, Water, Population and Communities 2011a. Approved Conservation Advice for *Aipysurus apraefrontalis* (Short-nosed Sea Snake). Canberra, ACT: Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/1115-conservation-advice.pdf

[DSEWPAC] Department of Sustainability, Environment, Water, Population and Communities 2011b. Approved Conservation Advice for *Aipysurus foliosquama* (Leaf-scaled Sea Snake). Canberra, ACT: Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/1118-conservation-advice.pdf

[DSEWPAC] Department of Sustainability, Environment, Water, Population and Communities 2011c. National recovery plan for threatened albatrosses and giant petrels 2011-2016. Commonwealth of Australia, Hobart. Available from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-threatened-albatrosses-and-giant-petrels-2011-2016

[DSEWPAC] Department of Sustainability, Environment, Water, Population and Communities 2011d. Approved Conservation Advice for *Sternula nereis nereis* (Fairy Tern). Canberra, ACT: Department of Sustainability, Environment, Water, Population and Communities. Available

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights are reserved.

from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/82950-conservation-advice.pdf

[DSEWPAC] Department of Sustainability, Environment, Water Population and Communities 2012a. Marine bioregional plan for the North-west Marine Region. Prepared under the *Environment Protection and Biodiversity Conservation Act 1999.* 269 pp.

[DSEWPAC] Department of Sustainability, Environment, Water Population and Communities 2012b. Marine bioregional plan for the South-west Marine Region. Prepared under the *Environment Protection and Biodiversity Conservation Act 1999.* 216 pp.

[DSEWPAC] Department of Sustainability, Environment, Water Population and Communities 2012c. Marine bioregional plan for the North Marine Region. Prepared under the *Environment Protection and Biodiversity Conservation Act 1999.* 200 pp.

[DSEWPAC] Department of Sustainability, Environment, Water, Population and Communities 2012d. Conservation Management Plan for the Southern Right Whale. A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 2011-2021. Canberra, ACT: Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/resource/conservation-management-plan-southern-right-whale-recovery-plan-under-environment

[DSEWPAC] Department of Sustainability, Environment, Water, Populations and Communities 2012e. Species group report card – seabirds and migratory shorebirds. Supporting the marine bioregional plan for the North-west Marine Region.

[DSEWPAC] Department of Sustainability, Environment, Water, Population and Communities 2013a. Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) 2013. Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/system/files/resources/1eb9233c-8474-40bb-8566-0ea02bbaa5b3/files/neophoca-cinerea-recovery-plan.pdf

[DSEWPAC] Department of Sustainability, Environment, Water, Population and Communities 2013b. Recovery Plan for the White Shark (*Carcharodon carcharias*). Department of Sustainability, Environment, Water, Population and Communities. Available from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/recovery-plan-white-shark-carcharodon-carcharias

[ERM] Environmental Resources Management 2009. Browse LNG Development: Social Study on Indonesian Fishers (Phase 2) 2008. Report produced for Woodside Energy Limited.

[PPA] Pilbara Ports Authority 2020. 2019-20 Annual Report. Available at: https://www.pilbaraports.com.au/about-ppa/publications/annual-report

Abascal, F.J., Quintans, M., Ramos-Cartelle, A. and Mejuto, J. 2011. Movements and environmental preferences of the shortfin mako, *Isurus oxyrinchus*, in the southeastern Pacific Ocean. Marine Biology 158: 1175–1184.

Abdul Wahab, M.A., Radford, B., Cappo, M., Colquhoun, J., Stewar, M., Depczynski, M., Miller, K. and Heyward, A. 2018. Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems. Coral Reefs 37: 327–343. https://doi.org/10.1007/s00338-017-1655-9

Allen, G.R. and Swainston, R. 1988. The Marine Fishes of North-Western Australia. A Field Guide for Anglers and Divers. Published by the Western Australian Museum, Perth, WA 6000.

Allen, S.J., Cagnazzi, D.D., Hodgson, A.J., Loneragan, N.R. and Bejder, L. 2012. Tropical inshore dolphins of north-western Australia: Unknown populations in a rapidly changing region. Pacific Conservation Biology 18: 56-63. https://doi.org/10.1071/PC120056

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights reserved.

Allen, S.J., Tyne, J.A., Kobry, H.T., Bejder, L., Pollock, K.H. and Lonergan, N.R. 2014. Patterns of Dolphin Bycatch in a North-Western Australian Trawl Fishery. PLoS ONE 9(4): e93178. https://doi.org:10.1371/journal.pone.0093178

Anderson, P.K. and Prince, R.I.T. 1985. Predation on dugongs: attacks by killer whales. Journal of Mammalogy 66(3): 554-556.

Andrzejaczek, S., Gleiss, A.C., Jordan, L.K.B. Pattiaratchi, C.B., Howey, L.A., Brooks, E.J. and Meekan, M.G. 2018. Temperature and the vertical movements of oceanic whitetip sharks, *Carcharhinus longimanus*. Scientific Reports 8, 8351. https://doi.org/10.1038/s41598-018-26485-3

Aulich, M.G., McCauley, R.D., Saunders, B.J., and Parsons, M.J.G. 2019. Fin whale (*Balaenoptera physalus*) migration in Australian waters using passive acoustic monitoring. Scientific Reports 9: 8840. https://doi.org/10.1038/s41598-019-45321-w

Baker, C., Potter, A., Tran, M. and Heap, A.D. 2008. Sedimentology and Geomorphology of the North-west Marine Region of Australia. Geoscience Australia, Canberra. 24 pp.

Bamford, M., Watkins, D., Bancroft, W., Tischler, G. and Wahl, J. 2008. Migratory shorebirds of the East Asian-Australasian flyway: population estimates and internationally important sites. Wetlands International – Oceania, Canberra.

Bannister, J., Kemper, C.M. and Warneke, R.M. 1996. The action plan for Australian cetaceans. Australian Nature Conservation Agency, Canberra.

Bannister, J.L. and Hedley, S.L. 2001. Southern Hemisphere group IV humpback whales: their status from recent aerial survey. Memoirs of the Queensland Museum 47(2): 587–98.

Bejder, L., Videsen, S., Hermannsen, L., Simon, M., Hanf, D. and Madsen, P.T. 2019. Low energy expenditure and resting behaviour of humpback whale mother-calf pairs highlights conservation importance of sheltered breeding areas. Scientific Reports 9: 771. https://doi.org/10.1038/s41598-018-36870-7

BirdLife Australia 2018. Seabird and Shorebird Baseline Studies, Ningaloo Region – Report on January 2018 bird surveys.

Blue Planet Marine 2020. Australian Blue Whale Species Assessment Report (No. v4). Unpublished report to Woodside Energy Ltd.

Bouchet, P.J., Thiele, D., Marley, S.A., Waples, K., Weisenberger, F., Balangarra Rangers, Bardi Jawi Rangers, Dambimangari Rangers, Nyamba Buru Yawuru Rangers, Nyul Nyul Rangers, Uunguu Rangers and Raudino, H. 2021. Regional assessment of the conservation status of Snubfin Dolphins (*Orcaella heinsohni*) in the Kimberley Region, Western Australia. Frontiers in Marine Science 7:article 614852.

Braccini, M. and Blay, N. 2020. Temperate Demersal Gillnet and Demersal Longline Fisheries Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 214-220.

Brewer, D., Lyne, V., Skewes, T. and Rothlisberg, P. 2007, Trophic Systems of the North West Marine Region, Report to the Department of the Environment and Water Resources, CSIRO Marine and Atmospheric Research, Cleveland. 167 pp.

Brown, A., Bejder, L., Cagnazzi, D., Parra, G.J. and Allen, S.J. 2012. The North West Cape, Western Australia: a potential hotspot for Indo-Pacific humpback dolphins *Sousa chinensis*? Pacific Conservation Biology 18: 240−246.

Brown, A.M., Bejder, L., Pollock, K.H. and Allen, S.J. 2016. Site-specific assessments of the abundance of three inshore dolphin species to inform conservation and management. Frontiers in Marine Science https://doi.org/10.3389/fmars.2016.00004

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights reserved.

Brown, A.M., Kopps, A.M., Allen, S.J., Bejder, L., Littleford-Colquhoun, B., Parra, G.J., Cagnazzi, D., Thiele, D., Palmer, C. and Frère, C.H. 2014. Population differentiation and hybridisation of Australian snubfin (*Orcaella heinsohni*) and Indo-Pacific humpback (*Sousa chinensis*) dolphins in north-western Australia. PLoS ONE 9: e101427.

Bruce, B.D. 2008. The biology and ecology of the white shark, *Carcharodon carcharias*. In: Camhi, M.D., Pikitch, E.K., Babcock, E.A. (eds.), Sharks of the Open Ocean : Biology, Fisheries and Conservation. Blackwell Publishing Limited, Oxford, pp. 69–81.

Bruce, B.D., Stevens, J.D., Malcolm, H. 2006. Movements and swimming behaviour of white sharks (*Carcharodon carcharias*) in Australian waters. Marine Biology 150: 161–172.

Bulman, C., 2006. Trophic webs and modelling of Australia's North West Shelf. North West Shelf Joint Environmental Management Study (NWSJEMS) Technical Report No. 9. CSIRO Marine and Atmospheric Research, Hobart. 49 pp.

Campana, S. and W. Joyce. 2004. Temperature and depth associations of porbeagle shark (*Lamna nasus*) in the northwest Atlantic. Fisheries Oceanography 13 (1): 52-64.

Campana, S.E., Marks, L. and Joyce, W. 2005. The biology and fishery of shortfin mako sharks (*Isurus oxyrinchus*) in Atlantic Canadian waters. Fisheries Research 73: 341–352.

Campana, S.E., Joyce, W. and Fowler, M. 2010. Subtropical pupping ground for a cold-water shark. Canadian Journal of Fisheries and Aquatic Sciences 67: 769-773.

Cannell, B., Hamilton, S. and Driessen, J. 2019. Wedge-tailed shearwater foraging behaviour in the Exmouth Region. BirdLife Australia and University of Western Australian study. Available from: https://www.birdlife.org.au/documents/wedge-tailed%20shearwater%20foraging%20behaviour.pdf

Carruthers, T.J.B., Dennison, W.C., Kendrick, G., Waycott, M., Walker, D.I. and Cambridge, M. 2007. Seagrasses of south west Australia: a conceptual synthesis of the world's most diverse and extensive seagrass meadows. Journal of Experimental Marine Biology & Ecology 350: 21-45.

Ceccarelli, D., McCrea, I., Collis, M. and Nicoll, R. 2011. Australia's Last Great Whale Haven – Cetacean distribution and conservation needs in the north-west marine region. International Fund for Animal Welfare, November 2011. 72 pp.

Chandrapavan, A. ,Sporer, E., Oliver R. and Cavalli, P. 2017. Shark Bay Blue Swimmer Crab Resource Status Report 2016. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2015/16*: The State of the Fisheries eds. W.J. Fletcher, M.D. Mumme and F.J. Webster, Department of Fisheries, Western Australia. pp. 95-98.

Chevron Australia. 2010. Draft Environmental Impact Statement/Environmental Review and Management Programme for the Proposed Wheatstone Project. Appendix Q7 –Baseline water quality assessment report. Chevron Australia, Perth, Western Australia. Available from: https://australia.chevron.com/our-businesses/wheatstone-project/environmental-approvals [Accessed 14 May 2021].

Chidlow, J., Gaughan, D. and McAuley, R. 2006. Identification of Western Australian Grey Nurse Shark Aggregation Sites: Final Report to the Australian Government, Department of the Environment and Heritage. In: Fisheries Research and Development Corporation (ed.), Fisheries Research Report, Perth, Department of Fisheries, Perth.

Cliff, G. and Wilson, G. 1994. Natal sharks board's guide to sharks and other marine animals. Natal Sharks Board, 33 pp.

Commonwealth of Australia 2006. A guide to the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) version 4.0. Department of Environment and Heritage, Canberra, Australia. 16 pp.

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights are reserved.

Commonwealth of Australia 2015a. Conservation Management Plan for the Blue Whale: A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2015-2025. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/blue-whale-conservation-management-plan

Commonwealth of Australia 2015b. Sawfish and River Sharks Multispecies Recovery Plan. Canberra, ACT: Commonwealth of Australia. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/sawfish-river-sharks-multispecies-recovery-plan

Commonwealth of Australia 2015c. Wildlife Conservation Plan for Migratory Shorebirds. Canberra, ACT: Commonwealth of Australia. Available from: https://www.environment.gov.au/system/files/resources/9995c620-45c9-4574-af8e-a7cfb9571deb/files/widlife-conservation-plan-migratory-shorebirds.pdf

Commonwealth of Australia 2017. Recovery Plan for Marine Turtles in Australia. Australian Government, Canberra. Available from: http://www.environment.gov.au/marine/publications/recovery-plan-marine-turtles-australia-2017

Commonwealth of Australia 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Canberra, ACT: Commonwealth of Australia. Available from: https://www.environment.gov.au/biodiversity/threatened/publications/tap/marine-debris-2018

Commonwealth of Australia 2019. Draft Wildlife Conservation Plan for Seabirds. Canberra, ACT: Commonwealth of Australia. Available from: https://www.environment.gov.au/biodiversity/threatened/comment/draft-wildlife-conservation-plan-for-seabirds

Condie, S.A, Andrewartha, J., Mansbridge, J. and Waring, J.R. 2006. Modelling circulation and connectivity on Australia's North West Shelf, Technical Report No. 6, North West Shelf Joint Environmental Management Study, CSIRO Marine and Atmospheric Research, Hobart, Tasmania.

D'Alberto, D.M., Chin, A., Smart, J.J., Baje, L., White, W.T. and Simpfendorfer, C.A. 2017. Age, growth and maturity of oceanic whitetip shark (*Carcharhinus longimanus*) from Papua New Guinea. Marine and Freshwater Research 68: 1118–1129.

D'Anastasi, B., Simpfendorfer, C.A. and van Herwerden, L. 2013. In: The IUCN Red List of Threatened Species. Version 2013.2. *Anoxypristis cuspidata* (Narrow Sawfish). http://www.iucnredlist.org/details/39389/0

Dawson, C.E. 1985. Indo-Pacific pipefishes (Red Sea to the Americas). Gulf Coast Research Laboratory, Ocean Springs, Mississippi, USA.

de Lestang, S., Rossbach, M. and Blay, N. 2018. West Coast Rock Lobster Resource Status Report 2017. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2017/18*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 32-36.

Done, T.J., Williams, D.McB., Speare, P.J., Davidson, J., DeVantier, L.M., Newman, S.J. and Hutchins, J.B. 1994. Surveys of coral and fish communities at Scott Reef and Rowley Shoals., Australian Institute of Marine Science, Townsville.

Duffy, R. and Blay, N. 2020a. West Coast Nearshore and Estuarine Finfish Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 55-64.

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights are reserved.

Duffy, R. and Blay, N. 2020b. South Coast Estuarine and Nearshore Scalefish and Invertebrate Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 201-209.

Duffy, R. and Blay, N. 2020c. West Coast Nearshore And Estuarine Finfish Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 55-64.

Fairclough, D. and Walters, S. 2018. West Coast Demersal Scalefish Resource Status Report 2018. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2017/18*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 56-62.

Falkner, I., Whiteway, T., Przeslawski, R. and Heap, A.D. 2009. Review of ten key ecological features (KEFs) in the North-west Marine Region. Record 2009/13, Geoscience Australia, Canberra.

Ferreira, L.C., Thums, M., Fossette, S., Wilson, P., Shimada, T., Tucker, A.D., Pendoley, K., Waayers, D., Guinea, M.L., Loewenthal, G., King, J., Speirs, M., Rob, D. and Whiting. S.D. 2021. Multiple satellite tracking datasets inform green turtle conservation at a regional scale. Diversity and Distributions 27(2): 249-266. https://doi.org/10.1111/ddi.13197

Field, I.C., Charters, R., Buckworth, R.C., Meekan, M.G. and Bradshaw, C.J.A. 2008. Distribution and abundance of *Glyphis* and sawfishes in northern Australia and their potential interactions with commercial fisheries. Report to Australian Government, Department of the Environment, Water, Heritage and the Arts. Canberra. 39 pp.

Fletcher, W.J. and Santoro, K. (eds) 2015. *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2014/15*: The State of the Fisheries. Department of Fisheries, Western Australia.

Fletcher, W.J. and Santoro, K. (eds) 2009. State of the fisheries report 2008/09. Western Australian Department of Fisheries, Perth.

Fletcher, W.J., Mumme, M.D. and Webster, F.J. (eds) 2017. *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2015/16: The State of the Fisheries*. Department of Fisheries, Western Australia.

Francis, M., Natanson, L. and Campana, S. 2002. The Biology and Ecology of the Porbeagle Shark, *Lamna nasus*. In: Camhi, M., E. Pikitch and E. Babcock, eds. Sharks of the Open Ocean: Biology, Fisheries and Conservation: 105-113.

Gaughan, D.J. and Santoro, K. (eds), 2018. *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17: The State of the Fisheries*. Department of Primary Industries and Regional Development, Western Australia.

Gaughan, D.J. and Santoro, K. (eds). 2020. *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2018/19: The State of the Fisheries*. Department of Primary Industries and Regional Development, Western Australia.

Gelsleichter, J., Musick, J.A. and Nichols, S. 1999. Food habits of the smooth dogfish, *Mustelus canis*, dusky shark, *Carcharhinus obscurus*, Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, and the sand tiger, Carcharias *taurus*, from the northwest Atlantic Ocean. Environmental Biology of Fishes 54: 205–217.

Goldsworthy, S.D., Shaughnessy, P.D., MacKay, A.I., Bailleul, F., Holman, D., Lowther, A.D., Page, B., Waples, K., Raudino, H., Bryars, S. and Anderson, T. 2021. Assessment of the status and trends in abundance of a coastal pinniped, the Australian sea lion, *Neophoca cinerea*. Endangered Species Research 44: 421-437.

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights reserved.

Guinea, M.L. 2006. Sea Turtles, Sea Snakes and Dugongs of Scott Reef, Seringapatam Reef and Browse Island with Notes on West Lacepede Island. Report to URS, Charles Darwin University.

Guinea, M.L. 2007a. Marine snakes: species profile for the north-western planning area, report for the Australian Government Department of the Environment, Water, Heritage and the Arts, Charles Darwin University, Northern Territory.

Guinea, M.L. 2007b. Final report survey March 16 – April 2 2007: sea snakes of Ashmore Reef, Hibernia Reef and Cartier Island with comments on Scott Reef, Charles Darwin University, Darwin.

Guinea, M.L. 2009. Long Term Marine Turtle Monitoring at Scott Reef. Report prepared for Woodside Pty Ltd.

Guinea, M. 2011. Long term monitoring of the marine turtles of Scott Reef satellite tracking of green turtles from Scott Reef #1 (p. 35). Appendix F27. Report prepared by Sinclair Knight Merz. Browse LNG Development.

Guinea, M.L. and Whiting, S.D. 2005. Insights into the distribution and abundance of sea snakes at Ashmore Reef. The Beagle (Supplement 1): 199-206.

Hallegraeff, G.M. 1995. Marine phytoplankton communities in the Australian region: current status and the future threats. Our sea, our future: major findings of the State of the Marine Environment Report for Australia. Great Barrier Reef Marine Park Authority, Canberra, Australia.

Hanf, D.M. 2015. Species Distribution Modelling of Western Pilbara Inshore Dolphins. Masters Research thesis. Murdoch University, Perth, Western Australia.

Hanf, D., Hunt, T. and Parra, G.J. 2016. Humpback dolphins of Western Australia: a review of current knowledge and recommendations for future management. Advances in Marine Biology 73: 193–218. https://doi.org.10.1016/bs.amb.2015.07.004

Hanson, C.E., Pattiaratchi, C.B. and Waite, A.M. 2005. Seasonal production regimes off south-western Australia: influence of the Capes and Leeuwin Currents on phytoplankton dynamics. Marine and Freshwater Research 56(7): 1011-1026.

Hanson, C.E., Waite, A.M., Thompson, P.A. and Pattiaratchi, C.B. 2007. Phytoplankton community structure and nitrogen nutrition in Leeuwin Current and coastal waters off the Gascoyne region of Western Australia. Deep Sea Research Part II: Topical Studies in Oceanography 54 (8–10): 902-924.

Harris, P., Heap, A., Passlow, V., Sbaffi, L. Fellows, M., Porter-Smith, R., Buchanan, C., and Daniell, J. 2005. Geomorphic Features of the Continental Margin of Australia. Geoscience Australia, Record 2003/30, 142 pp.

Harris, P.T., Heap, A., Marshall, J., Hemer, M., Daniell, J., Hancock, A., Buchanan, C., Brewer, D. and Heales, D. 2007. Submerged coral reefs and benthic habitats of the southern Gulf of Carpentaria: post survey report GA survey 276, RV Southern Surveyor, Record 2007/02, Geoscience Australia, Canberra.

Hart, A., Ferridge, R., Syers, C. and Kalinowski, P. 2017. Statewide Specimen Shell Resources Status Report 2017. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 204-206.

Hart, A., Bruce, C., Kalinowski, P. and Steele, A. 2018. Statewide Specimen Shell Resources Status Report 2018. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2017/18*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 204-206.

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights reserved.

Hart, A., Murphy, D. and Steele, A. 2019. Sea Cucumber Resource Status Report 2019. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2018/19*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 173-175.

Hart, A., Murphy, D. and Steele, A. 2020a. Pearl Oyster Managed Fishery Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 165-169.

Hart, A., Bruce, C. and Steele, A. 2020b. Statewide Specimen Shell Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 253-255.

Hart, A., Murphy, D. and Wiberg, L. 2020c. West Coast Octopus Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 50-54.

Heck Jr., K.L., Hays, G. and Orth, R.J. 2003. Critical evaluation of the nursery role hypothesis for seagrass meadows. Marine Ecology Progress Series 253: 123-136.

Hedley, S.L., Bannister, J.L. and Dunlop, R.A. 2011. Abundance estimates of Breeding Stock ‘D’ humpback whales from aerial and land-based surveys off Shark Bay, Western Australia, 2008. Journal of Cetacean Research Management (special issue 3): 209–21.

Heyward, A.J., Halford, A.R., Smith, L.D. and Williams, D.M. 1997. Coral reefs of north west Australia: baseline monitoring of an oceanic reef ecosystem. In: Proceedings on 8th International Coral Reef Symposium 1: 289–294.

Heyward, A.J., Revill, A.T. and Sherwood, C.R. 2000. Review of Research and Data Relevant to Marine Environmental Management of Australia’s North West Shelf’, Produced for the Western Australian Department of Environmental Protection. (Unpublished report).123 pp.

Himmelman, J.H., Guderley, H.E. and Duncan, P.F. 2009. Responses of the saucer scallop *Amusium balloti* to potential predators. Journal of Experimental Marine Biology and Ecology 378(1–2): 58-61.

Holley, D.K., Lawler, I.R. and Gales, N.J. 2006. Summer survey of dugong distribution and abundance in Shark Bay reveals additional key habitat area. Wildlife Research 33: 243-250. https://doi.org/10.1071/WR05031

Holloway, P. and Nye, H.C. 1985. Leeuwin Current and wind distributions on the southern part of the Australian North West Shelf between January 1982 and July 1983. Australian Journal of Marine and Freshwater Research 36: 123-137.

Holloway, P. 2001. A regional model of the semidiurnal internal tide on the Australian North West Shelf. Journal of Geophysical Research 106: 19625-19638.

How, J. and Orme, L. 2020a. West Coast Deep Sea Crustacean Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 113-117.

How, J. and Orme, L. 2020b. South Coast Crustacean Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 189-194.

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Howey-Jordan, L.A., Brooks, E.J., Abercrombie, D.L., Jordan, L.K., Brooks, A., Williams, S., Gospodarczyk, E. and Chapman, D.D. 2013. Complex movements, philopatry and expanded depth range of a severely threatened pelagic shark, the oceanic whitetip (*Carcharhinus longimanus*) in the western North Atlantic. PloS One 8:e56588. https://doi:10.1371/journal.pone.0056588

Hunt, T.N., Bejder, L., Allen, S.J., Rankin, R.W., Hanf, D. and Parra, G.J. 2017. Demographic characteristics of Australian humpback dolphins reveal important habitat toward the southwestern limit of their range. Endangered Species Research 32: 71-88. https://doi.org/10.3354/esr00784

Irvine, L.G., Thums, M., Hanson, C.E., McMahon, C.R. and Hindell, M.A. 2018. Evidence for a widely expanded humpback whale calving range along the Western Australian coast. Marine Mammal Science 34(2): 294-310. https://doi.org/10.1111/mms.12456

James, N.P., Bone, Y., Kyser, T.K., Dix, G.R. and Collins, L.B. 2004. The importance of changing oceanography in controlling late Quaternary carbonate sedimentation on a high-energy, tropical, oceanic ramp: north-western Australia. Sedimentology 51: 1179–1205.

Jefferson, T.A. and Rosenbaum, H.C. 2014. Taxonomic revision of the humpback dolphins (*Sousa* spp.), and description of a new species from Australia. Marine Mammal Science 30(4): 1494-1541.

Jenner, K., Jenner, M. and McCabe, K. 2001. Geographical and temporal movements of humpback whales in Western Australian waters. APPEA Journal 41: 692–707.

Jenner, C., Jenner, M., Burton, C., Sturrock, V., Salgado Kent, C., Morrice, M., Attard, C., Möller, L. and Double, M. 2008. Mark recapture analysis of pygmy blue whales from the Perth Canyon, Western Australia 2000-2005. Paper SC/60/SH16 presented to the Scientific Committee of the International Whaling Commission.

Johnston, D., Harris, D. and Blazeski, S. 2020. North Coast Crab Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 113-117.

Joyce, W., Campana, S., Natanson, L., Kohler, N., Pratt Jr., H. and Jensen, C. 2002. Analysis of stomach contents of the porbeagle shark (*Lamna nasus* Bonnaterre) in the northwest Atlantic. ICES Journal of Marine Science 53: 1263-1269.

Kangas, M., Sporer, E., Wilkin, S., Shanks, M., Cavalli, P., Pickles, L. and Oliver, R. 2018. North Coast Prawn Resource Status Report 2017. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 119-122.

Kangas, M., Wilkin, S., Shanks, M. and Brand-Gardner, S. 2019. North Coast Prawn Resource Status Report 2019. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 145-153.

Kangas, M., Wilkin, S., Shanks, M. and Brown, S. 2020a. North Coast Prawn Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 143-150.

Kangas, M., Wilkin, S., Breheny, N., Cavalli, P., Grounds, G. and Brown S. 2020b. Saucer Scallop Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 95-101.

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights are reserved.

Kirkwood, R., Pemberton, D. and Copson, G. 1992. The conservation and management of seals in Tasmania. Hobart: Department of Parks, Wildlife and Heritage. 48 pp.

Last, P., Lyne, V., Yearsley, G., Gledhill, D., Gommon, M., Rees, T. and White, W. 2005. Validation of national demersal fish datasets for the regionalisation of the Australian continental slope and outer shelf (>40 m depth). Australian Government Department of the Environment and Heritage and CSIRO Marine Research, Australia.

Last, P.R., and Stevens, J.D. 2009. Sharks and rays of Australia, 2nd edition, CSIRO Publishing, Melbourne.

Lewis, P. and Brand-Gardner, S. 2018. Statewide Large Pelagic Finfish Resource Status Report 2017. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 195-199.

Lewis, P., Blay, N. and Watt, M. 2020. Statewide Large Pelagic Finfish Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 241-247.

Limpus, C.J. 1992. Estimation of tag loss in marine turtle research. Wildlife Research 19: 457-469. https://doi.org/10.1071/WR9920457

Limpus, C.J. 2009. A biological review of Australian marine turtles. Environmental Protection Agency, Brisbane, QLD.

Limpus, C.J., Parmenter, C.J., Baker, V. and Fleay, A. 1983. The Flatback Turtle, *Chelonia depressa*, in Queensland: Post-Nesting Migration and Feeling Ground Distribution. Wildlife Research 10: 557-561. https://doi.org/10.1071/WR9830557

Liu, Q.Y., Feng, M., Wang, D. and Wijffels, S. 2015. Interannual variability of the Indonesian Throughflow transport: a revisit based on 30 year expendable bathythermograph data. Journal of Geophysical Research: Oceans 120: 8270-8282.

Lourie, S.A., Foster, S.J., Cooper, E.W.T. and Vincent, A.C.J. 2004. A guide to the identification of seahorses. Project Seahorse and TRAFFIC North America, University of British Columbia and World Wildlife Fund. Available from: https://cites.unia.es/cites/file.php/1/files/guide-seahorses.pdf [Accessed 22 Sep 2020]

Lourie, S.A., Vincent, A.C.J. and Hall, H.J. 1999. Seahorses: an identification guide to the world's species and their conservation. Project Seahorse, London, UK.

Lukoschek, V., Beger, M., Ceccarelli, D., Richards, Z. and Pratchett, M. 2013. Enigmatic declines of Australia's sea snakes from a biodiversity hotspot. Biological Conservation 166: 191e202.

Lulofs, H.M.A. and Sumner, N.R. 2002. Historical diving profiles for pearl oyster divers in Western Australia. Fisheries Research Report, 138.

Mackie, M., Gaughan, D.J. and Buckworth, R.C. 2003. Stock assessment of narrow-barred Spanish mackerel (*Scomberomorus commerson*) in Western Australia. FRDC Project No. 1999/151.

Mackie, M., Nardi, A., Lewis, P. and Newman, S. 2007. Small pelagic fishes of the north-west marine region. Department of Fisheries, Perth.

Marsh, H., Prince, R.I.T., Saafeld, W.K. and Shepherd, R. 1994. The distribution and abundance of the dugong in Shark Bay, Western Australia. Wildlife Research 21: 149-161. https://doi.org/10.1071/WR9940149

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights are reserved.

Marsh, H., Penrose, H., Eros C. and Hugues, J. 2002. Dugong Status Report and Action Plans for Countries and Territories. Early Warning Assessment Reports. United Nations Environment Programme, Nairobi.

Marsh, H., O'Shea, T.J. and Reynolds, J.R. 2011. The ecology and conservation of sirenia; dugongs and manatees. Cambridge University Press, London.

Marshall, A., Bennett, M., Kodja, G., Hinojosa-Alvarez, S., Galvan-Magana, F., Harding, M., Stevens, G. and Kashiwaga, T. 2011. *Manta birostris* (Chevron Manta Ray, Giant Manta Ray, Oceanic Manta Ray, Pacific Manta Ray, Pelagic Manta Ray) [WWW Document]. The IUCN Red List of Threatened Species. Accessed at http://www.iucnredlist.org/details/198921/0

Marshall, A.D., Compagno, L.J. and Bennett, M.B. 2009. Redescription of the genus *Manta* with resurrection of *Manta alfredi* (Krefft, 1868) (Chondrichthyes; Myliobatoidei; Mobulidae). Zootaxa 2301: 1–28.

Martin, R.A. 2007. A review of behavioural ecology of whale sharks. Fisheries Research 84: 10–16.

McAuley, R. 2004. Western Australian Grey Nurse Shark Pop Up Archival Tag Project. Final Report to Department of Environment and Heritage. Department of Fisheries, Western Australia. 49 pp.

McCauley, R.D. 2009. Sea Noise Logger Deployment Scott Reef: 2006–2008 – Whales, Fish and Seismic Survey. Report produced for Woodside Energy Ltd.

McCauley, R. 2011. Woodside Kimberley sea noise logger program, Sept-2006 to June-2009: Whales, Fish and Man-made Noise. Report produced for Woodside Energy Ltd.

McCauley, R. and Jenner, C. 2010. Migratory patterns and estimated population size of pygmy blue whales (*Balaenoptera musculus brevicauda*) traversing the Western Australian coast based on passive acoustics. Paper SC/62/SH26 presented to the IWC Scientific Committee, June 2010, Agadir, Morocco (unpublished). 9 pp.

McCauley, R. and Duncan, A. 2011. Sea noise logger deployment, Wheatstone and Onslow, April 2009 to November 2010 (Technical Report No. R2011-23). Centre for Marine Science and Technology, Curtin University of Technology, Perth.

McCauley, R., Jenner, C., Bannister, J., Cato, D. and Duncan, A. 2000. Blue whale calling in the Rottnest trench, Western Australia, and low frequency sea noise. Acoustics Australia / Australian Acoustical Society: 245-250.

McCauley, R., Salgado Kent, C., Gavrilov, A., Recalde-Salas, A., Burton, C. and Marley, S. 2004. Passive acoustic monitoring of baleen whales in Geographe Bay, Western Australia. Acoustics Australia Proceedings of Acoustics 2004 November Gold Coast.

McCauley, R.D., Gavrilov, A.N., Jolliffe, C.D., Ward, R. and Gill, P.C. 2018. Pygmy blue and Antarctic blue whale presence, distribution and population parameters in southern Australia based on passive acoustics. Deep-Sea Research Part II: Topical Studies in Oceanography 157-158: 154-168.

McClatchie, S., Middleton, J.F. and Ward, T.M. 2006. Water mass analysis and alongshore variation in upwelling intensity in the eastern Great Australian Bight. Journal of Geophysical Research, Oceans 111(C8). https://doi.org/10.1029/2004JC002699

McCosker, J. 1975. Feeding behavior of Indo-Australian hydrophiidae. The biology of sea snakes 1: 217-232.

Menezes, V.V., Phillips, H.E., Schiller, A., Domingues, C.M. and Bindoff, N.L. 2013. Salinity dominance on the Indian Ocean Eastern Gyral current. Geophysical Research Letters 40: 5716-5721.

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights reserved.

MetOcean Engineers, 2005, Preliminary metocean conditions for the Browse Development (Prospective Production Facilities/Areas, Pipeline Routes/Shore Crossings and Flow-Lines/Seabed Manifolds), Scott Reef Vicinity to Shore. Report produced for Woodside Energy Limited.

Minton, S., Heatwole, H. and Dunson, W. 1975. Sea snakes from reefs of the Sahul Shelf. University of Maryland Press, 1: 141-144.

Miyazaki, S. and Stagg, H. 2013. Exmouth Plateau [WWW Document]. Geoscience Australia: National Geological Provinces Online Database. Available at: http://www.ga.gov.au/provexplorer/provinceDetails.do?eno=30351

Mollet, H., Cliff, G., Pratt Jr, H. and Stevens, J. 2000. Reproductive biology of the female shortfin mako, *Isurus oxyrinchus* Rafinesque, 1810, with comments on the embryonic development of lamnoids. Fishery Bulletin – National Oceanic and Atmospheric Administration 98(2): 299-318.

Molony, B., Lai, E., and Jones, R. 2015. Mackerel Managed Fishery Report: Statistics Only. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2014/15*: The State of the Fisheries eds. W.J. Fletcher and K. Santoro, Department of Fisheries, Western Australia, pp. 207-210.

Morrice, M.G., Gill, P.C., Hughes, J. and Levings, A.H. 2004. Summary of aerial surveys for the Santos Ltd EPP32 seismic survey, 2–13 December 2003. Report WEG-SO 02/2004 to Santos Ltd. Whale Ecology Group, Deakin University, Warrnambool.

Newman, S.J., Wakefield, C., Skepper, C., Boddington, D., Blay, N., Jones, R. and Dobson, P. 2015. North Coast Demersal Fisheries Status Report 2015. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2014/15*: The State of the Fisheries eds. W.J. Fletcher and K. Santoro, Department of Fisheries, Western Australia, pp. 189-206.

Newman, S.J., Wakefield, C., Skepper, C., Boddington, D. and Smith, E. 2018. North Coast Demersal Resource Status Report 2017. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 125-133.

Newman, S.J., Wakefield, C., Skepper, C., Boddington, D. and Blay, N. 2019. North Coast Demersal Fisheries Status Report 2019. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2018/19*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 159-168.

Newman, S., Wakefield, C., Skepper, C., Boddington D. and Steele, A. 2020a. North Coast Demersal Fisheries Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 156-165.

Newman, S., Bruce, C. and Wiberg, L. 2020b. Statewide Marine Aquarium Fish and Hermit Crab Resources Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 247-252.

Norriss, J. and Blazeski, S. 2020. South Coast Small Pelagic Scalefish Resource Status Report 2020. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2019/20*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 209-213.

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights reserved.

Parra, G.J. 2006. Resource partitioning in sympatric delphinids: Space use and habitat preferences of Australian snubfin and Indo-Pacific humpback dolphins. Journal of Animal Ecology 75: 862-874.

Parra, G.J., Corkeron, P.J. and Marsh, H. 2002. The Indo-Pacific humpback dolphin, *Sousa chinensis* (Osbeck, 1765) in Australian waters: a summary of current knowledge and recommendations for their conservation. Unpublished Report to the Scientific Committee of the International Whaling Commission, SC/54/SM27.

Parra, G.J., Corkeron, P.J. and Marsh, H. 2006. Population sizes, site fidelity and residence patterns of Australian snubfin and Indo-Pacific humpback dolphins: implications for conservation. Biological Conservation 129: 167-180.

Patterson, H., Noriega, R., Georgeson, L., Larcombe, J. and Curtotti, R. 2017. Fishery status reports 2017, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 4.0.

Patterson, S.H., Larcombe, J., Woodhams, J. and Curtotti, R. 2020. Fishery status reports 2020, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 4.0. https://doi.org/10.25814/5f447487e6749

Pearce, A., Buchan, S., Chiffings, T., D'Adamo, N., Fandry, C., Fearns, P., Mills, D., Phillips, R. and Simpson, C. 2003. A review of the oceanography of the Dampier Archipelago, Western Australia, in: Wells, F., Walker, D., Jones, D. (Eds.), The Marine Flora and Fauna of Dampier, Western Australia. Western Australian Museum, Perth, pp. 13–50.

Pendoley, K.L. 2005. Sea turtles and the environmental management of industrial activities in North West Western Australia. PhD thesis, Murdoch University.

Pendoley, K., Vitenbergs, A., Whittock, P. and Bell, C. 2016. Twenty years of turtle tracks: marine turtle nesting activity at remote locations in the Pilbara region, Western Australia. Australian Journal of Zoology 64. https://doi.org.10.1071/ZO16021

Pillans, R.D., Stevens, J.D., Peverell, S. and Edgar. S. 2008. Spatial distribution and habitat utilisation of the speartooth shark *Glyphis glyphis* in relation to fishing in Northern Australia. Department of the Environment, Water, Heritage and the Arts, Canberra. 47 pp.

Pillans, R.D., Stevens, J.D., Kyne, P.M. and Salini, J. 2009. Observations on the distribution, biology, short-term movements and habitat requirements of river sharks *Glyphis* spp. in northern Australia. Endangered Species Research 10: 321–332.

Pitman, R.L., Totterdell, J.A., Fearnbach, H., Ballance, L.T., Durban, J.W. and Kemps, H. 2015. Whale killers: Prevalence and ecological implications of killer whale predation on humpback whale calves off Western Australia. Marine Mammal Science 31(2): 629-657. https://doi.org/10.1111/mms.12182

Pogonoski, J.J., Pollard, D.A. and Paxton, J.R. 2002. Conservation Overview and Action Plan for Australian Threatened and Potentially Threatened Marine and Estuarine Fishes. Canberra, ACT: Environment Australia. Available from: http://www.environment.gov.au/coasts/publications/marine-fish-action/pubs/marine-fish.pdf

Preen, A. 2004. Distribution, abundance and conservation status of dugongs and dolphins in the southern and western Arabian Gulf. Biological Conservation 118(2): 205-218.

Preen, A., Marsh, H., Lawler, I., Prince, R. and Shepherd, R. 1997. Distribution and abundance of dugongs, turtles, dolphins and other megafauna in Shark Bay, Ningaloo Reef and Exmouth Gulf, Western Australia. Wildlife Research 24: 185–208.

Prieto, R., Janiger, D., Silva, M.A., Waring, G.T. and Gonçalves, J.M. 2012. The forgotten whale: a bibliometric analysis and literature review of the North Atlantic sei whale *Balaenoptera borealis.* Mammal Review 42: 235–272. https://doi.org.10.1111/j.1365-2907.2011.00195.x

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights reserved.

Przeslawski, R., Daniell, J., Nichol, S., Anderson, T. and Barrie, J.V. 2011. Seabed Habitats and Hazards of the Joseph Bonaparte Gulf and Timor Sea, Northern Australia. Record 2011/040. Geoscience Australia, Canberra.

Przeslawski, R., Alvarez, B., Battershill, C. and Smith, T. 2014. Sponge biodiversity and ecology of the Van Diemen Rise and eastern Joseph Bonaparte Gulf, northern Australia. Hydrobiologia 730: 1-16.

Raudino, H., Hunt, T.N. and Waples, K.A. 2018. Records of Australian humpback dolphins (*Sousa sahulensis*) from an offshore island groups in Western Australia. Marine Biodiversity Records 11:14**-20**.

Reardon, M.B., Gerber, L. and Cavanagh, R.D. 2006. *Isurus paucus*. The IUCN Red List of Threatened Species 2006.

Reinhold, L. and Whiting, A. 2014. High-density Loggerhead Sea Turtle Nesting on Dirk Hartog Island, Western Australia. Marine Turtle Newsletter 141: 7-10.

Rob, D., Barnes, P., Whiting, S., Fossette, S., Tucker, T. and Mongan, T. 2019. Turtle activity and nesting on the Muiron Islands and Ningaloo Coast: Final Report 2018, Ningaloo Turtle Program. Report prepared for Woodside Energy Limited. Department of Biodiversity, Conservation and Attractions, Exmouth. 51 pp.

Rochester, W.A., Moeseneder, C.H., Miller, M.J., Milton, D.A., Fry, G.C., Griffiths, S.P, Pillans, R.D., Rothlisberg, P.C., Bustamante, R.H. and Butler, A.J. 2007. The North Marine Region marine bioregional plan: Information and analysis for the regional profile. Final report to the Department of the Environment and Water Resources. CSIRO Marine and Atmospheric Research.

Rosser, N.L. and Gilmour, J.P. 2008. New insights into patterns of coral spawning on Western Australian reefs. Coral Reefs 27: 345-349.

RPS 2016. Metocean Criteria Guidelines for MODU Mooring on Australia's North West Shelf.

Salgado Kent, C., Jenner, C., Jenner, M., Bouchet, P. and Rexstad, E. 2012. Southern Hemisphere breeding stock D humpback whale population estimates from North West Cape, Western Australia. Journal of Cetacean Research and Management 12(1): 29–38.

Saunders, R., Royer, F. and Clarke, M. 2011. Winter migration and diving behaviour of Porbeagle shark, *Lamna nasus*, in the Northeast Atlantic. ICES Journal of Marine Science 68(1): 166-174.

Schroeder, T., Lyne, V., Dekker, A.G. and Rathbone, C. 2009. Regional MODIS Satellite Data Study: Scott Reef. CSIRO report produced for Woodside Energy Ltd. CSIRO.

Sheppard, J., Preen, A.R., Marsh, H., Lawler, I.R., Whiting S. and Jones, R.E. 2006. Movement heterogeneity of dugongs, *Dugong dugon* (Muller) over large spatial scales. Journal of Experimental Marine Biology and Ecology 334: 64-83.

Simpson, C.J., Cary, J.L. and Masini, R.J. 1993. Destruction of corals and other reef animals by coral spawn slicks on Ningaloo Reef, Western Australia. Coral Reefs 12: 185–191. https://doi.org/10.1007/BF00334478

Sleeman, J.C., Meekan, M.G., Wilson, S.G., Jenner, K.C.S., Jenner, M.N., Boggs, G. and Bradshaw, C.J.A. 2007. Biophysical correlates of relative abundances of marine megafauna at Ningaloo Reef, Western Australia. Marine and Freshwater Research 58: 608-623.

Smale, M.J. 2005. The diet of the ragged-tooth shark *Carcharias Taurus* Rafinesque 1810 in the Eastern Cape, South Africa. African Journal of Marine Science 27: 331–335. https://doi:10.2989/18142320509504091

Sporer, E., Kangas, M., Shanks, M. and Blay, N. 2015. North Coast Prawn Managed Fisheries Status Report. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia*

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights reserved.

2014/15:The State of the Fisheries eds. Fletcher, W.J. and Santoro, K., Department of Fisheries, Western Australia, pp. 173-188.

Stevens, J.D., Pillans, R.D. and Salini, J.P. 2005. Conservation assessment of *Glyphis glyphis* (speartooth shark), *Glyphis garicki* (northern river shark), *Pristis microdon* (freshwater sawfish) and *Pristis zijsron* (green sawfish). Report to Department of Environment and Heritage. Canberra. Australia. 84 pp.

Stevens, J., McAuley, R., Simpfendorfer, C. and Pillans, R. 2008. Spatial distribution and habitat utilisation of sawfish (*Pristis* spp.) in relation to fishing in northern Australia. CSIRO Marine and Atmospheric Research, Hobart.

Stevens, J.D., Bradford, R.W. and West, G.J. 2010. Satellite tagging of blue sharks (*Prionace glauca*) and other pelagic sharks off eastern Australia: depth behaviour, temperature experience and movements. Marine Biology 157: 575–591.

Strahan, R. 1983. The Australian Museum Complete Book of Australian Mammals. London, United Kingdom: Angus and Robertson.

Strain, L., Brown, J. and Walters, S. 2018. West Coast Roe's Abalone Resource Status Report 2017. In: *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17*: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. pp. 36–40.

Surman, C.A. 2019. Houtman Abrolhos – A Natural History. Halfmoon Biosciences. 192 pp.

Surman, C.A., Nicholson, L.W. and Philipps, R.A. 2018. Distribution and patterns of migration of a tropical seabird community in the Eastern Indian Ocean. Journal of Ornithology 158: 867-877.

Sutton, A.L., Jenner, K.C.S. and Jenner, M-N.M. 2019. Habitat associations of cetaceans and seabirds in the tropical eastern Indian Ocean. Deep Sea Research Part II: Topical Studies in Oceanography 166: 171-186.

Thiele, D. and Gill P.C. 1999. Cetacean observations during a winter voyage into Antarctic sea ice south of Australia. Antarctic Science 11(1): 48-53.

Thorburn, D.C. 2006. Biology, ecology and trophic interactions of elasmobranchs and other fishes in riverine waters of northern Australia. PhD Thesis, Murdoch University, Perth, Western Australia.

Thorburn, D.C. and Morgan, D.L. 2004. The northern river shark *Glyphis sp. C.* (Carcharhinidae) discovered in Western Australia. Zootaxa 685: 1–8.

Thorburn, D.C., Peverell, S.C., Stevens, J.D., Last, P.R. and Rowland, A.J. 2003. Status of freshwater and estuarine elasmobranchs in Northern Australia. Final Report to the Natural Heritage Trust, pp. 1–75.

Thorburn, D.C., Morgan, D.L., Rowland, A.J., Gill, H.S. and Paling, E. 2008. Life history notes of the critically endangered dwarf sawfish, *Pristis clavata*, Garman 1906 from the Kimberley region of Western Australia*.* Environmental Biology of Fishes 83: 139–145.

Threatened Species Scientific Committee 2009. Commonwealth Listing Advice on *Galeorhinus galeus*. Department of the Environment, Water, Heritage and the Arts. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/68453-listing-advice.pdf

Threatened Species Scientific Committee 2010. Commonwealth Listing Advice on *Thunnus maccoyii* (Southern Bluefin Tuna). Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/69402-listing-advice.pdf

Threatened Species Scientific Committee 2013. Commonwealth Listing Advice on *Centrophorus zeehaani* (southern dogfish). Department of Sustainability, Environment, Water, Population and

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights reserved.

Communities. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/82679-listing-advice.pdf

Threatened Species Scientific Committee 2014. Listing Advice *Isurus oxyrinchus* shortfin mako shark. Department of Sustainability, Environment, Water, Population and Communities. Department of the Environment and Energy. Accessed at http://www.environment.gov.au/biodiversity/threatened/species/pubs/79073-listing-advice.pdf

Threatened Species Scientific Committee 2015a. Conservation Advice *Balaenoptera borealis* sei whale. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/34-conservation-advice-01102015.pdf

Threatened Species Scientific Committee 2015b. Conservation Advice *Megaptera novaeangliae* humpback whale. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/38-conservation-advice-10102015.pdf

Threatened Species Scientific Committee 2015c. Conservation Advice *Balaenoptera physalus* fin whale. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/37-conservation-advice-01102015.pdf

Threatened Species Scientific Committee 2015d. Conservation Advice *Rhincodon typus* whale shark. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/66680-conservation-advice-01102015.pdf

Threatened Species Scientific Committee 2015e. Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/26000-conservation-advice-01102015.pdf

Threatened Species Scientific Committee 2015f. Conservation Advice *Pterodroma mollis* soft-plumaged petrel. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/1036-conservation-advice-01102015.pdf

Threatened Species Scientific Committee 2016a. Conservation Advice *Calidris tenuirostriss* Great knot. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/862-conservation-advice-05052016.pdf

Threatened Species Scientific Committee 2016b. Conservation Advice *Calidris canutus* Red knot. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/855-conservation-advice-05052016.pdf

Threatened Species Scientific Committee 2016c. Conservation Advice *Limosa lapponica menzbieri* Bar-tailed godwit (northern Siberian). Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/86432-conservation-advice-05052016.pdf

Threatened Species Scientific Committee 2016d. Conservation Advice *Charadrius leschenaultii* Greater sand plover. Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/877-conservation-advice-05052016.pdf

Threatened Species Scientific Committee 2016e. Conservation Advice *Charadrius mongolus* Lesser sand plover. Canberra: Department of the Environment. Available from:

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights are reserved.

http://www.environment.gov.au/biodiversity/threatened/species/pubs/879-conservation-advice-05052016.pdf

Threatened Species Scientific Committee 2018. Listing Advice *Sphyrna lewini* scalloped hammerhead. Canberra: Department of the Environment and Energy. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/85267-listing-advice-15032018.pdf

Threatened Species Scientific Committee 2020a. Conservation Advice *Neophoca cinerea* Australian Sea Lion. Canberra: Department of Agriculture, Water and the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/22-conservation-advice-23122020.pdf

Threatened Species Scientific Committee 2020b. Conservation Advice for the Abbott's Booby - *Papasula abbotti*. Canberra: Department of Agriculture, Water and the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/59297-conservation-advice-19102020.pdf

Townsend, C.H. 1935. The distribution of certain whales as shown by logbook records of American whaleships. Zoologica 19: 3–50.

Udyawer, V., Read, M., Hamann, M., Heupel, M.R., and Simpfendorfer, C.A. 2016. Importance of shallow tidal habitats as refugia from trawl fishing for sea snakes. Journal of Herpetology 50: 527–533. https://doi.org.10.1670/15-026

Udyawer, V., Somaweera, R., Nitschke, C., d'Anastasi, B., Sanders, K., Webber, B.L., Hourston, M. and Heupel, M.R. 2020. Prioritising search effort to locate previously unknown populations of endangered marine reptiles. Global Ecology and Conservation 22. https://doi.org/10.1016/j.gecco.2020.e01013

Vincent, A.C.J. 1996. The international trade in seahorses. TRAFFIC International, Cambridge, UK. Available from: http://www.trafficj.org/publication/96_International_Trade_Seahorse.pdf [Accessed 22 Sep 2020].

Voris, H.K. 1972. The role of sea snakes (Hydrophiidae) in the trophic structure of coastal ocean communities. Journal of the Marine Biological Association of India 14(2): 429- 442.

Voris, H.K. and Voris, H.H. 1983. Feeding strategies in marine snakes: an analysis of evolutionary, morphological, behavioral and ecological relationships. American Zoology 23: 411–425. https://doi.org.10.1093/icb/23.2.411

Waayers, D., Smith, L. and Malseed, B. 2011. Internesting distribution of green turtles (*Chelonia mydas*) and flatback turtles (*Natator depressus*) at the Lacepede Islands, Western Australia. Journal of the Royal Society of Western Australia 94: 359–364.

Weller, D.R and Lee, C.V. 2017. Migratory shorebird conservation action plan. BirdLife Australia, unpublished report, September 2017.

Whiting, S.D. 2000. The foraging ecology of juvenile green and hawksbill sea turtles in north-western Australia. PhD thesis, Northern Territory University, Darwin, NT.

Whiting, A.U., Thomson, A., Chaloupka, M. and Limpus, C.J. 2008. Seasonality, abundance and breeding biology of one of the largest populations of nesting flatback turtles: Cape Domett. Western Australia. Australian Journal of Zoology 56: 297-303.

Whitty, J.M., Phillips, N.M., Morgan, D.L., Chaplin, J.A., Thorburn, D.C. and Peverell, S.C. 2008. Habitat associations of Freshwater Sawfish (*Pristis microdon*) and Northern River Sharks (*Glyphis garricki*): including genetic analysis of freshwater sawfish across northern Australia. Report to Australian Government, Department of the Environment, Water, Heritage and the Arts. Murdoch University Centre for Fish and Fisheries Research. Perth, Western Australia. 75 pp.

This document is protected by copyright. No part of this document may be reproduced, adapted, transmitted, or stored in any form by any process (electronic or otherwise) without the specific written consent of Woodside. All rights are reserved.

Wijeratne, S. Pattiaratchi, C. and Proctor, R. 2018. Estimates of surface and subsurface boundary current transport around Australia. Journal of Geophysical Research: Oceans 123: 3444-3466.

Williamson, P.C., Sumner, N.R. and Malseed, B.E. 2006. A 12-month survey of recreational fishing in the Pilbara region of Western Australia during 1999-2000, Fisheries Research Report No. 153, Department of Fisheries, Western Australia. 61 pp.

Wilson, B.R. 2013. The biogeography of the Australian North West Shelf: Environmental Change and Life's Response. Western Australian Museum, Perth, Australia. 415 pp.

Wilson, S., Carleton, J. and Meekan, M. 2003. Spatial and temporal patterns in the distribution and abundance of macrozooplankton on the southern North West Shelf, Western Australia. Estuarine, Coastal and Shelf Science 56: 897–908.

Wilson, S.K., Depczynski, M. and Fisher, R. 2010. Habitat associations of juvenile fish at Ningaloo Reef, Western Australia: the importance of coral and algae. PLoS ONE 5(12): e15185. https://doi.org/10.1371/journal.pone.0015185

Woodside 2012. Eastern Flank – Preliminary Metocean Design and Operating Criteria. Controlled reference number A9650RT7964290. Woodside Energy Limited, Perth, Western Australia.

Woodside 2016. Vincent – basic design data specification sheet – metocean (No. V0000ST9650826). Woodside Energy Limited, Perth, Western Australia.

Woodside 2019. Proposed Browse to NWS Project Draft EIS/ERD. EPA Assessment No. 2191, EPBC 2018/8319. December 2019. 1986 pp.

Woodside 2020. Scarborough Offshore Project Proposal, Revision 5 Submission, February 2020. Woodside Energy Ltd. 806 pp.

Wynen. L., Larson, H., Thorburn, D., Peverell, S., Morgan, D., Field, I. and Gibb, K. 2009. Mitochondrial DNA supports the identification of two endangered river sharks (*Glyphis glyphis* and *Glyphis garricki*) across northern Australia. Marine and Freshwater Research 60: 554–562.

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APPENDIX A. PROTECTED MATTER SEARCH REPORTS FOR NWMR, SWMR AND NMR

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Australian Government

Department of Agriculture, Water and the Environment

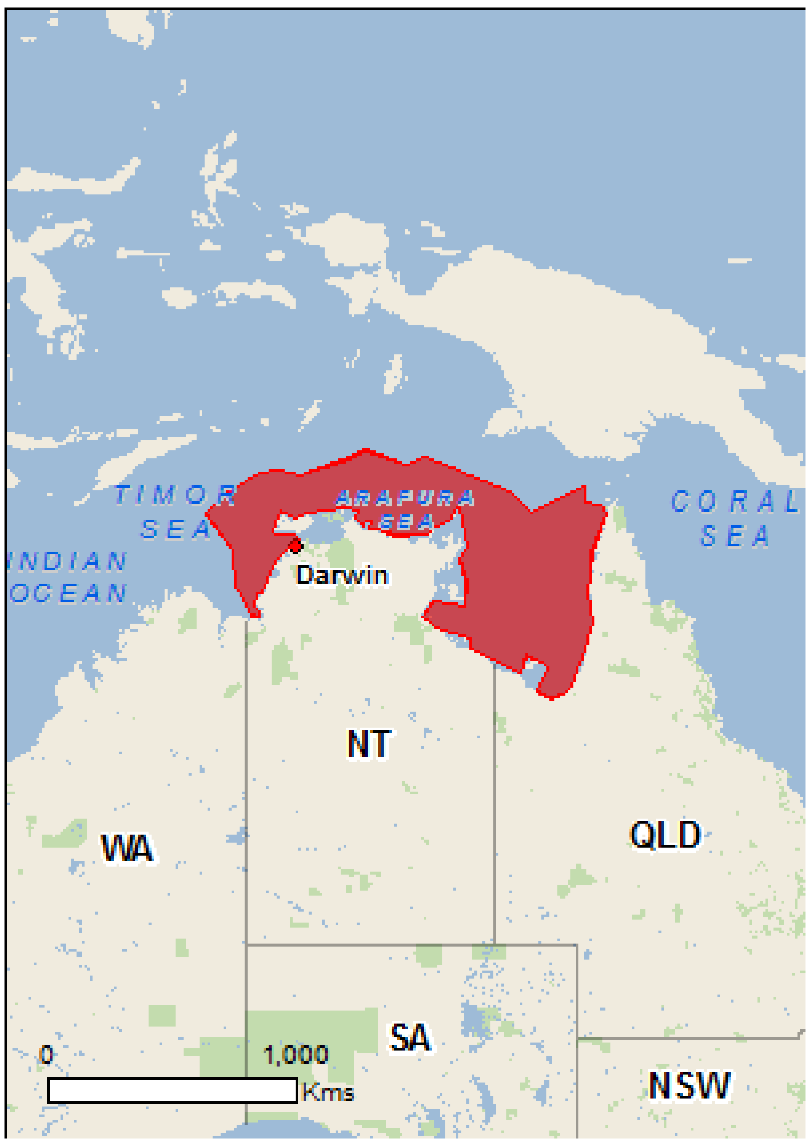
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

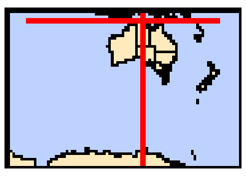
Report created: 10/05/21 12:59:15



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

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:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	33
Listed Migratory Species:	70

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:	127
Whales and Other Cetaceans:	25
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	15

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	1
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	8

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
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

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat may occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-	Vulnerable	Species or species

Name	Status	Type of Presence
tailed Godwit [86380]		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
Rostratula australis Australian Painted Snipe [77037]	Endangered	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
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Notomys aquilo Northern Hopping-mouse, Woorrentinta [123]	Endangered	Species or species habitat may occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat may occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Cryptoblepharus gurrmul Arafura Snake-eyed Skink [83106]	Endangered	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat known to occur within area
Glyphis glyphis Speartooth Shark [82453]	Critically Endangered	Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Foraging, feeding or related behaviour known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
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

Name	Threatened	Type of Presence
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
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Dugong dugon Dugong [28]		Species or species habitat 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
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat 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 likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding likely to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Foraging, feeding or related behaviour known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area

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
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding likely to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Stiltia isabella Australian Pratincole [818]		Species or species habitat known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area
Fish		

Name	Threatened	Type of Presence
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys haematopterus Reef-top Pipefish [66201]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys ocellatus Orange-spotted Pipefish, Ocellated Pipefish [66203]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Cosmocampus maxweberi Maxweber's Pipefish [66209]		Species or species habitat may occur within area
Doryrhamphus 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
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus macrorhynchus Whiskered Pipefish, Ornate Pipefish [66222]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area
Hippichthys parvicarinatus Short-keel Pipefish, Short-keeled Pipefish [66230]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippichthys spicifer Belly-barred Pipefish, Banded Freshwater Pipefish [66232]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Hippocampus zebra Zebra Seahorse [66241]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Micrognathus brevirostris thorntail Pipefish, Thorn-tailed Pipefish [66254]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Microphis brachyurus Short-tail Pipefish, Short-tailed River Pipefish [66257]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Congregation or aggregation known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area
Hydrophis caerulescens Dwarf Seasnake [1103]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis gracilis Slender Seasnake [1106]		Species or species habitat may occur within area
Hydrophis inornatus Plain Seasnake [1107]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis melanosoma Black-banded Robust Seasnake [1109]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Hydrophis pacificus Large-headed Seasnake, Pacific Seasnake [1112]		Species or species habitat may occur within area
Hydrophis vorisi a seasnake [25927]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Laticauda colubrina a sea krait [1092]		Species or species habitat may occur within area
Laticauda laticaudata a sea krait [1093]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Parahydrophis mertoni Northern Mangrove Seasnake [1090]		Species or species habitat may occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera 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

Name	Status	Type of Presence
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Arafura	Multiple Use Zone (IUCN VI)
Arafura	Special Purpose Zone (Trawl) (IUCN VI)
Arnhem	Special Purpose Zone (IUCN VI)
Gulf of Carpentaria	National Park Zone (IUCN II)
Gulf of Carpentaria	Special Purpose Zone (Trawl) (IUCN VI)
Joseph Bonaparte Gulf	Multiple Use Zone (IUCN VI)

Name	Label
Joseph Bonaparte Gulf	Special Purpose Zone (IUCN VI)
Limmen	Habitat Protection Zone (IUCN IV)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)
Wessel	Habitat Protection Zone (IUCN IV)
Wessel	Special Purpose Zone (Trawl) (IUCN VI)
West Cape York	Habitat Protection Zone (IUCN IV)
West Cape York	National Park Zone (IUCN II)
West Cape York	Special Purpose Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Anindilyakwa	NT
Marthakal	NT

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
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Southern Gulf Aggregation	QLD

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Carbonate bank and terrace system of the Van	North
Gulf of Carpentaria basin	North
Gulf of Carpentaria coastal zone	North
Pinnacles of the Bonaparte Basin	North
Plateaux and saddle north-west of the Wellesley	North
Shelf break and slope of the Arafura Shelf	North
Submerged coral reefs of the Gulf of Carpentaria	North
Tributary Canyons of the Arafura Depression	North

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-14.758882 129.178077,-13.960657 128.826514,-13.768665 128.606788,-12.484784 128.496924,-11.183724 127.563087,-10.460737 128.233253,-9.746889 129.518653,-9.660256 130.254737,-9.779371 130.935889,-9.280976 132.528907,-8.901286 133.385841,-9.411062 134.858008,-9.129149 135.473243,-10.363488 138.582374,-11.129831 139.395362,-10.190527 141.339942,-10.806262 141.317969,-10.817053 141.922217,-11.10827 142.087012,-12.527687 141.559669,-13.330764 141.515723,-13.960657 141.40586,-15.045535 141.570655,-15.945419 141.317969,-17.22994 140.823585,-17.513041 140.53794,-17.659661 140.032569,-17.429205 139.593116,-16.630864 139.966651,-16.409675 139.812842,-16.177683 139.208594,-16.820251 138.966895,-15.924291 137.165137,-15.575354 137.132178,-15.458909 136.934424,-15.289418 136.11045,-14.822615 135.45127,-14.269641 135.846778,-14.418655 136.97837,-13.608551 137.011329,-12.784952 136.780616,-12.388227 137.055274,-10.957305 136.76963,-10.957305 136.703712,-11.399198 136.407081,-11.679068 135.824805,-11.904912 135.616065,-11.947909 134.473487,-11.679068 133.869239,-11.700585 133.50669,-11.431505 133.528663,-11.442273 133.363868,-11.64679 133.254005,-11.313028 132.979346,-11.04358 133.067237,-10.90337 132.583839,-11.151389 131.221534,-11.3238 130.782081,-11.054363 130.287696,-11.474575 130.111915,-11.765126 129.958106,-11.947909 130.067969,-11.894162 130.760108,-12.119827 130.913917,-12.441874 130.474464,-12.870649 130.100928,-13.939333 129.584571,-13.971319 129.419776,-14.47185 129.28794,-14.631358 129.507667,-14.843856 129.452735,-14.769505 129.178077,-14.758882 129.178077

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 Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 10/05/21 13:07:00

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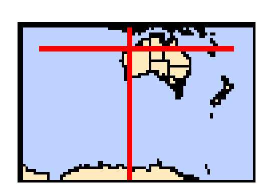
Coordinates

Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	2
National Heritage Places:	5
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	70
Listed Migratory Species:	84

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	1
Listed Marine Species:	149
Whales and Other Cetaceans:	34
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	17

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	10
Regional Forest Agreements:	None
Invasive Species:	23
Nationally Important Wetlands:	3
Key Ecological Features (Marine)	5

Details

Matters of National Environmental Significance

World Heritage Properties
[Resource Information]

Name	State	Status
Shark Bay, Western Australia	WA	Declared property
The Ningaloo Coast	WA	Declared property

National Heritage Properties
[Resource Information]

Name	State	Status
Natural		
Shark Bay, Western Australia	WA	Listed place
The Ningaloo Coast	WA	Listed place
The West Kimberley	WA	Listed place
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place
Historic		
Dirk Hartog Landing Site 1616 - Cape Inscription Area	WA	Listed place

Wetlands of International Importance (Ramsar)
[Resource Information]

Name	Proximity
Eighty-mile beach	Within Ramsar site
Ord river floodplain	Within 10km of Ramsar

Commonwealth Marine Area
[Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions
[Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Ecological Communities
[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Endangered	Community likely to occur within area

Listed Threatened Species
[Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Geophaps smithii blaauwi Partridge Pigeon (western) [66501]	Vulnerable	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Malurus leucopterus leucopterus White-winged Fairy-wren (Dirk Hartog Island), Dirk Hartog Black-and-White Fairy-wren [26004]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely 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 lesueur Burrowing Bettong (Shark Bay), Boodie [66659]	Vulnerable	Species or species habitat likely to occur within area
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat likely to occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat may occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Isoodon auratus auratus Golden Bandicoot (mainland) [66665]	Vulnerable	Species or species habitat likely to occur within area
Lagostrophus fasciatus fasciatus Banded Hare-wallaby, Merrnine, Marnine, Munning [66664]	Vulnerable	Translocated population known to occur within area
Leporillus conditor Wopilkara, Greater Stick-nest Rat [137]	Vulnerable	Translocated population known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat known to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
Perameles bougainville bougainville Western Barred Bandicoot (Shark Bay) [66631]	Endangered	Translocated population known to occur within area
Petrogale concinna monastria Nabarlek (Kimberley) [87607]	Endangered	Species or species habitat known to occur within area
Phascogale tapoatafa kimberleyensis Kimberley brush-tailed phascogale, Brush-tailed Phascogale (Kimberley) [88453]	Vulnerable	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat may occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat likely 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
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Lerista nevinae Nevin's Slider [85296]	Endangered	Species or species habitat known to occur within area
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Foraging, feeding or related behaviour likely to occur within area
Sterna dougallii Roseate Tern [817]		Breeding likely to occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat likely to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur

Name	Threatened	Type of Presence
		within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat 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 likely to occur within area
Migratory Wetlands Species		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Heritage Places		[Resource Information]
Name	State	Status
Natural		
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		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat may occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may 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
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Foraging, feeding or related behaviour likely to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Breeding known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding likely to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
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
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
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773]		Species or species habitat may occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis inornatus Plain Seasnake [1107]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	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

Name	Status	Type of Presence
		area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species

Name	Status	Type of Presence
		habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Abrolhos	Habitat Protection Zone (IUCN IV)
Abrolhos	Multiple Use Zone (IUCN VI)
Abrolhos	Special Purpose Zone (IUCN VI)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Dampier	Habitat Protection Zone (IUCN IV)
Dampier	Multiple Use Zone (IUCN VI)
Eighty Mile Beach	Multiple Use Zone (IUCN VI)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Joseph Bonaparte Gulf	Multiple Use Zone (IUCN VI)
Kimberley	Multiple Use Zone (IUCN VI)
Ningaloo	Recreational Use Zone (IUCN IV)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Roebuck	Multiple Use Zone (IUCN VI)
Shark Bay	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Bardi Jawi	WA
Dambimangari	WA
Dambimangari	WA
Dirk Hartog Island	WA
Faure Island	WA
Little Rocky Island	WA
Tent Island	WA
Unnamed WA36913	WA
Unnamed WA36915	WA
Uunguu	WA

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Jatropha gossypifolia		
Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat may occur within area
Lycium ferocissimum		
African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp.		
Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Tamarix aphylla		
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Exmouth Gulf East	WA
Hamelin Pool	WA
Shark Bay East	WA

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Carbonate bank and terrace system of the Sahul	North-west
Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west
Pinnacles of the Bonaparte Basin	North-west
Wallaby Saddle	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

-11.269933 127.440005,-12.516962 128.274966,-13.416271 128.362857,-13.854015 128.406802,-14.652617 128.879214,-14.833236 128.956119,-14.737633 128.439761,-14.280288 127.769595,-13.864681 127.385074,-13.864681 127.143375,-13.67261 126.934634,-13.875347 126.418277,-13.843348 126.242496,-13.896678 125.967837,-14.077907 125.934878,-14.34416 125.836001,-14.216398 125.649234,-14.461212 125.099918,-14.641988 125.044986,-14.88633 125.143863,-14.971254 124.990054,-15.257624 124.649478,-15.268222 124.231998,-15.416549 124.16608,-15.490673 124.407779,-16.293713 124.286929,-16.072142 123.616763,-16.219884 123.429996,-16.567693 123.408023,-16.778181 123.561832,-16.914874 123.704654,-17.114478 123.397037,-16.546631 123.034488,-16.251529 123.078433,-16.704537 122.540103,-17.135476 122.144595,-17.502564 122.056705,-18.244939 122.078677,-18.432649 121.738101,-18.76585 121.551334,-19.45099 121.100894,-19.999097 119.584781,-19.906155 119.101382,-20.236365 118.727847,-20.308506 118.112613,-20.648142 117.321597,-20.555589 116.948062,-20.360014 117.01398,-20.318809 116.816226,-20.802273 116.26691,-20.822812 116.113101,-21.468342 115.377017,-21.754335 114.629947,-22.344932 114.355289,-22.202601 114.146548,-21.67268 114.245425,-21.886924 113.849918,-22.669716 113.586246,-23.003846 113.751041,-23.458145 113.696109,-24.031352 113.300601,-24.51208 113.311587,-25.893759 114.135562,-26.258875 114.003726,-25.953045 113.926822,-25.398562 113.45441,-25.686027 113.366519,-26.249022 113.641177,-26.229314 113.509341,-25.378711 112.949039,-25.557248 112.839175,-26.485263 113.256656,-27.161748 113.816959,-27.571531 114.036685,-27.552052 113.113834,-27.151972 112.981998,-25.368784 112.278873,-26.022173 110.389224,-25.893759 110.323306,-25.804776 109.872867,-25.537424 109.587222,-25.626608 109.23566,-24.582033 109.389468,-23.306884 109.872867,-22.882439 110.026675,-21.621623 110.169498,-20.945986 110.510074,-20.030065 110.949527,-19.025706 112.092105,-17.816621 112.981998,-17.271909 113.773013,-16.935895 115.442935,-15.681156 116.014224,-14.790751 116.89313,-14.056594 118.266421,-13.266614 118.42023,-13.949995 120.046207,-13.234532 121.825992,-12.838516 122.529117,-12.15205 122.51813,-11.883411 122.726871,-11.786636 123.067447,-11.926411 123.440982,-12.248693 123.583804,-11.63603 125.737125,-11.334573 126.539126,-11.280707 127.440005,-11.269933 127.440005

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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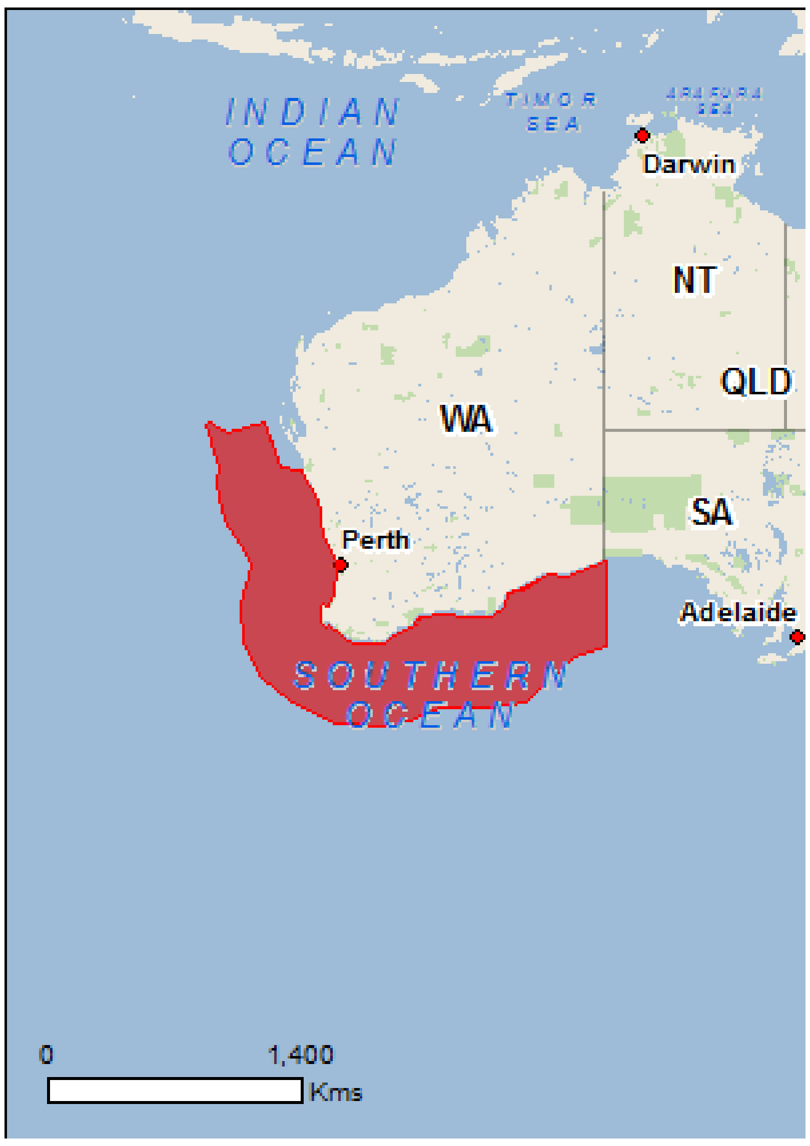
EPBC Act Protected Matters Report

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: 10/05/21 12:51:00



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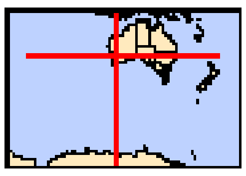
Coordinates

Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	65
Listed Migratory Species:	67

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:	1
Listed Marine Species:	106
Whales and Other Cetaceans:	40
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	21

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	10
Regional Forest Agreements:	None
Invasive Species:	42
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	8

Details

Matters of National Environmental Significance

National Heritage Properties [Resource Information]

Name	State	Status
Indigenous		
Cheetup Rock Shelter	WA	Listed place

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Becher point wetlands	Within 10km of Ramsar
Forrestdale and thomsons lakes	Within 10km of Ramsar
Peel-yalgorup system	Within 10km of Ramsar
Vasse-wonnerup system	Within 10km of Ramsar

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
South-west

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community may occur within area
Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia	Endangered	Community may occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Atrichornis clamosus		
Noisy Scrub-bird, Tjimiluk [654]	Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Cereopsis novaehollandiae grisea Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]	Vulnerable	Breeding known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel	Endangered	Species or species

Name	Status	Type of Presence
[1060]		habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Pezoporus flaviventris Western Ground Parrot, Kyloring [84650]	Critically Endangered	Species or species habitat likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
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 penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Breeding known to occur within area
Parantechinus apicalis Dibbler [313]	Endangered	Species or species habitat known to occur within area
Petrogale lateralis hacketti Recherche Rock-wallaby [66849]	Vulnerable	Species or species habitat known to occur within area
Potorous gilbertii Gilbert's Potoroo, Ngilkat [66642]	Critically Endangered	Translocated population known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat may occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat known to occur within area
Plants		
Caladenia elegans Elegant Spider-orchid [56775]	Endangered	Species or species habitat may occur within area
Caladenia granitora [65292]	Endangered	Species or species habitat may occur within area
Caladenia hoffmanii Hoffman's Spider-orchid [56719]	Endangered	Species or species habitat may occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Drummondita ericoides Morseby Range Drummondita [9193]	Endangered	Species or species habitat likely to occur within area
Eucalyptus insularis Twin Peak Island Mallee [3057]	Endangered	Species or species habitat likely to occur within area
Isopogon uncinatus Albany Cone Bush, Hook-leaf Isopogon [20871]	Endangered	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Name	Status	Type of Presence
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Egernia stokesii badia		
Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat may occur within area
Liopholis pulchra longicauda		
Jurien Bay Skink, Jurien Bay Rock-skink [83162]	Vulnerable	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (west coast population)		
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Breeding known to occur within area
Ardenna grisea		
Sooty Shearwater [82651]		Species or species habitat may occur within area
Ardenna pacifica		
Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Ardenna tenuirostris		
Short-tailed Shearwater [82652]		Breeding known to occur within area
Diomedea amsterdamensis		
Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena		
Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora		
Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
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
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Breeding known to occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
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
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
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	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Foraging, feeding or related behaviour known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		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
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to 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 likely to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		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 - HMAS STIRLING-ROCKINGHAM ;HMAS STIRLING - GARDEN ISLAND

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Garden Island	WA	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris alba Sanderling [875]		Species or species

Name	Threatened	Type of Presence
		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 likely to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Cereopsis novaehollandiae grisea Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]	Vulnerable	Breeding known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area

Name	Threatened	Type of Presence
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Breeding known to occur within area
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
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pelagodroma marina White-faced Storm-Petrel [1016]		Breeding known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Breeding known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		to occur within area
Puffinus assimilis Little Shearwater [59363]		Breeding known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Breeding known to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat may occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Puffinus tenuirostris Short-tailed Shearwater [1029]		Breeding known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		

Name	Threatened	Type of Presence
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Breeding known to occur within area
Reptiles		
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
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known 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
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans

[Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera 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
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Hyperoodon planifrons Southern Bottlenose Whale [71]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Foraging, feeding or related behaviour known to occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tasmacetus shepherdi Shepherd's Beaked Whale, Tasman Beaked Whale [55]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Abrolhos	Habitat Protection Zone (IUCN IV)
Abrolhos	Multiple Use Zone (IUCN VI)
Abrolhos	Special Purpose Zone (IUCN VI)
Bremer	National Park Zone (IUCN II)
Bremer	Special Purpose Zone (Mining
Eastern Recherche	National Park Zone (IUCN II)
Eastern Recherche	Special Purpose Zone (IUCN VI)
Geographe	Habitat Protection Zone (IUCN IV)
Geographe	Multiple Use Zone (IUCN VI)
Geographe	National Park Zone (IUCN II)
Geographe	Special Purpose Zone (Mining
Great Australian Bight	Special Purpose Zone (Mining
Jurien	Special Purpose Zone (IUCN VI)
South-west Corner	Habitat Protection Zone (IUCN IV)
South-west Corner	Multiple Use Zone (IUCN VI)
South-west Corner	National Park Zone (IUCN II)
South-west Corner	Special Purpose Zone (IUCN VI)
South-west Corner	Special Purpose Zone (Mining
Twilight	National Park Zone (IUCN II)
Twilight	Special Purpose Zone (Mining
Two Rocks	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Bald Island	WA
Boullanger, Whitlock, Favourite, Tern And Osprey Islands	WA
Eclipse Island	WA
Escape Island	WA
Flinders Bay	WA
Penguin Island	WA
Recherche Archipelago	WA
St Alouarn Island	WA
Unnamed WA44682	WA
Unnamed WA48968	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Canis lupus familiaris		
Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer		
Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii		
Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus		
House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus		
Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus		
Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia		
Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus		
Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides		
Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus		
Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica		
Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris		
Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera		
Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera		
Boneseed [16905]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

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 90-120m depth	South-west
Commonwealth marine environment surrounding	South-west
Commonwealth marine environment within and	South-west
Commonwealth marine environment within and	South-west
Diamantina Fracture Zone	South-west
Naturaliste Plateau	South-west
Western demersal slope and associated fish	South-west
Western rock lobster	South-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-25.765206 109.237891,-25.725623 109.501563,-25.992551 109.732276,-25.992551 109.875098,-26.071525 110.182716,-26.229314 110.325538,-25.656321 112.127296,-27.717513 112.984229,-27.814726 114.02793,-28.202708 114.159766,-28.483117 114.445411,-28.695347 114.577247,-28.974447 114.599219,-29.147305 114.818946,-29.530391 114.950782,-29.921554 114.89585,-30.746498 115.082618,-31.517621 115.533057,-31.863505 115.730811,-32.523601 115.67588,-32.634692 115.544044,-33.16049 115.620948,-33.619137 115.302344,-33.49096 114.994727,-33.737988 114.928809,-34.275319 114.972755,-34.46575 115.126563,-34.366055 115.269385,-34.818257 115.917579,-34.908402 116.060401,-35.106373 116.598731,-35.11536 117.389747,-35.169263 117.774268,-35.169263 118.081885,-34.980447 118.312598,-34.402321 119.663917,-34.30255 119.56504,-34.029844 119.883643,-33.938746 120.960303,-33.911398 121.399757,-34.011632 121.949073,-34.102652 122.476417,-34.038948 123.432227,-33.591687 124.091407,-33.10529 124.212257,-32.902593 125.014258,-32.319576 126.134864,-32.375265 127.123633,-31.760809 129.035255,-35.294897 129.068214,-35.634921 127.541114,-37.453004 125.157081,-37.696807 123.058692,-37.688114 120.817481,-38.46644 118.664161,-38.337294 115.697852,-37.418109 113.368751,-36.584603 112.028419,-34.998448 111.061622,-33.545916 110.973731,-31.984725 111.512061,-31.414542 111.270362,-30.026241 110.182716,-28.396173 109.798194,-27.756409 109.875098,-25.765206 109.237891,-25.765206 109.237891

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX B. SUPPORTING FIGURES FOR SECTION 2.3 METEOROLOGY AND OCEANOGRAPHY

Browse

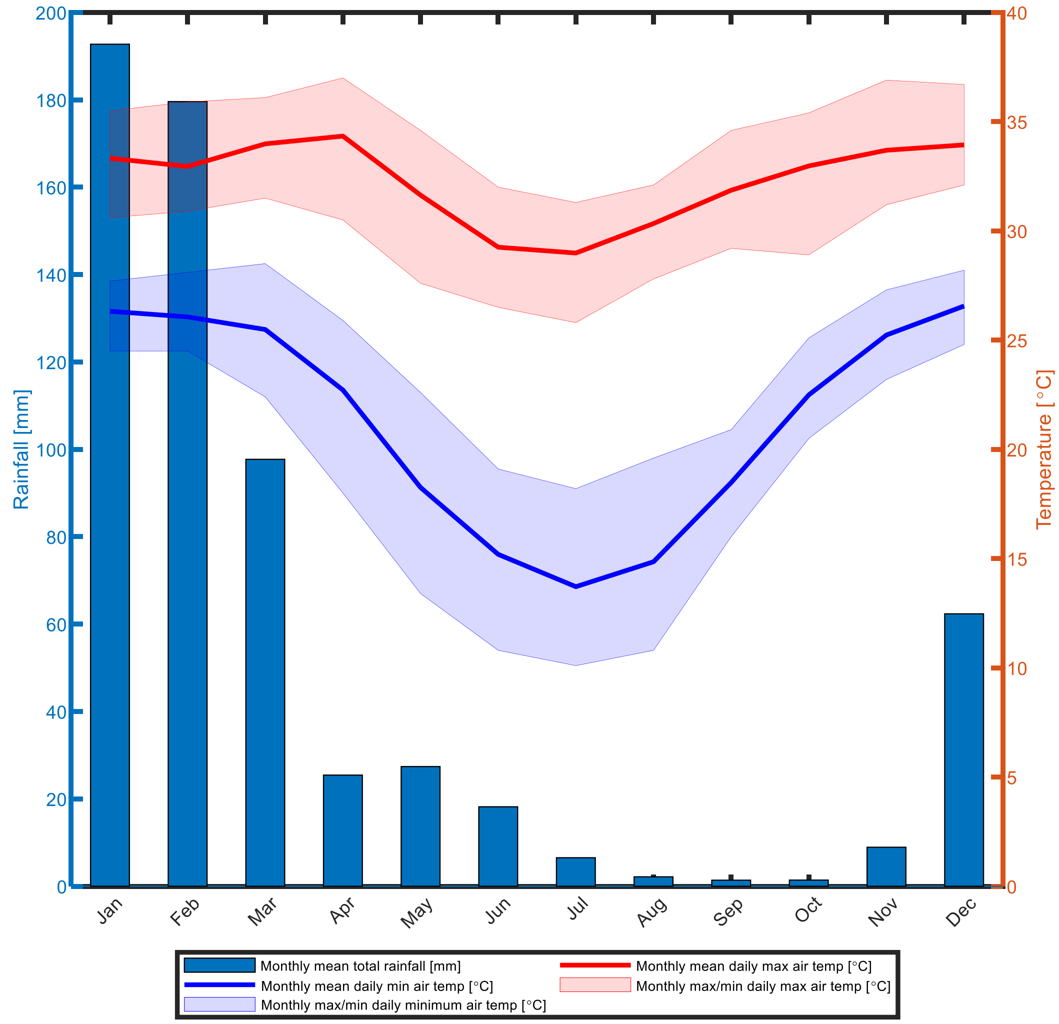

Figure 1. Monthly average total rainfall [mm] and air temperature [°C], calculated based on observations at the Broome Airport weather station from 1939-2020 (Bureau of Meteorology 2020). Bars show the monthly average total rainfall values, and thick blue and red lines denote monthly average daily minimum and maximum air temperatures, respectively. Shaded blue and red areas denote monthly recorded extremes of daily minimum and maximum air temperature, respectively.

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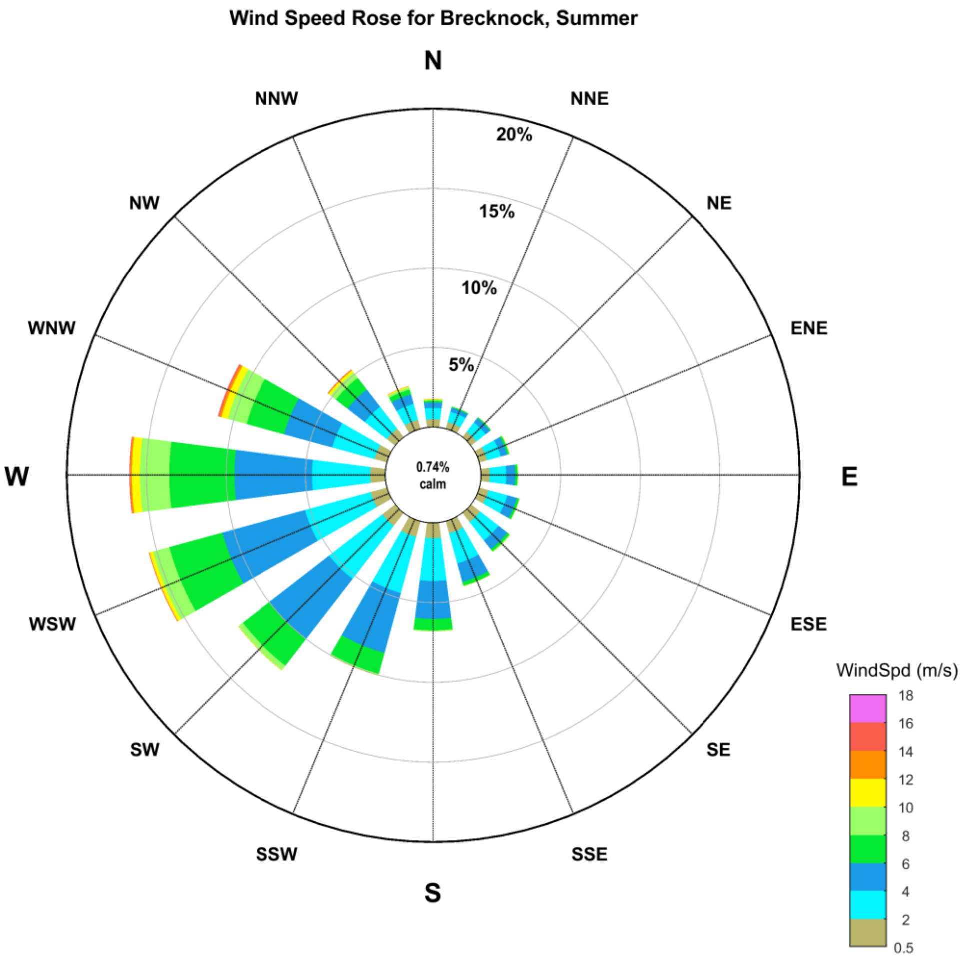

Data Information:
Project: Browse
Location: Brecknock [121.6500°E, 14.5300°S]
Data Period: Summer (01-Jan-1979 to 01-Jan-2019)
Data Source: Modelled Hindcast
Record Elevation: 10 m AMSL
Local Water Depth (m): 560
Data Summary: Summer
Number of Records: 164812
Missing Data (%): 5.80
Calm (% < 0.50m/s): 0.74
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 20.60 m/s
Mean Wind Speed: 4.55 m/s
StdDev. Wind Speed: 2.31 m/s

Woodside

Figure 2. Summer distributions of 10-minute average wind speeds by 22.5° directional sectors at the Brecknock site (Metocean Solutions Ltd, 2019). Note tropical cyclone events were not included in this distribution. Winds at Brecknock in summer are predominantly from the WNW to SW due to the North West Monsoon (WEL, 2019).

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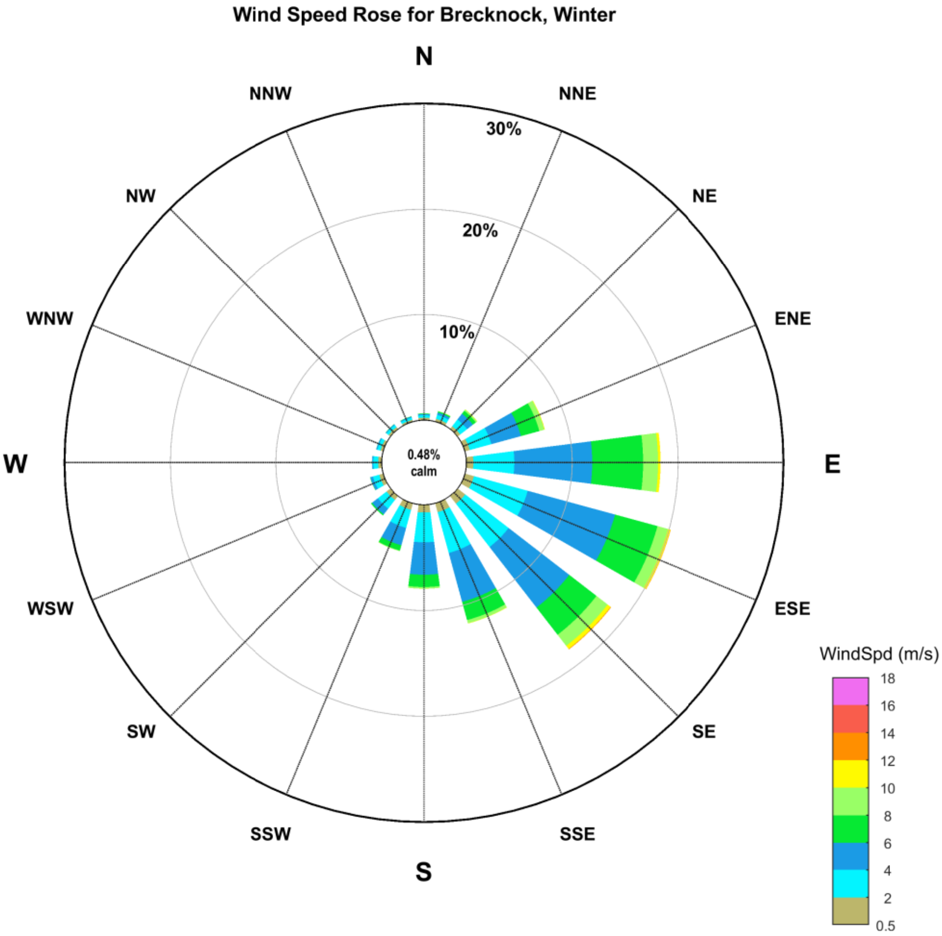

Data Information:
Project: Browse
Location: Brecknock [121.6500°E, 14.5300°S]
Data Period: Winter (01-Apr-1979 to 30-Sep-2018)
Data Source: Modelled Hindcast
Record Elevation: 10 m AMSL
Local Water Depth (m): 560
Data Summary: Winter
Number of Records: 173751
Missing Data (%): 1.10
Calm (% < 0.50m/s): 0.48
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 14.34 m/s
Mean Wind Speed: 4.71 m/s
StdDev. Wind Speed: 2.01 m/s

Woodside

Figure 3. Winter distributions of 10-minute average wind speeds by 22.5° directional sectors at the Brecknock site (Metocean Solutions Ltd, 2019). Note tropical cyclone events were not included in this distribution. Winds at Brecknock in winter are predominantly from the E to SE due to the South East Trade Winds coming from the Australian mainland (WEL, 2019).

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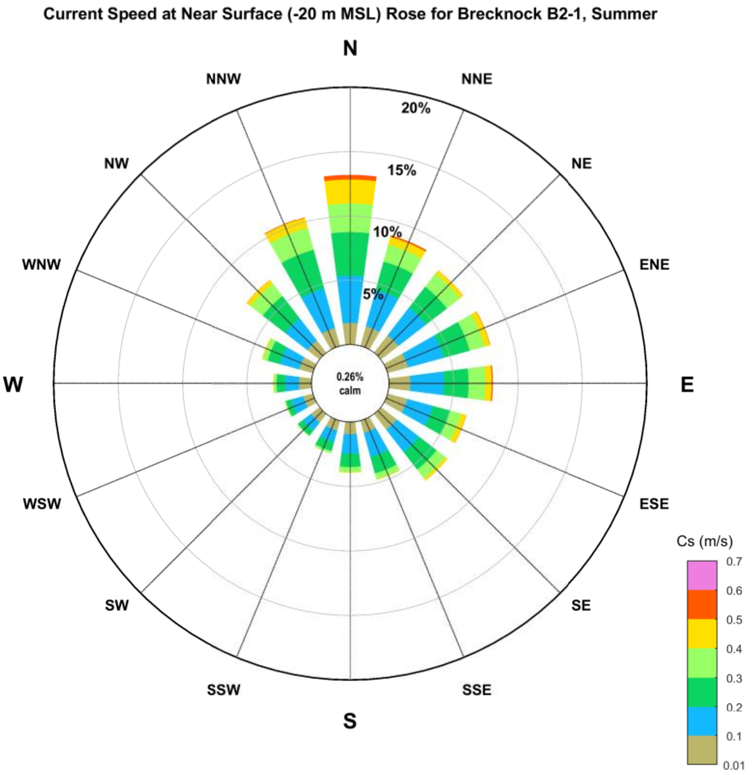

Data Information:
Project: Browse
Location: Brecknock B2-1 [121.5700°E, 14.5100°S]
Data Period: Summer (01-Oct-2006 to 31-Mar-2007)
Data Source: CM04 Measured
Record Elevation: Near Surface (-20 m MSL)
Local Water Depth (m): 560
Data Summary: Summer
Number of Records: 243472
Missing Data (%): 7.10
Calm (% < 0.01m/s): 0.26

Key Statistics for Data Shown:
Max Curr Spd: 0.63 m/s
Mean Curr Spd: 0.20 m/s
StdDev. Curr Spd: 0.11 m/s

Woodside

Figure 4. Summer (Nov-Apr) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at Brecknock B2-1 location (cyclones removed) (RPS Metocean Ltd. 2008).

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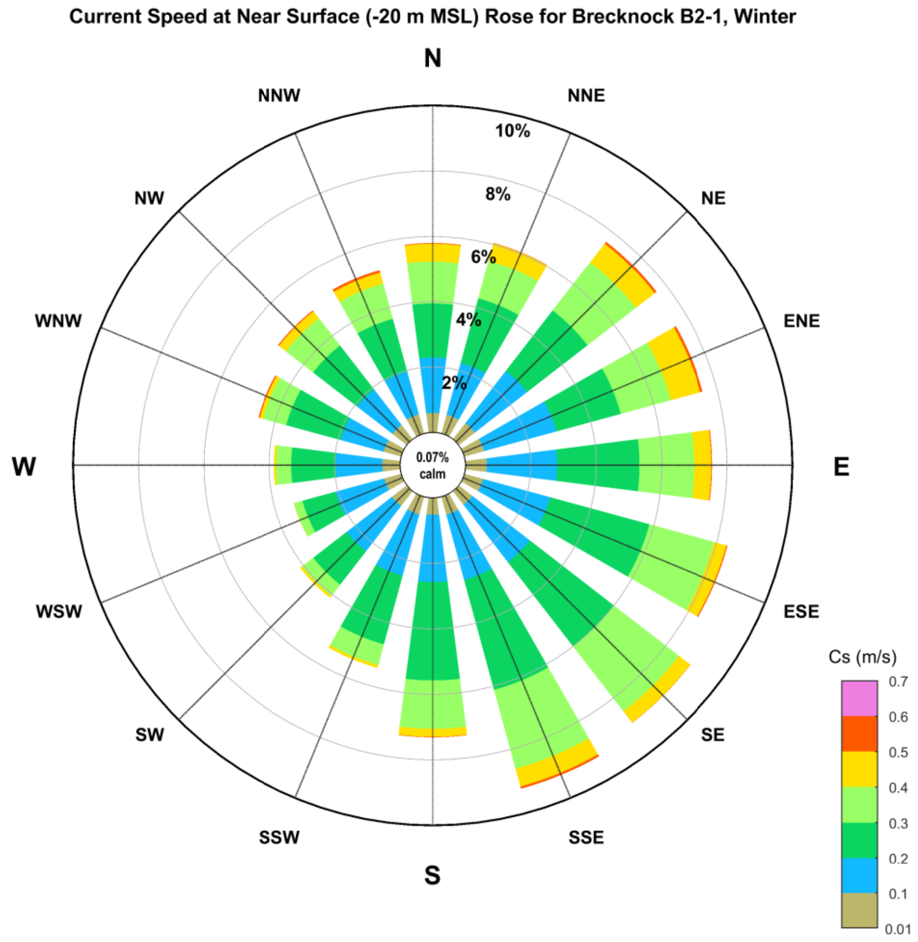

Data Information:
Project: Browse
Location: Brecknock B2-1 [121.5700°E, 14.5100°S]
Data Period: Winter (17-Sep-2006 to 08-Sep-2007)
Data Source: CM04 Measured
Record Elevation: Near Surface (-20 m MSL)
Local Water Depth (m): 560
Data Summary: Winter
Number of Records: 246184
Missing Data (%): 1.46
Calm (% < 0.01m/s): 0.07

Key Statistics for Data Shown:
Max Curr Spd: 0.62 m/s
Mean Curr Spd: 0.24 m/s
StdDev. Curr Spd: 0.10 m/s

Woodside

Figure 5. Winter (May-Sep) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at Brecknock B2-1 location (cyclones removed) (RPS Metocean Ltd. 2008).

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North-west Shelf/Scarborough

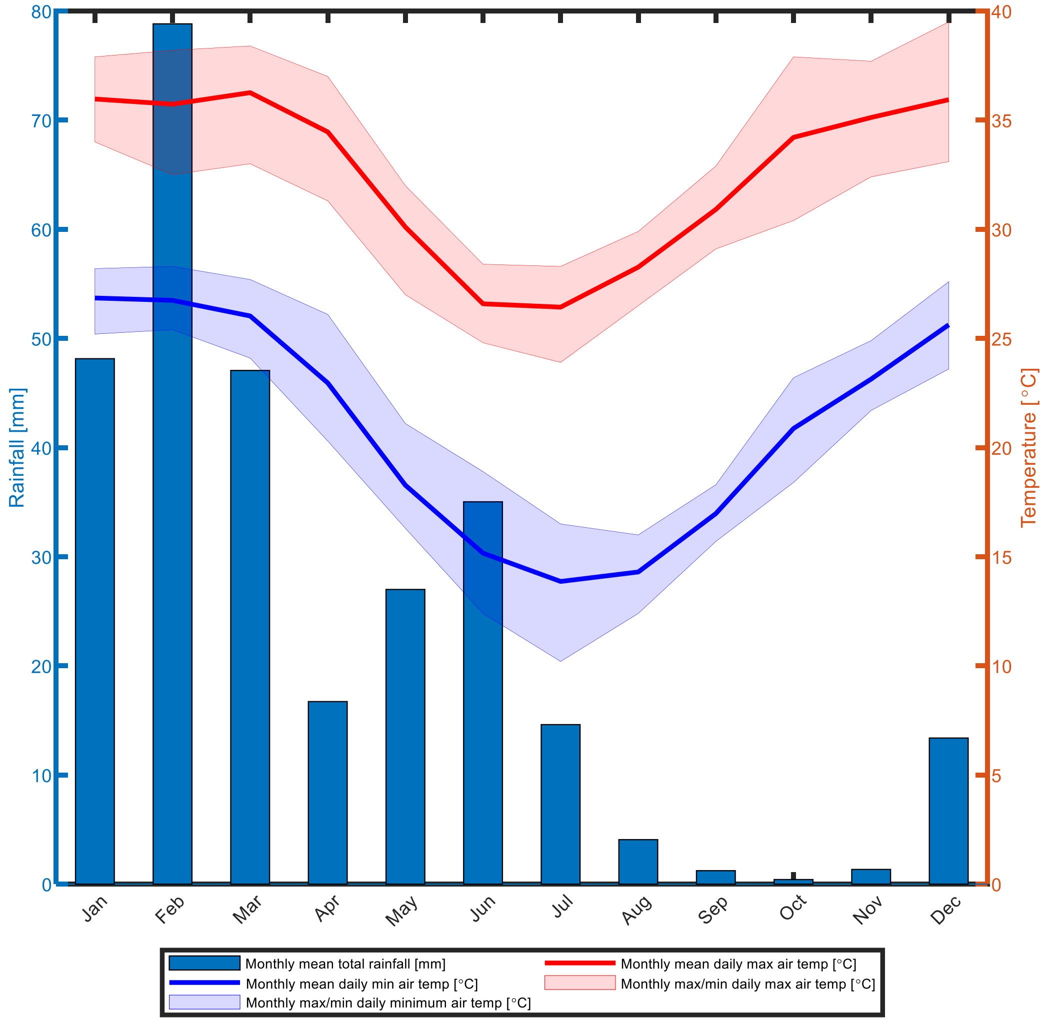

Figure 1. Monthly average total rainfall [mm] and air temperature [°C], calculated based on observations at the Karratha Aero weather station from 1972-2020 and 1993-2020 respectively (Bureau of Meteorology 2020). Bars show the monthly average total rainfall values, and thick blue and red lines denote monthly average daily minimum and maximum air temperatures, respectively. Shaded blue and red areas denote monthly recorded extremes of daily minimum and maximum air temperature, respectively.

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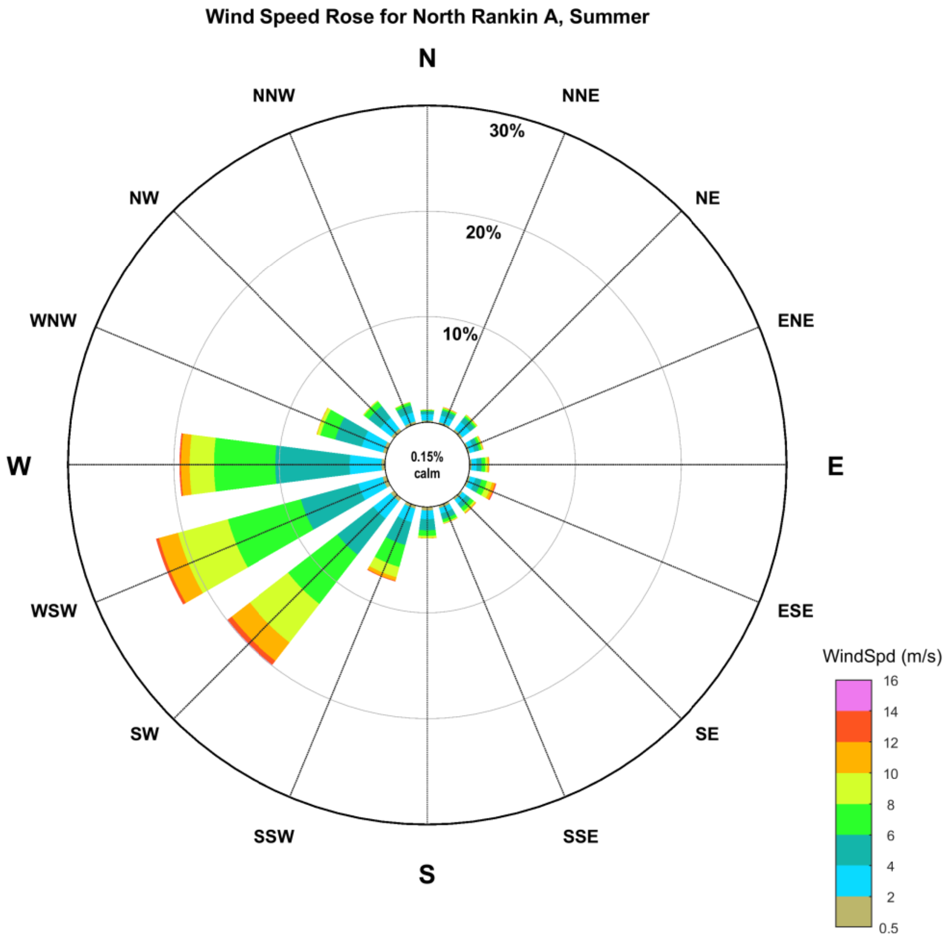

Data Information:
Project: North West Shelf
Location: North Rankin A [116.1200°E, 19.6100°S]
Data Period: Summer (01-Oct-1995 to 30-Nov-2015)
Data Source: Measured Winds
Record Elevation: 10 m AMSL
Local Water Depth (m): 125
Data Summary: Summer
Number of Records: 674659
Missing Data (%): 7.24
Calm (% < 0.50m/s): 0.15
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 18.50 m/s
Mean Wind Speed: 6.04 m/s
StdDev. Wind Speed: 2.55 m/s

Figure 2. Summer distributions of 10-minute average wind speeds by 22.5° directional sectors at the North Rankin A site (WEL, 2015). Note tropical cyclone events were not included in this distribution. Winds at North Rankin A in summer are characterised by W to SW driven by the North West Monsoon (RPS, 2016).

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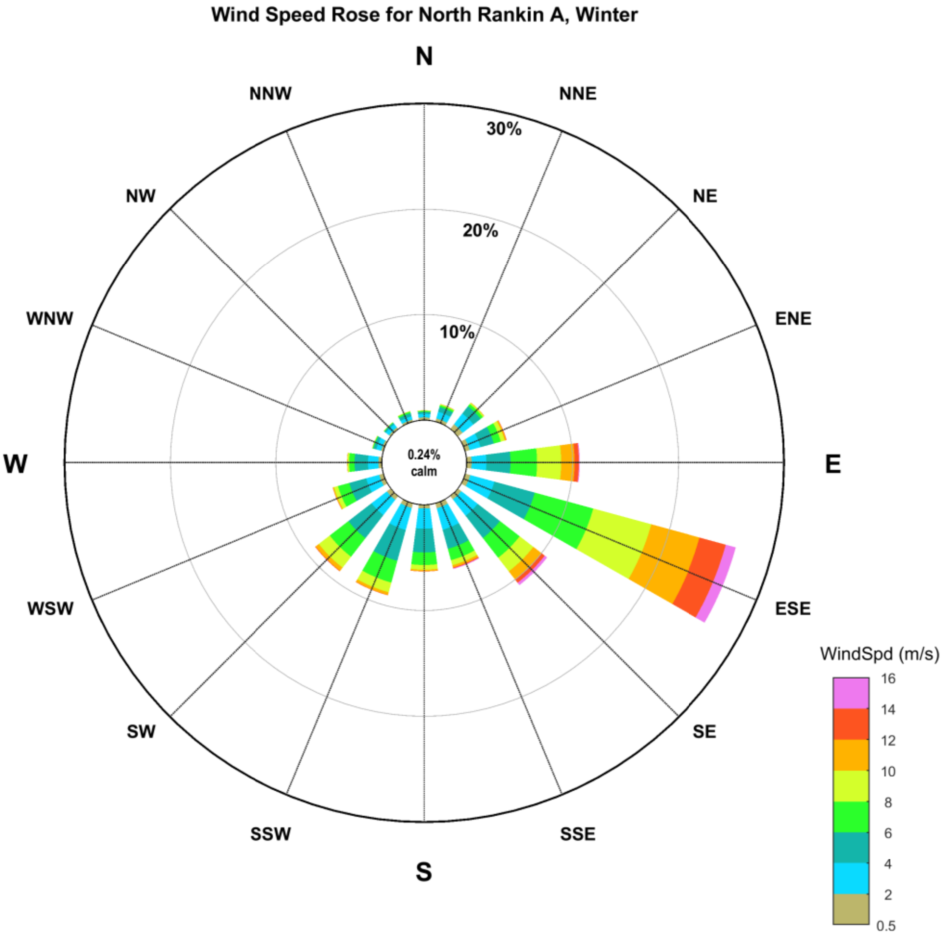

Data Information:
Project: North West Shelf
Location: North Rankin A [116.1200°E, 19.6100°S]
Data Period: Winter (22-Jun-1995 to 30-Sep-2015)
Data Source: Measured Winds
Record Elevation: 10 m AMSL
Local Water Depth (m): 125
Data Summary: Winter
Number of Records: 673213
Missing Data (%): 4.43
Calm (% < 0.50m/s): 0.24
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 24.23 m/s
Mean Wind Speed: 6.25 m/s
StdDev. Wind Speed: 3.16 m/s

Woodside

Figure 3. Winter distributions of 10-minute average wind speeds by 22.5° directional sectors at the North Rankin A site (WEL, 2015). Note tropical cyclone events were not included in this distribution. Winds at North Rankin in winter are predominantly influenced by the South East Trade Winds over Australia (RPS, 2016).

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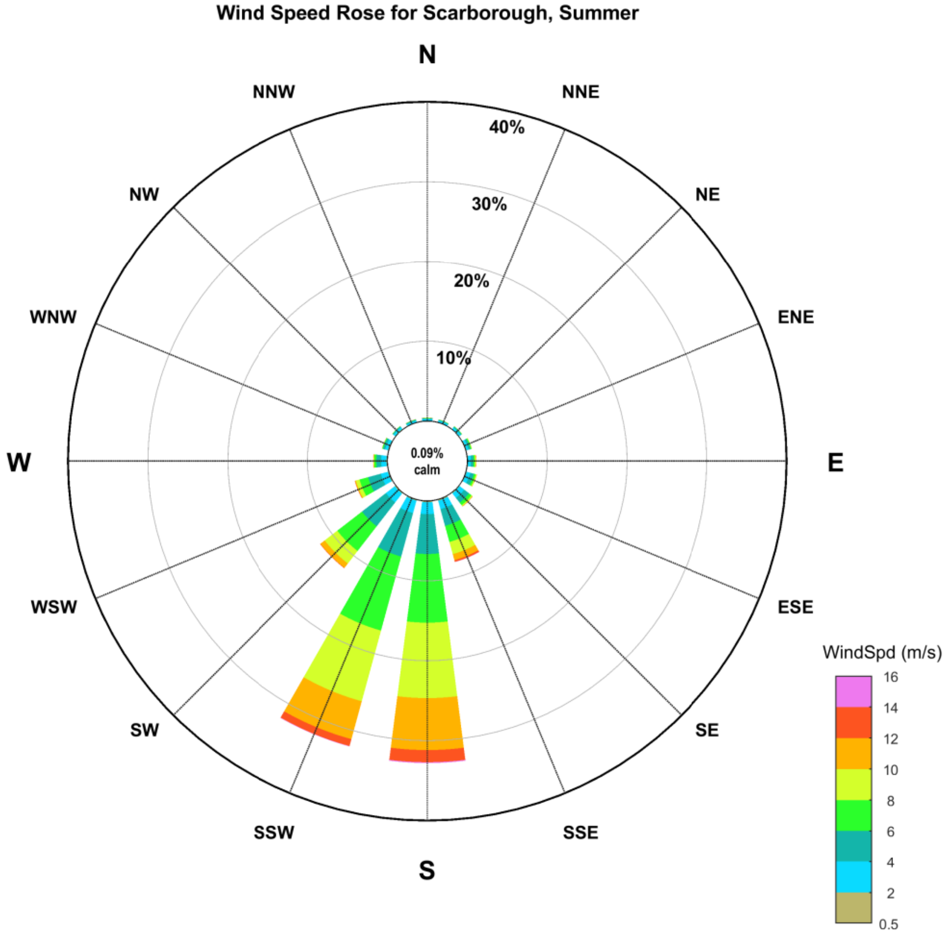
Scarborough



Data Information:
Project: North West Shelf
Location: Scarborough [113.2000°E, 19.8800°S]
Data Period: Summer (01-Jan-1979 to 01-Jan-2011)
Data Source: CSFR
Record Elevation: 10 m AMSL
Local Water Depth (m): 950
Data Summary: Summer
Number of Records: 129521
Missing Data (%): 7.46
Calm (% < 0.50m/s): 0.09
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 16.75 m/s
Mean Wind Speed: 7.23 m/s
StdDev. Wind Speed: 2.64 m/s

Woodside

Figure 4. Summer distributions of wind speeds (10-minute at 10m ASL) by 22.5° directional sectors at the Scarborough site (WEL, 2018). Note tropical cyclone events were not included in this distribution. Winds at Scarborough in summer are predominantly from the S to SSW due to a Pilbara Heat Low forming over the northwest coast of Western Australia [R8] SW winds are also experienced at this site due to the monsoon trough.

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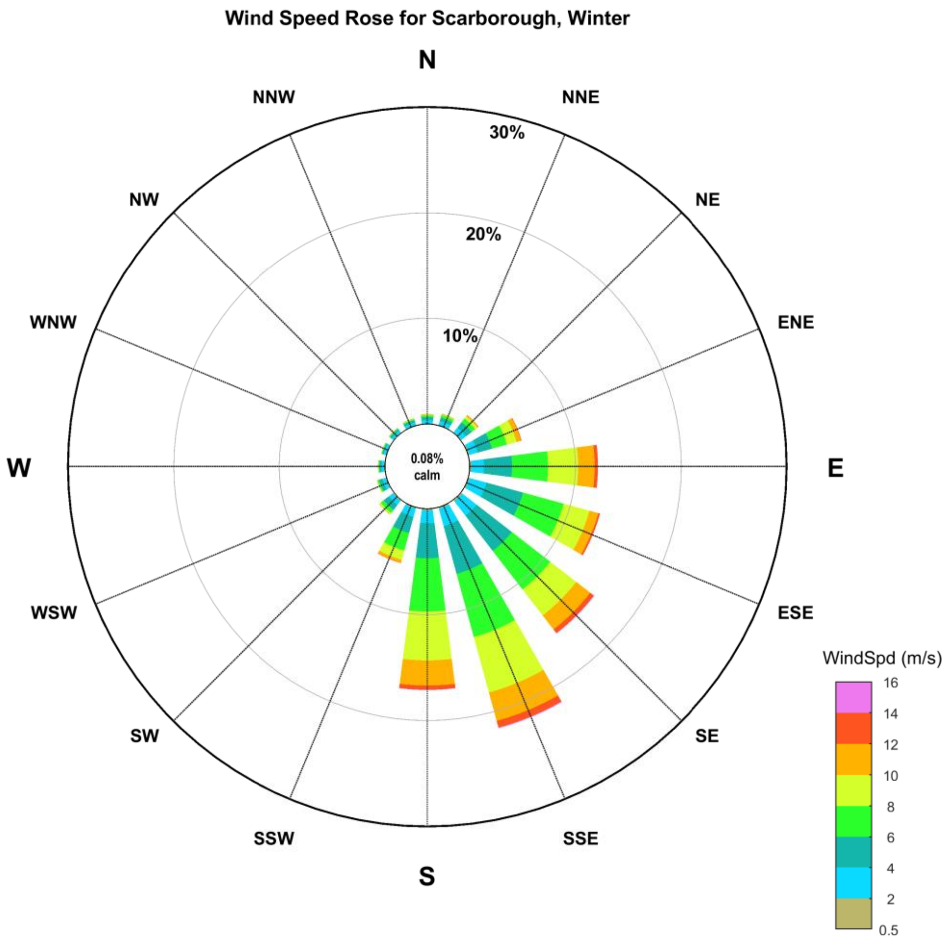

Data Information:
Project: North West Shelf
Location: Scarborough [113.2000°E, 19.8800°S]
Data Period: Winter (01-Apr-1979 to 30-Sep-2010)
Data Source: CSFR
Record Elevation: 10 m AMSL
Local Water Depth (m): 950
Data Summary: Winter
Number of Records: 138863
Missing Data (%): 1.20
Calm (% < 0.50m/s): 0.08
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 19.15 m/s
Mean Wind Speed: 6.90 m/s
StdDev. Wind Speed: 2.57 m/s

Figure 5. Winter distributions of wind speeds (10-minute at 10 m ASL) by 22.5° directional sectors at the Scarborough site (WEL, 2018). Note tropical cyclone events were not included in this distribution. Winds at Scarborough in winter are predominantly from the S to E driven by the South East Trade Winds over Australia (RPS, 2016).

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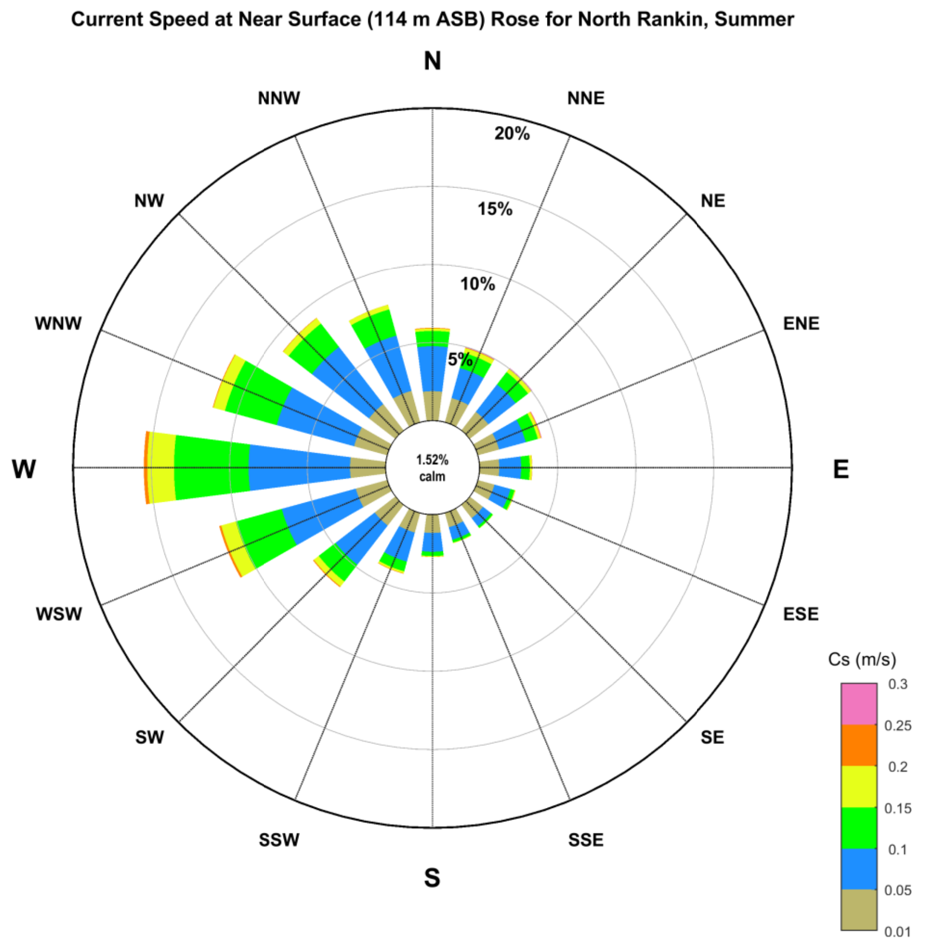
North-west Shelf



Data Information:
Project: North West Shelf
Location: North Rankin [116.1400°E, 19.5800°S]
Data Period: Summer (01-Oct-2004 to 31-Mar-2009)
Data Source: Measured Data
Record Elevation: Near Surface (114 m ASB)
Local Water Depth (m): 124.5
Data Summary: Summer
Number of Records: 496705
Missing Data (%): 6.63
Calm (% < 0.01m/s): 1.52

Key Statistics for Data Shown:
Max Curr Spd: 0.49 m/s
Mean Curr Spd: 0.08 m/s
StdDev. Curr Spd: 0.04 m/s

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Figure 6. Summer (Nov-Apr) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at the North Rankin location (cyclones removed) (WEL, 2011).

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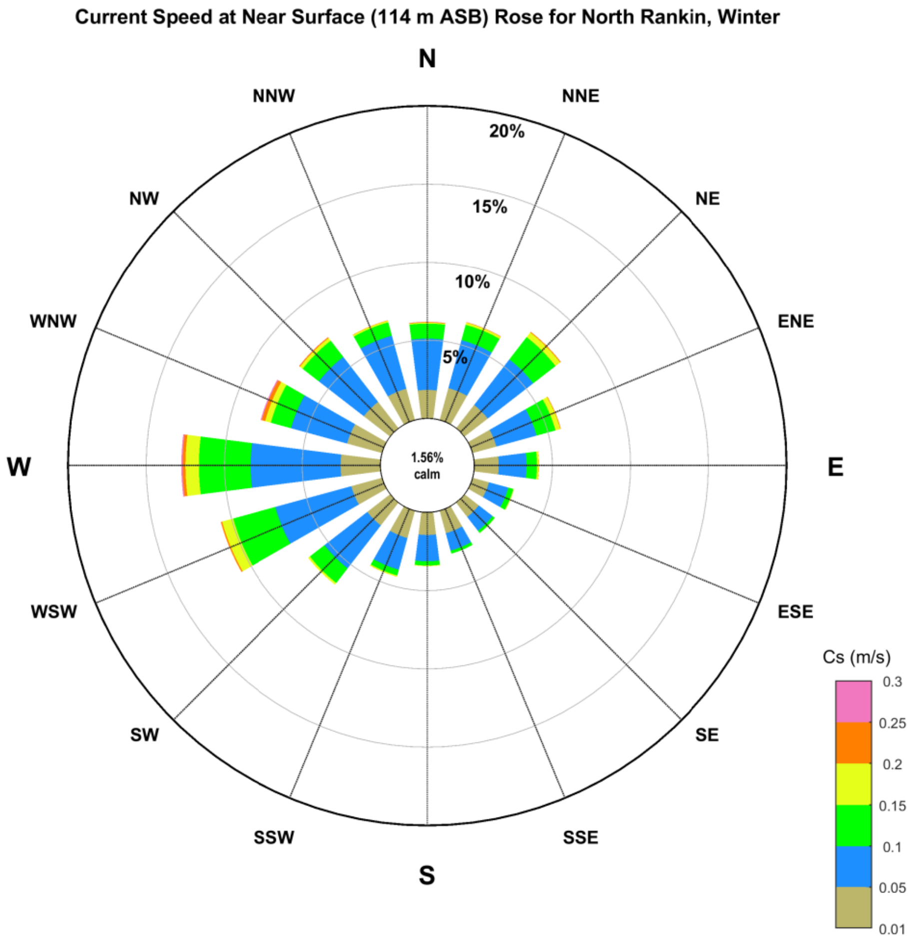

Data Information:
Project: North West Shelf
Location: North Rankin [116.1400°E, 19.5800°S]
Data Period: Winter (21-Sep-2004 to 08-May-2009)
Data Source: Measured Data
Record Elevation: Near Surface (114 m ASB)
Local Water Depth (m): 124.5
Data Summary: Winter
Number of Records: 337723
Missing Data (%): 0.88
Calm (% < 0.01m/s): 1.56

Key Statistics for Data Shown:
Max Curr Spd: 0.32 m/s
Mean Curr Spd: 0.07 m/s
StdDev. Curr Spd: 0.04 m/s

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Figure 7. Winter (May-Sep) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at the North Rankin location (cyclones removed) (WEL, 2011).

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Scarborough

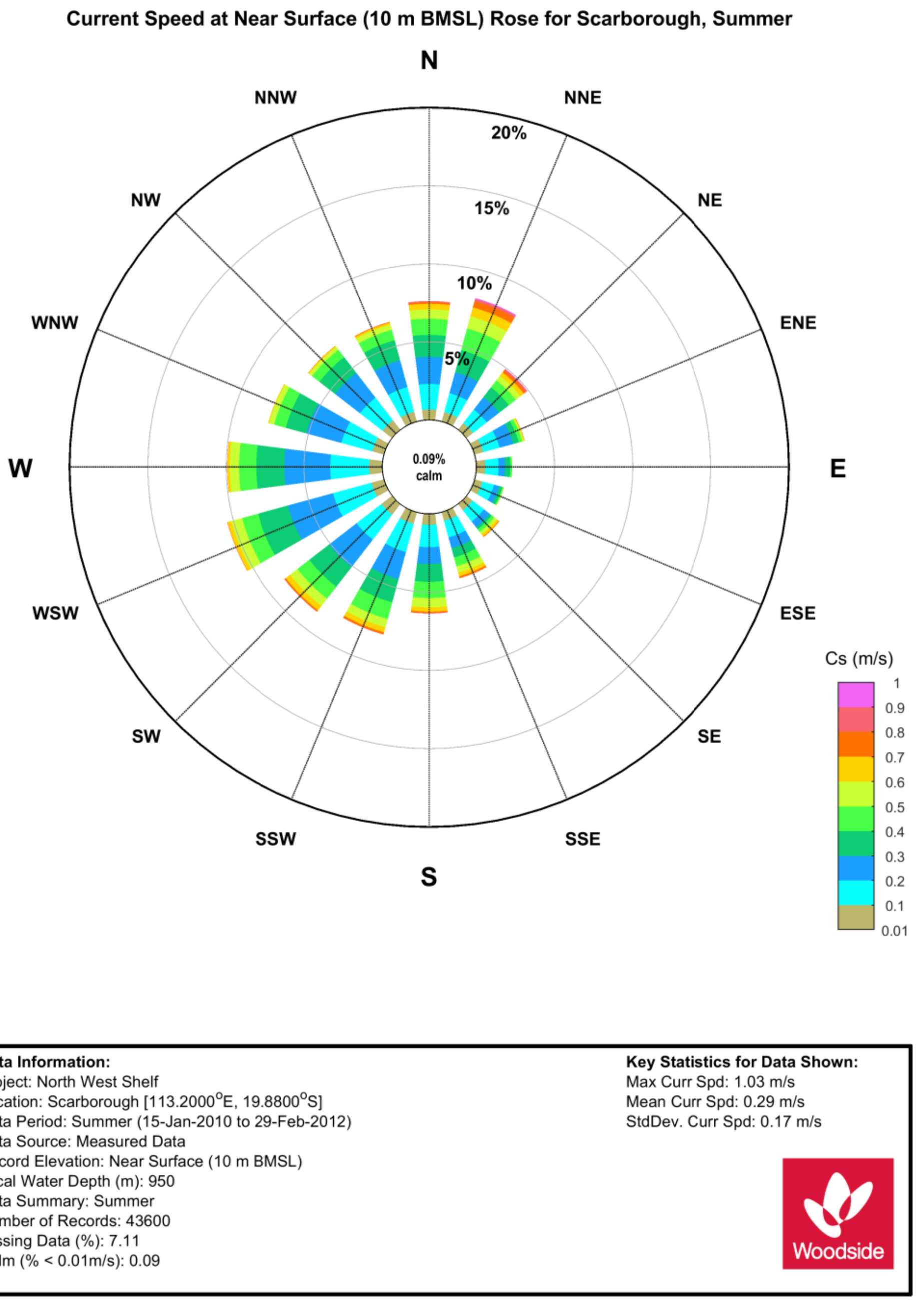

Figure 8. Summer (Nov - April) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at the Scarborough location (cyclones removed) (WEL, 2018).

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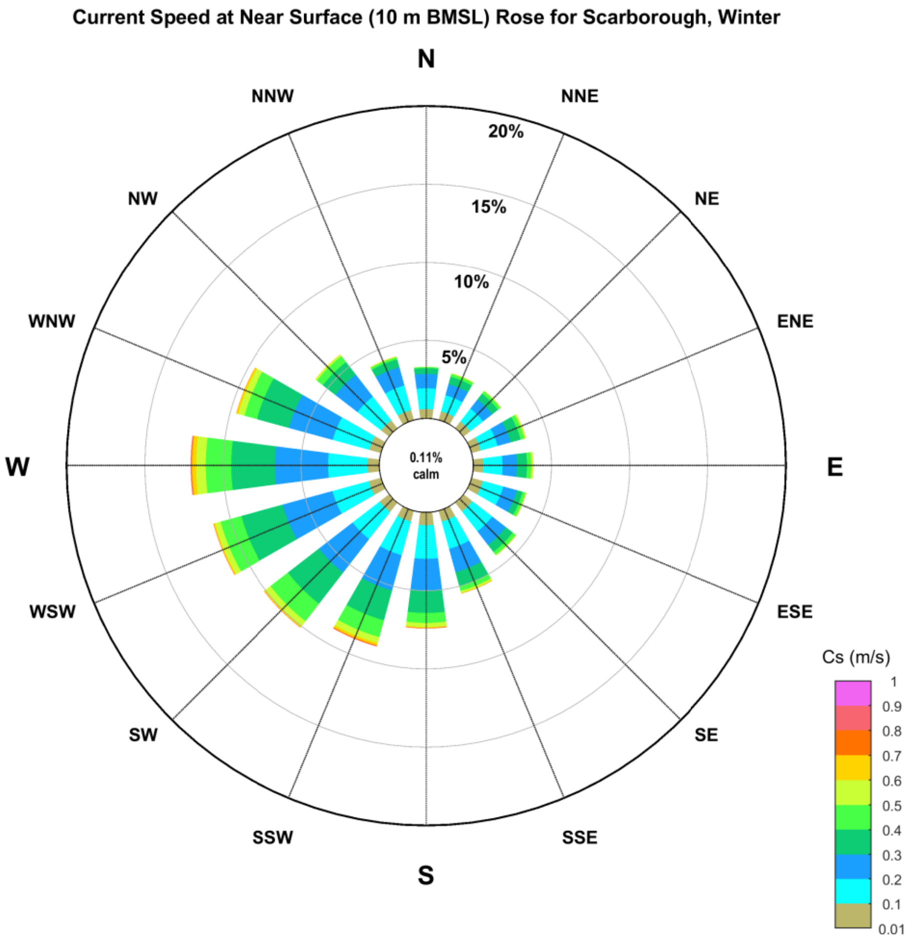

Data Information:	Key Statistics for Data Shown:
Project: North West Shelf	Max Curr Spd: 1.03 m/s
Location: Scarborough [113.2000°E, 19.8800°S]	Mean Curr Spd: 0.25 m/s
Data Period: Winter (01-Apr-2010 to 30-Sep-2011)	StdDev. Curr Spd: 0.13 m/s
Data Source: Measured Data	
Record Elevation: Near Surface (10 m BMSL)	
Local Water Depth (m): 950	
Data Summary: Winter	
Number of Records: 49345	
Missing Data (%): 3.01	
Calm (% < 0.01m/s): 0.11	

Figure 9. Winter (May-Sep) near surface combined frequency of 1-min mean current speed and direction (towards) measured at the Scarborough location (cyclones removed) (WEL, 2018).

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North-west Cape

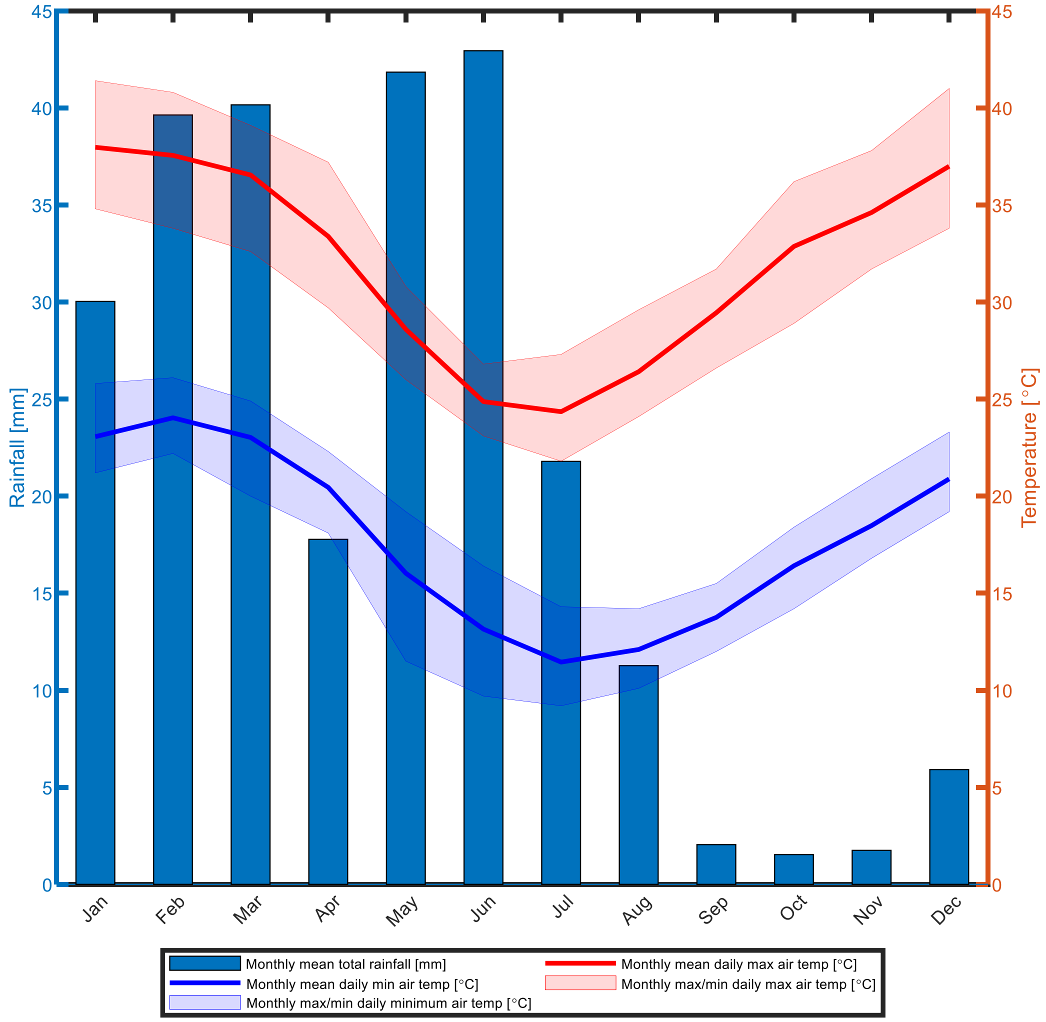

Figure 1. Monthly average total rainfall [mm] and air temperature [°C], calculated based on observations at the Learmonth Airport weather station from 1945-2020 and 1975-2020 respectively (Bureau of Meteorology 2020). Bars show the monthly average total rainfall values, and thick blue and red lines denote monthly average daily minimum and maximum air temperatures, respectively. Shaded blue and red areas denote monthly recorded extremes of daily minimum and maximum air temperature, respectively.

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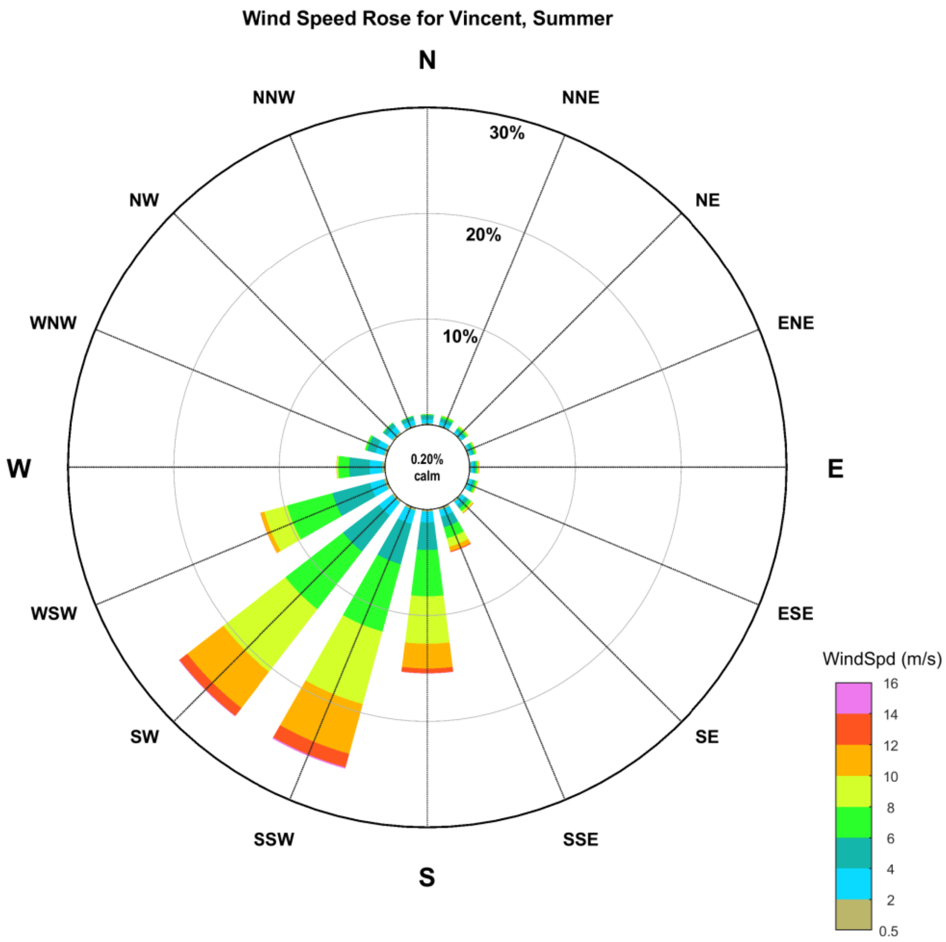

Data Information:
Project: North West Cape
Location: Vincent [114.0600°E, 21.4400°S]
Data Period: Summer (01-Jan-1979 to 01-Jan-2019)
Data Source: Modelled Hindcast
Record Elevation: 10 m AMSL
Local Water Depth (m): 350
Data Summary: Summer
Number of Records: 159379
Missing Data (%): 8.91
Calm (% < 0.50m/s): 0.20
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 18.86 m/s
Mean Wind Speed: 7.10 m/s
StdDev. Wind Speed: 2.75 m/s

Figure 2. Summer distributions of wind speeds (10-minute at 10 m ASL) by 22.5° directional sectors at the Vincent site (Vincent Metocean). Note tropical cyclone events were not included in this distribution. Winds at Vincent in summer are predominantly from the SW to SSW in summer due to the presence of the Pilbara Heat Low (MetOcean Engineers, 2005).

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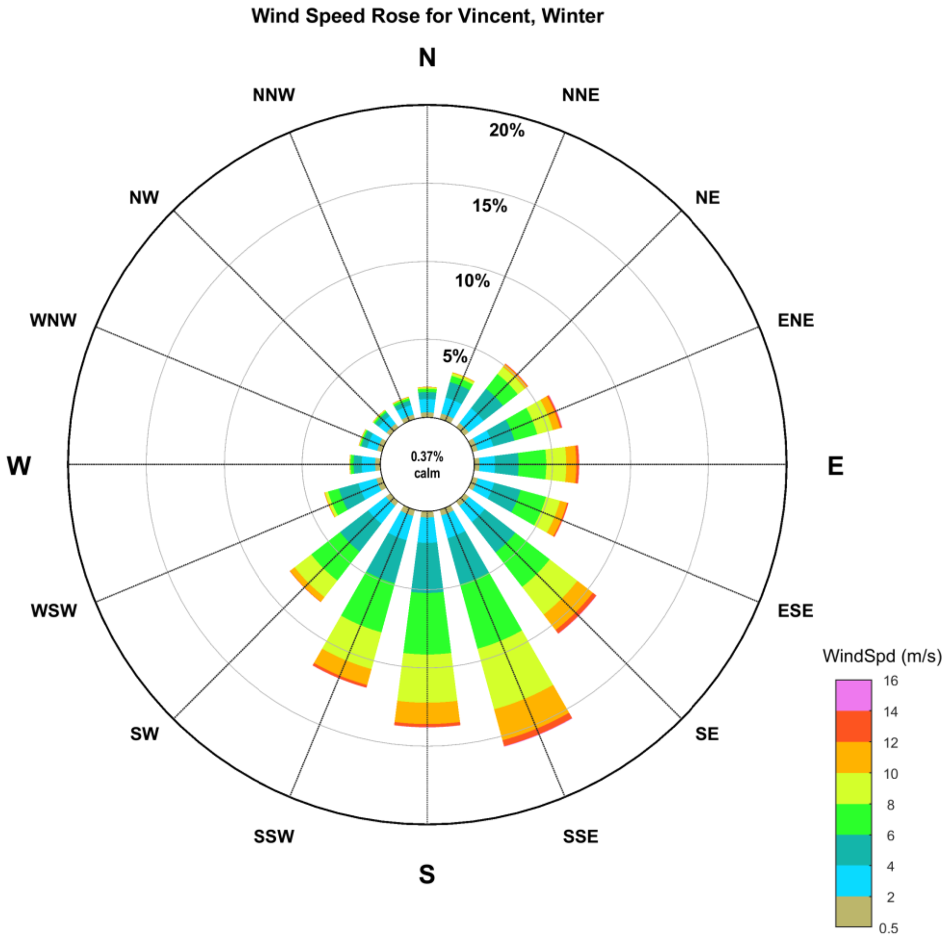

Data Information:
Project: North West Cape
Location: Vincent [114.0600°E, 21.4400°S]
Data Period: Winter (01-Apr-1979 to 30-Sep-2018)
Data Source: Modelled Hindcast
Record Elevation: 10 m AMSL
Local Water Depth (m): 350
Data Summary: Winter
Number of Records: 173626
Missing Data (%): 1.17
Calm (% < 0.50m/s): 0.37
Measurement Format: 10-minute avg.

Key Statistics for Data Shown:
Max Wind Speed: 19.39 m/s
Mean Wind Speed: 6.23 m/s
StdDev. Wind Speed: 2.78 m/s

Figure 3. Winter distributions of wind speeds (10-minute at 10 m ASL) 22.5° directional sectors at the Vincent site (Vincent Metocean). Note tropical cyclone events were not included in this distribution. In winter, winds at are predominantly from the S to SE, associated with the South East Trades. Easterly gales are experienced at the Vincent location due to high pressure systems generating from the Great Australian Bight area to the site (MetOcean Engineers, 2005).

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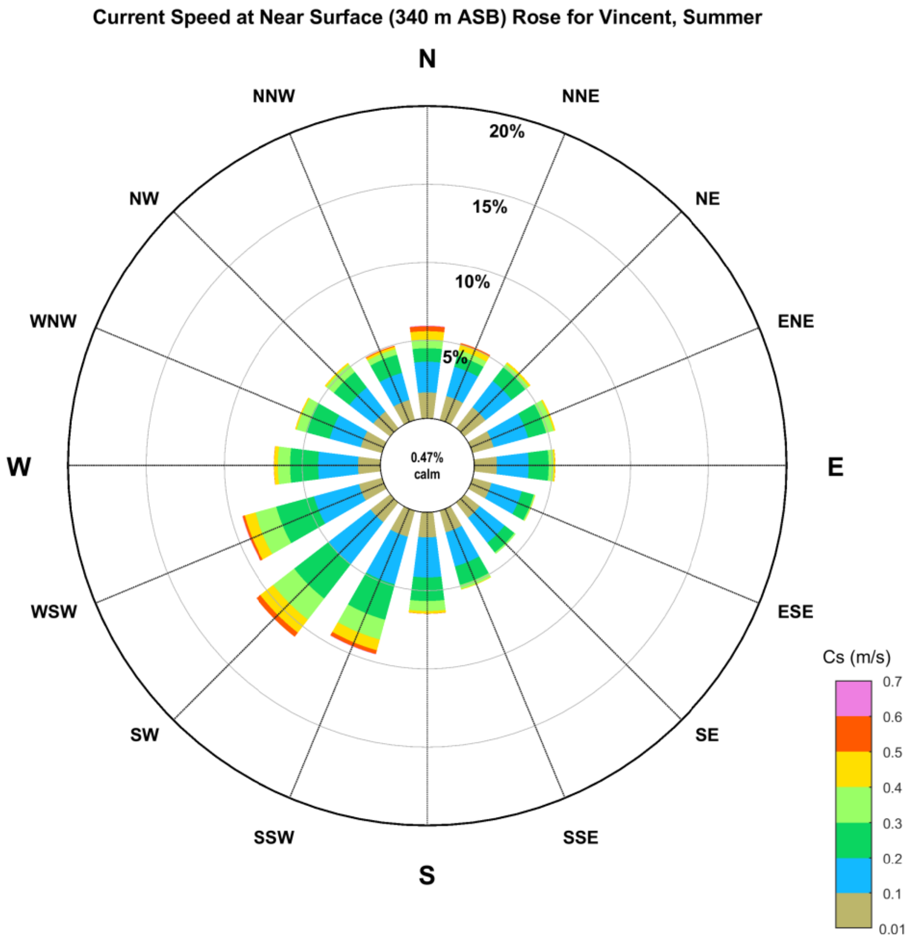

Data Information:
Project: North West Cape
Location: Vincent [114.0600°E, 21.4400°S]
Data Period: Summer (21-Nov-2000 to 13-Dec-2001)
Data Source: Measured Data
Record Elevation: Near Surface (340 m ASB)
Local Water Depth (m): 350
Data Summary: Summer
Number of Records: 144668
Missing Data (%): 1.59
Calm (% < 0.01m/s): 0.47

Key Statistics for Data Shown:
Max Curr Spd: 0.75 m/s
Mean Curr Spd: 0.19 m/s
StdDev. Curr Spd: 0.11 m/s

Woodside

Figure 4. Summer (May – Sep) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at the Vincent location (cyclones removed) (WEL, 2016).

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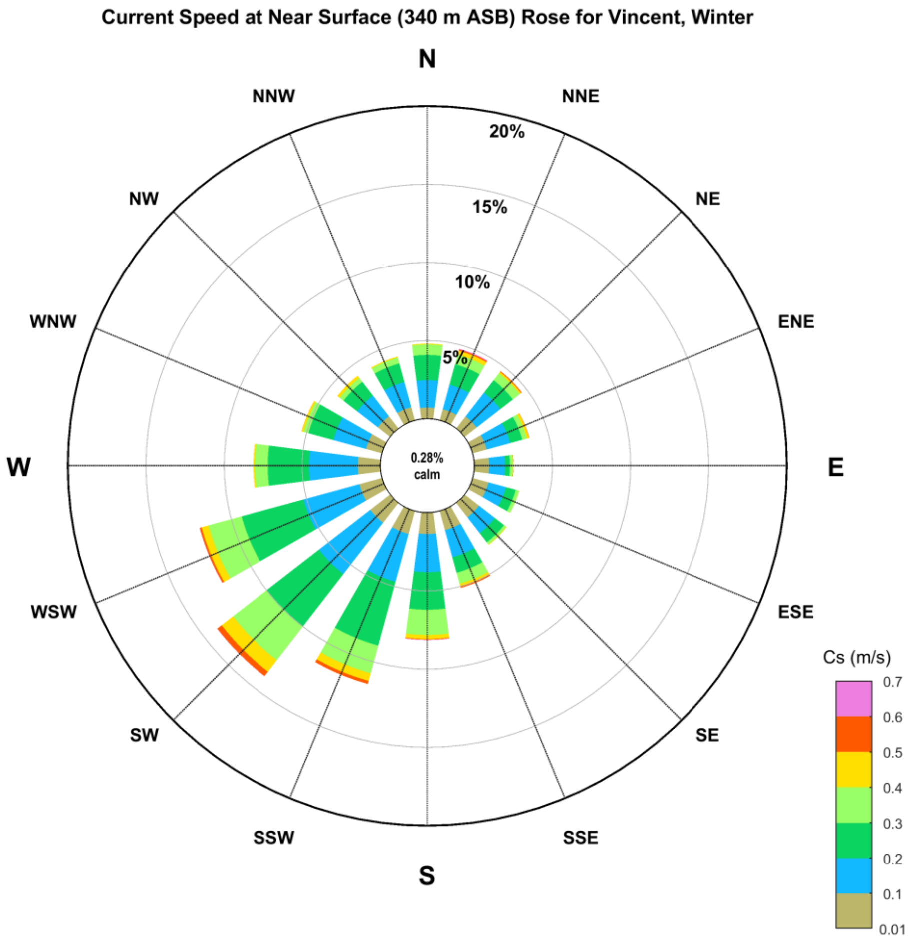

Data Information:	Key Statistics for Data Shown:
Project: North West Cape	Max Curr Spd: 0.64 m/s
Location: Vincent [114.0600°E, 21.4400°S]	Mean Curr Spd: 0.20 m/s
Data Period: Winter (01-Apr-2001 to 30-Sep-2001)	StdDev. Curr Spd: 0.11 m/s
Data Source: Measured Data	
Record Elevation: Near Surface (340 m ASB)	
Local Water Depth (m): 350	
Data Summary: Winter	
Number of Records: 126313	
Missing Data (%): 4.13	
Calm (% < 0.01m/s): 0.28	

Figure 5. Winter (Nov – Apr) near surface combined frequency of 1-minute mean current speed and direction (towards) measured at the Vincent location (cyclones removed) (WEL, 2016).

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REFERENCES

AFMA 2021. Southern Blue Fin Tuna. Accessed 3 June 2021 www.afma.gov.au/fisheries-management/species/southern-bluefin-tuna

Bureau of Meteorology 2020. Climate Statistics for Australian Locations, Summary Statistics Broome Airport Accessed 1 October 2020 <http://www.bom.gov.au/climate/averages/tables/cw_003003.shtml>.

MetOcean Engineers 2005. Vincent Development Metocean Criteria Report No. R1276.

Metocean Solutions Ltd 2019. "Australia North-West Shelf wave hindcast: Description and

Validation of SWAN ST6 Wave Model", DRIMS 1401150817.

RPS 2016. Metocean Criteria Guidelines for Modu Mooring on Australia's North West Shellf, DRIMS 1400522719.

RPS Metocean Pty Ltd 2008. "Browse LNG Development - Offshore MetOcean Measurement

Programme: September 2006 to February 2008 Final Data Report." CRN: JB0020RT0019.

Vincent Metocean – 40 Year Non-Cyclonic Metocean Database for Design Studies CRN: VAOOOORT1400067309.

WEL 2011. Greater Western Flank Detailed Metocean Design Criteria, Rev 2. CRN: A3000RG5492827.

WEL 2016. Vincent – Basic Design Data Specification sheet – Metocean CRN: VA0000RT1400067309.

WEL 2015. Winds Measured at North Rankin A 1995-2015.

WEL 2018. Scarborough Development - Non-Cyclonic and Operational Metocean Design Criteria – Spreadsheet, Revision A, CRN: SA0009CT1400722569.

WEL 2019. "Browse Development – Metocean Design Basis" CRN: JJ0013ST1400274448.

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APPENDIX D OIL SPILL PEPAREDENSS AND RESPONSE STRATEGY SELECTION AND EVALUATION

Oil Spill Preparedness and Response Mitigation Assessment for the Goodwyn Alpha (GWA) Facility Operations Environment Plan

Security & Emergency Management
Hydrocarbon Spill Preparedness Unit

August 2021

Revision: 1

TABLE OF CONTENTS

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FIGURES

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TABLES

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EXECUTIVE SUMMARY

Woodside Energy Limited (Woodside) has developed its oil spill preparedness and response position for the Goodwyn Alpha (GWA) Facility Operations, 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	**MEE[1]-01, Credible Scenario-01 (MEE-01-01): Unplanned hydrocarbon release of GWA Condensate – loss of well containment during drilling of development well GDA05** 108,843 m^3 release of GWA Condensate over 71 days[2] from GDA05 well (19° 43' 15.968" S, 115° 51' 10.743" E). 0.8% residual component of 870.7 m^3 or 12.2 m^3 per day.	Section 2.2
	MEE-01, Credible Scenario-02 (MEE-01-02): Unplanned surface release of 171,033 m^3 of GWA Condensate (GWA03) from the GWA platform (GWA08) 171,033 m^3 release of GWA Condensate (GWA03) over 68 days[2] from GWA08 platform (19° 39' 12.809" S, 115° 55' 42.567" E). 1.6% residual component of 2,832.5 m^3 or 41.7 m^3 per day.	
	MEE-05: Hydrocarbon release of marine diesel caused by vessel collision– breach of installation vessel fuel tanks due to collision with third party vessel, including commercial shipping/ fisheries. Instantaneous release of 1000 m^3. 5% residue of 50 m^3.	
Hydrocarbon Properties	**GWA Condensate** GWA condensate is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi-volatile components. In favourable evaporation conditions, 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. **GWA Condensate (GWA03)** GWA condensate (GWA03) is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi-volatile components. In favourable evaporation conditions, about 71.6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 19.8% should evaporate within the	Section 2.2.1 Section 6.7 of the EP Appendix A of the First Strike Plan

[1] Major Environmental Event

[2] Loss of containment duration has been calculated based on time to drill a relief well in both scenarios. Timing variations between relief well durations are due to the wells' casing program differences.

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<table>
<tr><td></td><td colspan="4">first 24 hours (180 °C < BP < 265 °C); and a further 7.0% should evaporate over several days (265 °C < BP < 380 °C). Approximately 1.6% 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.</td><td></td></tr>
<tr><td rowspan="3">Modelling Results</td><td colspan="4">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).</td><td rowspan="2">Section 2.3</td></tr>
<tr><td colspan="4">Deterministic modelling
Deterministic modelling was then undertaken for scenarios MEE-01-01 and MEE-01-02 (Table 2-1) as the worst-case credible scenarios (WCCS) to establish the following for response planning purposes:
• Maximum cumulative area for contact by floating oil (at concentrations in excess of 50 g/m^2).
• Minimum time to floating oil contact with the offshore edge(s) of any shoreline receptor polygon (at a threshold of 10 g/m^2).
• Minimum time to commencement of oil accumulation at any shoreline receptor (at a threshold of 100 g/m^2).
• Maximum cumulative oil volume accumulated across all shoreline receptors (at concentrations in excess of 100 g/m^2).
• Maximum cumulative oil volume accumulated at any individual shoreline receptor (at concentrations in excess of 100 g/m^2).
Based on the results, MEE-01-02 was established as the WCCS and carried forward for assessment as the impacts of MEE-01-01 are deemed to be lesser in nature and scale.
Deterministic modelling was not undertaken for MEE-05 but the stochastic results have been included here to ensure complete response planning. Results as follows:</td></tr>
<tr><td></td><td>MEE-01-01: Hydrocarbon release caused by loss of well containment (GWA) (108,843 m3 of GWA Condensate over 71 days)</td><td>MEE-01-02: Hydrocarbon release caused by loss of well containment (Platform well release (171,033 m^3 of GWA Condensate (GWA03) over 68 days)</td><td>MEE-05: Hydrocarbon release caused by vessel collision (instantaneous release of 1000 m^3 marine diesel)</td><td></td></tr>
</table>

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	Maximum cumulative area for contact by floating oil (at concentrations in excess of 50 g/m^2)	Model 20, Q1 2.9 km^2 (Open Ocean)	Model 15, Q2 3.9 km^2 (Open Ocean)	*No contact at threshold*[3]	
	Minimum time to floating oil contact with the offshore edge(s) of any shoreline receptor polygon (at a threshold of 10 g/m^2)	*No contact at threshold*	*No contact at threshold*	*No contact at threshold*	
	Minimum time to commencement of oil accumulation at any shoreline receptor (at a threshold of 100 g/m^2)	*No contact at threshold*	Model 2, Q2 71.4 days at Muiron Islands	*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)	*No contact at threshold*	Model 2, Q2 5.7 m^3 (Muiron Islands)	*No contact at threshold*	
	Maximum cumulative oil volume accumulated at any individual shoreline receptor (at concentrations in excess of 100 g/m^2)	*No contact at threshold*	Model 2, Q2 5.7 m^3 (Muiron Islands)	*No contact at threshold*	
Net Environmental Benefit Assessment	Monitor and evaluate, source control via relief well drilling, source control via capping stack (MEE-01-01 only), source control (vessel), 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

[3] No contact to receptor predicted for specified threshold.

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1 INTRODUCTION

1.1 Overview

Woodside has developed its oil spill preparedness and response position for the Goodwyn Alpha (GWA) Facility Operations, 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 GWA Facility Operations Environment Plan (EP)
- Oil Pollution Emergency Arrangements (OPEA) (Australia)
- The GWA Facility Operations 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 3-1 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.

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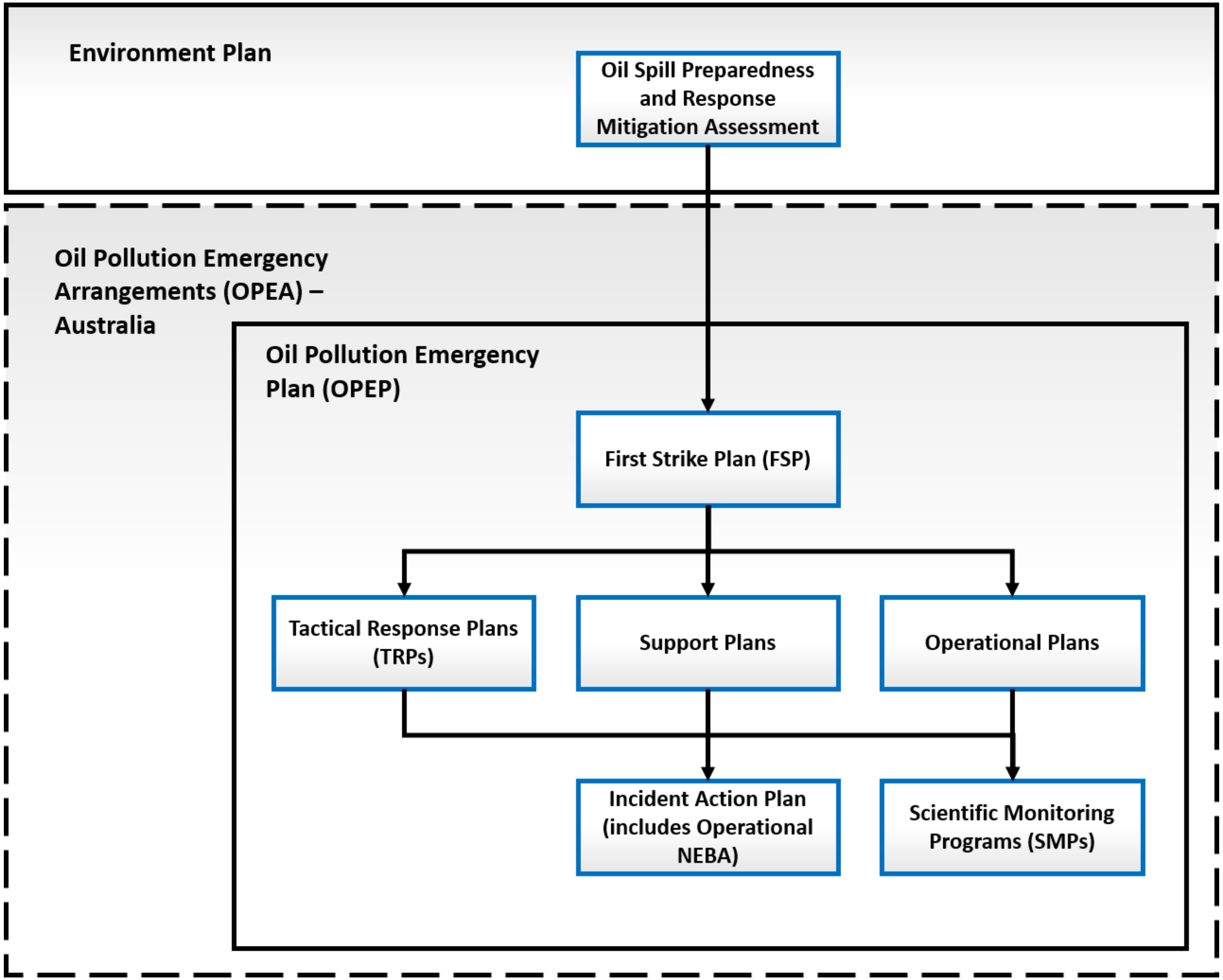

Figure 1-1: Woodside hydrocarbon spill document structure

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Table 1-1: Hydrocarbon spill preparedness and response – document references

Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
GWA Facility Operations EP	Demonstrates that potential adverse impacts on the environment associated with the GWA Facility Operations (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 GWA Facility Operations (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.	
GWA Facility Operations 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 activity-specific response information.	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	

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Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
			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 Plan 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.	A list of available Tactical Response Plans is available in ANNEX E: Tactical Response Plans
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)

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Document	Document overview	Stakeholders	Relevant information	Document subsections (if applicable)
				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

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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 GWA Facility Operations 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.

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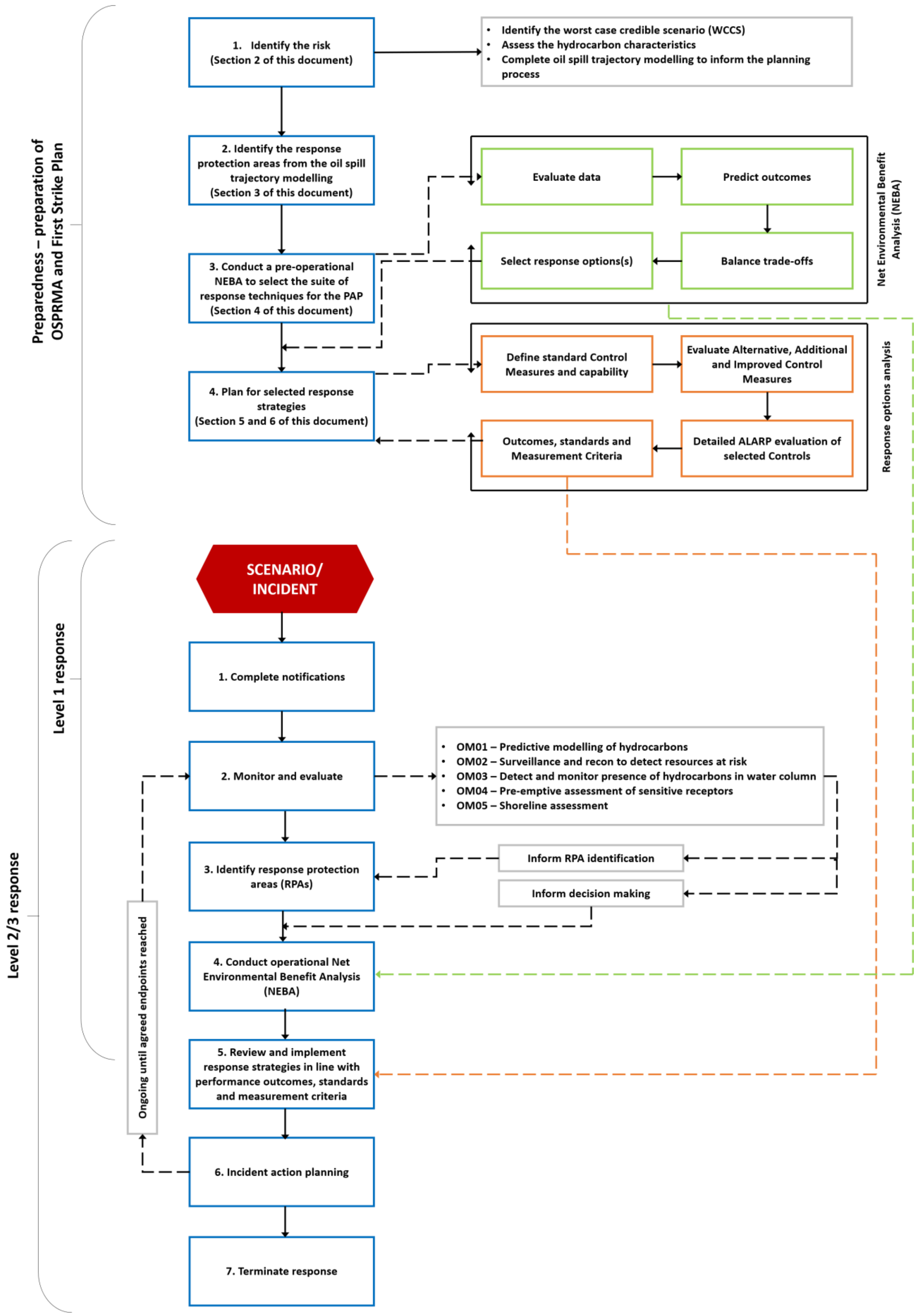

Figure 2-1: Response planning and selection process

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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 (Refer to Table 2-4).

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

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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

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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 (MEE-01-01 and MEE-01-02) were both deterministically modelled.

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Table 2-1: Petroleum Activities Program credible spill scenarios

Credible Spill Scenarios	Scenario selected for planning purposes	Scenario description	Maximum credible volume released (liquid m³)[1]	Incident Level	Hydrocarbon (HC) type	Residual proportion	Residual volume (liquid m³)
MEE-01, Credible Scenario-01 (MEE-01-01)	No	Well blowout at seabed – subsea well head (GDA05) release Uncontrolled release of GWA condensate. 1,533 m^3/day of GWA condensate for 71 days at the surface (residual portion 12.2m^3 per day)	108,843	3	GWA Condensate	0.8%	12.2m^3 per day
MEE-01, Credible Scenario-02 (MEE-01-02)	Yes	Well blowout at surface – platform wellhead release (WCCS) Uncontrolled surface release of GWA condensate. 2,515 m^3/day of GWA condensate for 68 days at the surface (residual portion 40.2 m^3 per day)	171,033	3	GWA Condensate (GWA03)	1.6%	40.2m^3 per Day
MEE-02	No	Flowlines (GWF-1 / GWF-2) subsea release outboard of SSIV	237	2	GWF-2 Condensate	2.7%	6m^3
	No	Subsea release from IFL (including 2TL inventory) downstream of SSIV but within 500 m of GWA facility GWA condensate release of 8090 m3 considered the worst case for MEE-02. The WCCS for a condensate release is considered under MEE- 01	8,090	2/3	GWA Condensate	1.6%	129m^3
	No	Surface release from IFL (including 2TL inventory) from rupture of riser at GWA facility	7,623	2/3	GWA Condensate	1.6%	122m^3
MEE-03 and 04	No	Topsides release – loss of topside hydrocarbon inventories	343	2	Marine Diesel	5%	50m^3

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Credible Spill Scenarios	Scenario selected for planning purposes	Scenario description	Maximum credible volume released (liquid m³)[1]	Incident Level	Hydrocarbon (HC) type	Residual proportion	Residual volume (liquid m³)
	No	Loss of marine diesel at the surface from a loss of topside inventory during operations considered the worst case for a diesel spill The WCCS for a condensate release is considered under MEE-01 The WCCS for a diesel spill is described in MEE-05	403	2	GWA Condensate	1.6%	6 m^3
	No		135	2	Gas and GWA Condensate	1.6%	2 m^3
	No		105	2	Marine Diesel	5%	5.25 m^3
MEE-05	Yes	Surface release of marine diesel after a vessel fuel tank rupture near the GDA05 Well	1000	2	Marine Diesel	5%	50 m^3
MEE-06	No	Loss of control of a suspended load from the platform	As per MEE-02 and MEE-03				
N/A	No	Loss of diesel during bunkering activities The WCCS for a diesel spill is described in MEE-05	8	1	Marine Diesel	5%	0.4 m^3

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2.2.1 Hydrocarbon characteristics

More detailed hydrocarbon characteristics, including modelled weathering data and ecotoxicity, are included in Section 6 of the EP.

GWA Condensate

GWA condensate is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi-volatile components. In favourable evaporation conditions, 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 whole oil has a low asphaltene content (< 0.5%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble, aromatic, hydrocarbons contribute approximately 16.3% by mass of the whole oil. Around 9.1% by mass is highly soluble and highly volatile. A further 7.2% by mass has semi-to-low volatility. These compounds dissolve more slowly but tend to persist in soluble form for longer. Discharge onto the water surface will favour the process of evaporation over dissolution under calm sea conditions, but increased entrainment of oil and dissolution of soluble compounds can be expected under breaking wave conditions.

GWA Condensate (GWA03)

GWA condensate (GWA03) is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi-volatile components. In favourable evaporation conditions, about 71.6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 19.8% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 7.0% should evaporate over several days (265 °C < BP < 380 °C). Approximately 1.6% of the oil is shown to be persistent.

The whole oil has a low asphaltene content (< 0.5%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble, aromatic, hydrocarbons contribute approximately 13.2% by mass of the whole oil. Around 9.6% by mass is highly soluble and highly volatile. A further 3.6% by mass has semi-to-low volatility. These compounds dissolve more slowly but tend to persist in soluble form for longer. Discharge onto the water surface will favour the process of evaporation over dissolution under calm sea conditions, but increased entrainment of oil and dissolution of soluble compounds can be expected under breaking wave conditions.

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 (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.

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.

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

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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 MEE-01-01, MEE-01-02 and MEE-05 (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.

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Table 2-2: Summary of thresholds applied to the stochastic hydrocarbon spill modelling to determine the EMBA and environmental impacts

Hydrocarbon Type	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. 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 MEE-01-01 and MEE-01-02 (which are loss of well containment scenarios at subsea and surface respectively) and, based on the results, MEE-01-02 was established as the WCCS and carried forward for response planning purposes as the impacts of MEE-01-01 are deemed to be lesser in nature and scale. MEE-01-02 (the GWA08 platform release) was selected for modelling as current production rates from the well are significantly higher than the other Goodwyn platform wells. GWA03 Condensate was used as it is the most similar available analogue to the condensate from GWA08.

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
-19.657	115.929	60	53.16739	29.90083	53316.01	53.31601
-19.657	115.929	84	57.55573	30.83806	57716.61	57.71661
-19.657	115.9195	90	57.37641	37.27555	57536.86	57.53686
-19.648	115.929	114	50.54212	37.81493	50686.3	50.6863

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.

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.

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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[4]	Code 3 – Dull metallic colours	5 to 50
50	Predicted minimum floating oil threshold for containment and recovery and surface dispersant application [5]	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 clean-up 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.

[4] 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.

[5] 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.

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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 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).

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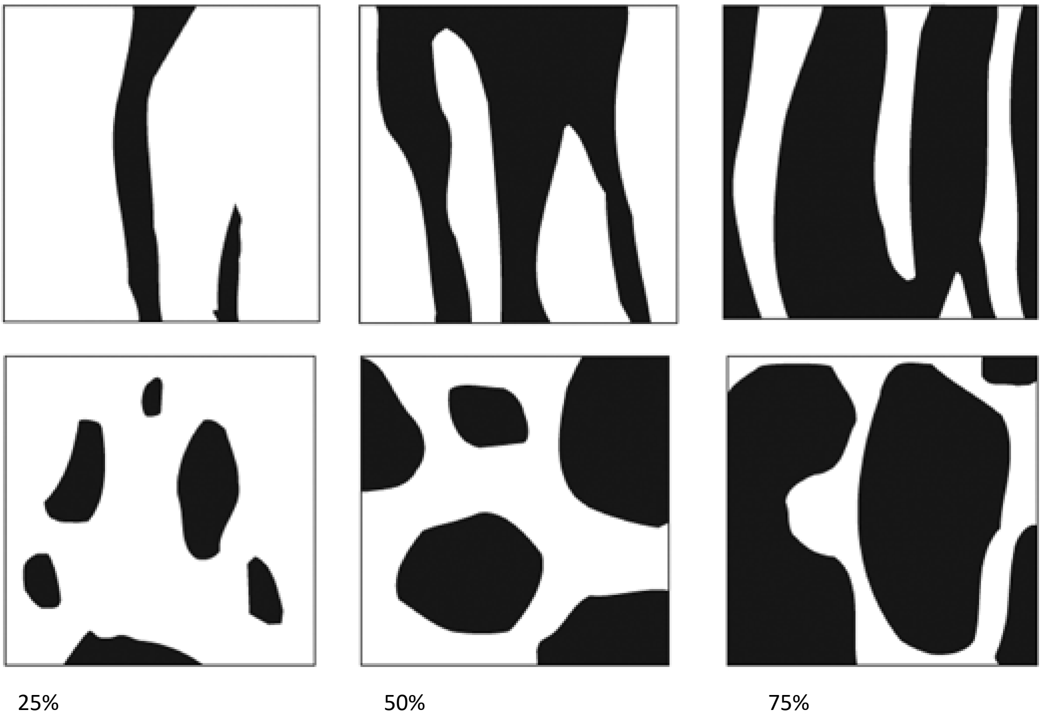

Figure 2-3: Proportion of total area coverage (AMSA, 2014)

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.

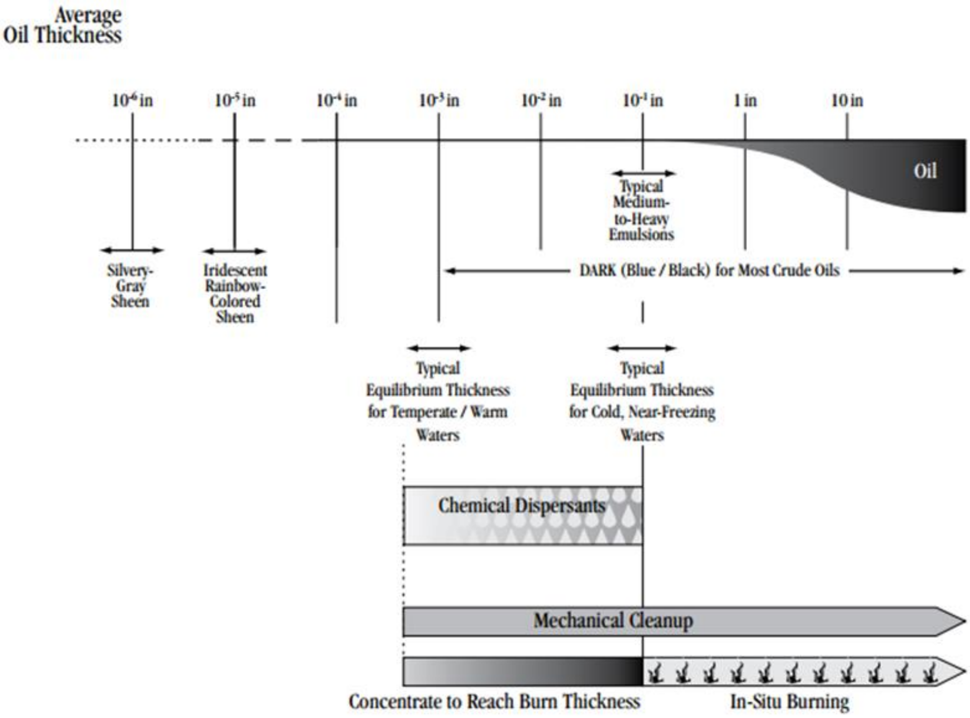

Figure 2-4: Oil thickness versus potential response options (from Allen & Dale 1996)

Wind and wave influence on the feasibility of response operations are also considered below (adapted from NOAA 2013):

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- 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 Surface hydrocarbon viscosity

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:

- Maximum cumulative area for contact by floating oil (at concentrations in excess of 50 g/m2).

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- Minimum time to floating oil contact with the offshore edge(s) of any shoreline receptor polygon (at a threshold of 10 g/m2).
- Minimum time to commencement of oil accumulation at any shoreline receptor (at a threshold of 100 g/m2).
- Maximum cumulative oil volume accumulated across all shoreline receptors (at concentrations in excess of 100 g/m2).
- Maximum cumulative oil volume accumulated at any individual shoreline receptor (at concentrations in excess of 100 g/m2).

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 MEE-05 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**		
	MEE-01-01: Hydrocarbon release caused by loss of well containment (GWA) (Subsea well release at GDA05)	**MEE-01-02: Hydrocarbon release caused by loss of well containment (Platform well release)**	**MEE-05: Hydrocarbon release due to loss of marine vessel separation**
Maximum continuous liquid hydrocarbon release rate and duration	108,843 m^3 of GWA Condensate over 71 days	171,033 m^3 of GWA Condensate (GWA03) over 68 days	Instantaneous release of 1000 m^3 of marine diesel
Maximum residual surface hydrocarbon after weathering	0.8% residual component of 12.2 m^3	1.6% residual component of 40.2 m^3	5% residual component of 50 m^3
Deterministic modelling results			
Maximum cumulative area for contact by floating oil (at concentrations in excess of 50 g/m^2)	Model 20, Q1 2.9 km^2 (Location N/A)	Model 15, Q2 3.9 km^2 (Location N/A)	*No contact at threshold*
Minimum time to floating oil contact with the offshore edge(s) of any shoreline receptor polygon (at a threshold of 10 g/m^2)	*No contact at threshold*	*No contact at threshold*	*No contact at threshold*
Minimum time to commencement of oil accumulation at any shoreline receptor (at a threshold of 100 g/m^2)	*No contact at threshold*	Model 2, Q2 71.4 days at Murion Islands	*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)	*No contact at threshold*	Model 2, Q2 5.7 m^3 (Murion Islands)	*No contact at threshold*
Maximum cumulative oil volume accumulated at any individual shoreline receptor (at concentrations in excess of 100 g/m^2)	*No contact at threshold*	Model 2, Q2 5.7 m3 (Murion Islands)	*No contact at threshold*

As shown in Table 2-6, deterministic modelling does not show floating oil at threshold (>10 g/m^2) at any RPA. Surface hydrocarbons at response threshold (>50 g/m^2) are, however, predicted to be present in open water

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within 1 km of the well for both MEE-01-01 and MEE-01-02. MEE-01-02 has the greater surface area as follows:

- MEE-01-02:
    - 1 km^2 on day 2
    - 2 km^2 on day 3
    - 1 km^2 on day 4
    - Surface hydrocarbons return to 0 km^2 (0 m^3) thereafter.

Due to the volatile nature of GWA/GWA03 Condensate and very low residue (0.8% and 1.6% respectively), together with no predicted floating oil >10 g/m^2 at any RPA and minimal shoreline impact, surface dispersant is not deemed an appropriate response technique. Containment and recovery of condensate poses a significant safety risk and low flash points. Corralling low flash point substances should be avoided, therefore this response technique is not feasible.

Additional safety considerations that may prevent an offshore response include high winds (>20 knots), waves and/or sea states (>1.5m waves) and high ambient temperatures.

From the above results, model run 2 (Q2) from the deterministic modelling for MEE-01-02 and the stochastic modelling for MEE-05 have been used as the basis for response planning and are included in Section 4.2.

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3 IDENTIFY RESPONSE PROTECTION AREAS (RPAS)

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.

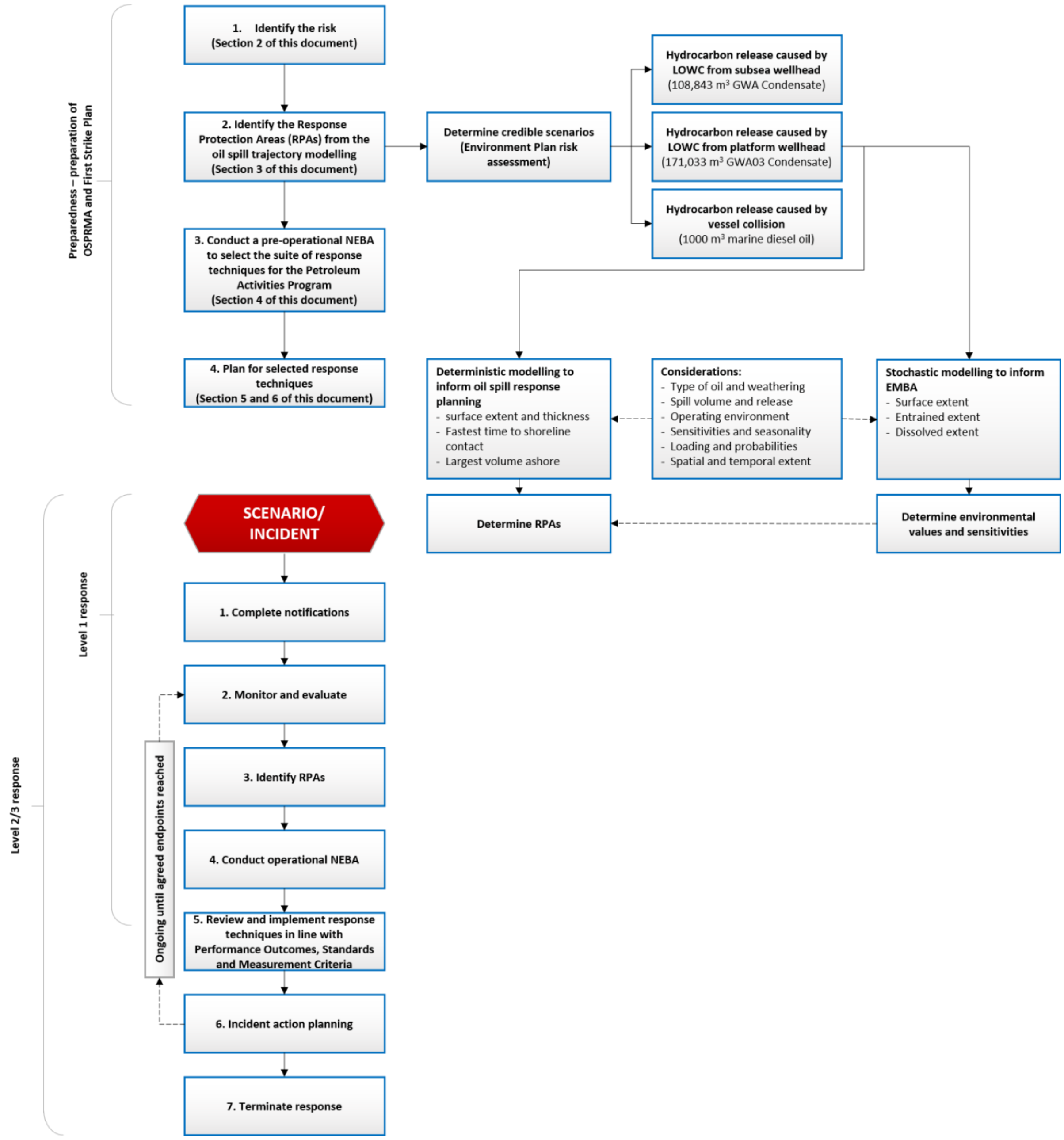

Figure 3-1: Identify Response Protection Areas flowchart

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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[6]) 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.

[6] 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.

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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/m²) in days [7]	Maximum shoreline accumulation (above 100g/m²) in m³ [8]	Minimum time to shoreline contact (above 100g/m²) in days	Maximum shoreline accumulation (above 100g/m²) in m³	Minimum time to shoreline contact (above 100g/m²) in days [9]	Maximum shoreline accumulation (above 100g/m²) in m³ [10]
			MEE-01-01		MEE-01-02		MEE-05	
Muiron Islands/ Muiron Islands MMA	Marine Management Area	IUCN VI – Protected area with sustainable use of natural resources IUCN IA – Strict Nature Reserve	*No contact at threshold*	*No contact at threshold*	71.4	5.7	*No contact at threshold*	*No contact at threshold*

[7] This volume and time represent the first time to contact on defined shoreline polygon and the maximum volume ashore for that 24 hour period.
[8] This volume and time represent the maximum volume ashore on defined shoreline polygon for any 24 hour time period
[9] This volume and time represent the first time to contact on defined shoreline polygon and the maximum volume ashore for that 24 hour period.
[10] This volume and time represent the maximum volume ashore on defined shoreline polygon for any 24 hour time period

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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.

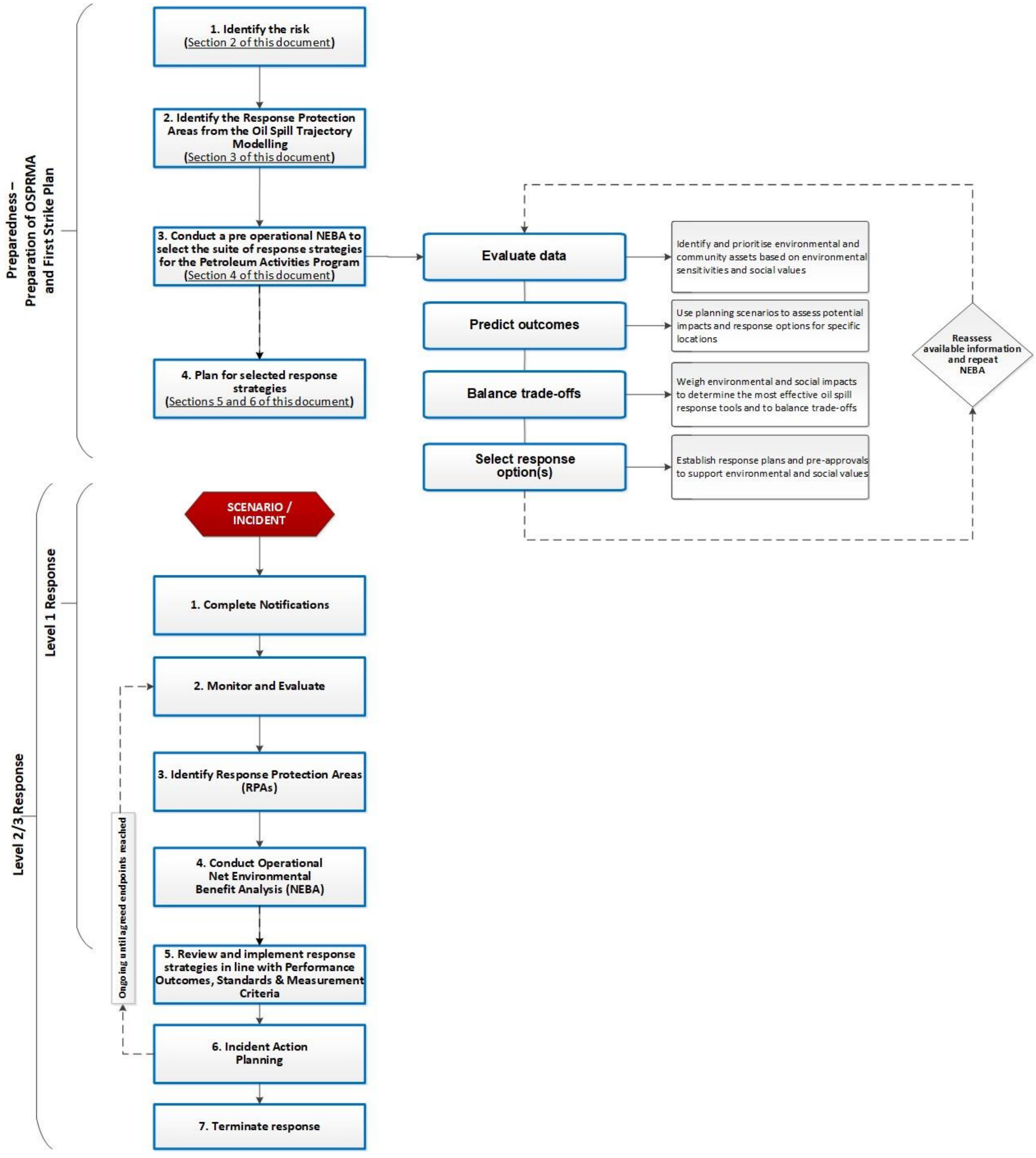

Figure 4-1: Net Environmental Benefit Analysis (NEBA) flowchart

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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.

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Table 4-1: Scenario summary information (WCCS)

Scenario summary information (MEE-01-01)	
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	GWA 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	108,843 m^3 over 71 days
Scenario summary information (MEE-01-02)	
Scenario	Hydrocarbon release caused by loss of well containment – platform well release
Location	Lat: 19° 39’ 12.809” S Long: 115° 55’ 42.567” E
Oil Type	GWA Condensate (GWA03)
Fate and Weathering	71.6% of the mass should evaporate within the first 12 hours (BP < 180 °C) 19.8% of the mass should evaporate within the first 24 hours (180 °C < BP < 265 °C) 7.0% of the mass should evaporate over several days (265 °C < BP < 380 °C) 1.6% residue
Volume and duration of release	171,033 m^3 over 68 days
Scenario summary information (MEE-05)	
Scenario	Marine Diesel release caused by a loss of marine vessel separation
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

GWA Condensate

GWA condensate is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi-volatile components. In favourable evaporation conditions, 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 whole oil has a low asphaltene content (< 0.5%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble, aromatic, hydrocarbons contribute approximately 16.3% by mass of the whole oil. Around 9.1% by mass is highly soluble and highly volatile. A further 7.2% by mass has semi-to-low volatility. These compounds dissolve more slowly but tend to persist in soluble form for longer. Discharge onto the water surface will favour the process of evaporation over dissolution under calm sea conditions, but

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increased entrainment of oil and dissolution of soluble compounds can be expected under breaking wave conditions.

GWA Condensate (GWA03)

GWA condensate (GWA03) is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi-volatile components. In favourable evaporation conditions, about 71.6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 19.8% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 7.0% should evaporate over several days (265 °C < BP < 380 °C). Approximately 1.6% of the oil is shown to be persistent.

The whole oil has a low asphaltene content (< 0.5%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble, aromatic, hydrocarbons contribute approximately 13.2% by mass of the whole oil. Around 9.6% by mass is highly soluble and highly volatile. A further 3.6% by mass has semi-to-low volatility. These compounds dissolve more slowly but tend to persist in soluble form for longer. Discharge onto the water surface will favour the process of evaporation over dissolution under calm sea conditions, but increased entrainment of oil and dissolution of soluble compounds can be expected under breaking wave conditions.

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 (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.

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.

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Table 4-2: Oil fate, behaviour and impacts

Modelling results			
	MEE-01-01	**MEE-01-02**	**MEE-05**
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 1 km of the well covering an area of 2.9 km^2	Surface hydrocarbons at response threshold (>50 g/m^2 and <15,000 cSt) are predicted to be present in the open water within 1 km of the well covering an area of 3.9 km^2	Nil
Maximum cumulative area for contact by floating oil (at concentrations in excess of 50 g/m^2)	Model 20, Q1 2.9 km^2 (open water)	Model 15, Q2 3.9 km^2 (open water)	*No contact at threshold*
Minimum time to floating oil contact with the offshore edge(s) of any shoreline receptor polygon (at a threshold of 10 g/m^2)	*No contact at threshold*	*No contact at threshold*	*No contact at threshold*
Minimum time to commencement of oil accumulation at any shoreline receptor (at a threshold of 100 g/m^2)	*No contact at threshold*	Model 2, Q2 71.4 days at Murion Islands	*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)	*No contact at threshold*	Model 2, Q2 5.7 m^3 (Murion Islands)	*No contact at threshold*
Maximum cumulative oil volume accumulated at any individual shoreline receptor (at concentrations in excess of 100 g/m^2)	*No contact at threshold*	Model 2, Q2 5.7 m3 (Murion Islands)	*No contact at threshold*

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Response Protection Areas						
	MEE-01-01		MEE-01-02		MEE-05	
Areas of coastline contacted	**Minimum time to shoreline contact (above 100g/m²) in days**	**Maximum shoreline accumulation (above 100g/m²) in m³**	**Minimum time to shoreline contact (above 100g/m²) in days**	**Maximum shoreline accumulation (above 100g/m²) in m³**	**Minimum time to shoreline contact (above 100g/m²) in days**	**Maximum shoreline accumulation (above 100g/m²) in m³**
Muiron Islands/ Muiron Islands MMA	*No contact at threshold*	*No contact at threshold*	71.4	5.7	*No contact at threshold*	*No contact at threshold*

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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, and Table 4-4. 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.

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Table 4-3: Response technique evaluation – GWA Condensate release from loss of well containment

Response technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: GWA 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 GWA 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 using ROV and hotstab	N/A	N/A	**No**	N/A – GWA08 and GDA05 are production wells with no blowout preventer thus intervention and/or hotstab are not feasible response techniques.
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.	**GWA MEE-01-02, (platform release GWA08):** GWA08 is a platform wellhead therefore capping stack deployment is not feasible for this wellhead release scenario. **GWA MEE-01-01, (subsea release GDA05):** Woodside has developed a project specific capping stack deployment plan and commissioned an independent, subsea site-specific plume and gas dispersion study for the GDA05 well (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. 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 **Error! Reference source not found.**. 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 the xmas tree.	**Yes**	For MEE-01-01, 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.

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Response technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: GWA Condensate				
Source control via relief well drilling	A platform release of condensate will be over approximately 71 days (GWA MEE-01-01) or 68 days (GWA MEE-01-02). Relief well drilling will be the primary option to stop the release.	**MEE-01-01:** For a spill from the GDA05 subsea wellhead, relief well drilling will be the primary means of controlling a well containment event. **MEE-01-02:** For a spill from the GWA08 platform wellhead, relief well drilling will be the only feasible means of controlling a well containment event.	**Yes**	Relief well drilling will be the primary feasible technique employed to control a loss of well containment event. Relief well drilling is a widely accepted and utilised technique.
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.	**MEE-01-01:** GWA Condensate is highly volatile with a low residue of 0.8%. Modelling predicts temporally and spatially limited oil at threshold (>50 g/m^2) on the surface and no shoreline contact. The use of SSDI would therefore not provide an environmental benefit and would increase dispersed/entrained hydrocarbon levels which can potentially have higher toxicity to biota in shallow water than naturally dispersed hydrocarbons. **MEE-01-02:** GWA08 is a platform wellhead, therefore, SSDI is not feasible for this surface release scenario.	**No**	A spill from the GDA05 well (MEE-01-01) is not predicted to result in significant surface oil at threshold and no shoreline impacts therefore the use of SSDI would increase dispersed/entrained hydrocarbon levels without providing a net environmental benefit. General safety risks associated with responding in close proximity to well release of volatile hydrocarbons. GWA08 (MEE-01-02) is a platform wellhead therefore SSDI is not feasible for this surface release scenario.
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. GWA Condensate is highly volatile with a low residue of 0.8%. Modelling predicts rapid spreading and evaporation with temporally and spatially limited oil at threshold (>50 g/m^2) on the surface and shoreline contact is only predicted at one receptor (Muiron Islands) on day 71 (MEE-01-02). The use of surface dispersant would therefore not provide an environmental benefit and would increase dispersed/entrained hydrocarbon levels which can potentially have higher toxicity to biota in shallow water than naturally dispersed hydrocarbons. Additionally, this technique may be prevented from being undertaken due to personnel safety issues arising from predicted high local concentrations of atmospheric volatiles.	**No**	Use of surface dispersant is not deemed to be an appropriate technique for use on highly volatile, low residue condensate and would 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. Furthermore, atmospheric volatile levels would make in unsafe for response personnel.
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. This method will not be adopted due to significant safety risks.
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. Also, there is a lack of equipment and trained personnel available in Australia.
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	Predicted low effectiveness – typical expectation is less than 10% of hydrocarbon released can be contained and recovered. Deepwater Horizon/Macondo effectiveness was approx. 3–5% with the largest containment and recovery operation ever conducted. Modelling of a GWA Condensate spill predicts that floating oil will be prone to rapid spreading and evaporation and will only reach the required threshold (>50 g/m^2) for containment and recovery to be feasible within 1 km of the well.	**No**	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. Surface concentrations will meet the 50 g/m^2 minimum concentration required for response options to be deployed, however, corralling a volatile hydrocarbon such as GWA.

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Response technique	Effectiveness	Feasibility	Decision	Rationale for the decision
Hydrocarbon: GWA Condensate				
	with submerged receptors by removing oil before further natural entraining/dissolving of hydrocarbons occurs.	Surface hydrocarbon would need to be corralled to a sufficient thickness to permit efficient recovery by skimmers, however, corralling a volatile, low flash point substance poses a significant safety risk and should be avoided. Meteorological conditions and sea-state must also allow the deployment of booms and skimmers.		Condensate poses a significant safety risk due to low flash points and thus should be avoided. This response technique is therefore not recommended.
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 MEE-01-02, the only shoreline contact is predicted from shoreline accumulation hydrocarbon in 71.4 Days (199 g/m^2 at Muiron Islands/ Muiron Islands MMA) allowing adequate time to deploy this technique. As only a small amount of oil will take a long time to spread to shorelines, this technique potentially may be used if M&E detect oil heading to sensitive receptors. Protection strategies can be used for targeted protection of sensitive resources. Access to sensitive areas may cause more negative impact than benefit.	**Potentially**	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 monitoring during a spill event, shoreline protection and deflection techniques may 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 MEE-01-02, the only shoreline contact is predicted from shoreline accumulation hydrocarbon in 71.4 Days (199 g/m^2 at Muiron Islands/ Muiron Islands MMA) 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 is 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 GWA 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.

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Table 4-4: Response technique evaluation – marine diesel release from vessel collision (MEE-05)

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 have 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

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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 is 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 is at risk of contamination, oiled wildlife response will be undertaken as and where required.

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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 Source control via Blow-out Preventer (BOP) intervention

GWA08 and GDA05 wells are production wells with no BOP thus intervention and/or hotstab are not feasible response techniques.

4.2.3.2 Subsea dispersant injection

GWA Condensate is highly volatile with a low residue of 0.8%. Modelling for MEE-01-01 predicts temporally and spatially limited oil at threshold (>50 g/m^2) on the surface and no shoreline contact. The use of SSDI would therefore not provide an environmental benefit and would increase dispersed/entrained hydrocarbon levels which can potentially have higher toxicity to biota in shallow water than naturally dispersed hydrocarbons.

GWA08 (MEE-01-02) is a platform wellhead, therefore, SSDI is not feasible for this surface release scenario.

4.2.3.3 Surface dispersant application

GWA Condensate is highly volatile, has very low residues and is prone to rapid spreading and evaporation. Modelling results for both MEE-01-01 and MEE-01-02 indicate that there will be temporally and spatially limited surface oil at response threshold (>50 g/m^2) for surface dispersant application in the open ocean within 1 km of the spill location. No floating oil at threshold reaches any offshore receptors. One shoreline receptor is impacted on day 71.4 (5.7 m^3 at Muiron Islands/ Muiron Islands MMA) for MEE-01-02. Therefore, surface dispersant application is unlikely to be effective in preventing isolated incidents of accumulation with no incremental benefit over natural weathering. It would unnecessarily introduce additional chemical substances to the marine environment and increase exposure of subsea species and habitats to hydrocarbons. It would thus not provide a net environmental benefit.

Additionally, the ongoing nature of the release combined with the potential for the plume to breach the surface may cause conditions leading to high local concentrations of atmospheric volatiles producing a health and safety risk, thus limiting the ability of a surface dispersant response to safely target fresh GWA Condensate.

4.2.3.4 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.

4.2.3.5 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

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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.

4.2.3.6 Containment and recovery

GWA Condensate is highly volatile, has very low residues and is prone to rapid spreading and evaporation. Modelling results for both MEE-01-01 and MEE-01-02 indicate that there will be temporally and spatially limited surface oil at response threshold (>50 g/m^2) suitable for containment and recovery in the open ocean within 1 km of the spill location. No floating oil at threshold reaches any offshore receptors. One shoreline receptor is impacted on day 71.4 (5.7 m^3 at Muiron Islands/ Muiron Islands MMA) for MEE-01-02.

For effective containment and recovery, surface hydrocarbons would need to be corralled to a sufficient thickness to permit efficient recovery by skimmers. Corralling a volatile, low flash point substance such as GWA Condensate, however, poses a significant safety risk and should be avoided. Therefore, due to the limited availability of recoverable hydrocarbons, the safety implications outweigh any predicted environmental benefit.

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.

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Table 4-5: 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												Outline response technique
		Monitor and evaluate	Source control – debris clearance and 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	
MEE-01-01: Hydrocarbon release caused by loss of well containment (subsea) 108,843 m^3 of GWA Condensate over 71 days (residual component of 870.7 m^3 or 12.2 m^3 per day).	Fastest time to shoreline accumulation >100 g/m^2 – no contact	Yes	Yes*	N/A	Yes	No	No	No	No	No	No	No	Yes	Monitor and evaluate. Initiate debris clearance and capping stack deployment (if plume radius is ~25 m). Initiate relief well drilling. Plan for oiled wildlife response and implement if oiled wildlife is observed.
MEE-01-02: Hydrocarbon release caused by loss of well containment (Platform well release) 171,033 m^3 of GWA Condensate over 68 days (residual component of 40.2 m^3).	Fastest time to shoreline accumulation >100 g/m^2 – 71.4 days at Muiron Islands and Muiron Islands MMA (5.7 m^3) Maximum shoreline accumulation – 5.7 m^3 at Muiron Islands and Muiron Islands MMA	Yes	No	N/A	Yes	No	No	No	No	No	Potentially	Yes	Yes	Monitor and evaluate. Initiate relief well drilling. 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.
MEE-05: 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	Yes	N/A	N/A	No	No	No	No	No	No	Yes	Monitor and evaluate. Initiate vessel 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 – MEE-01-01 and MEE-01-02), and marine diesel from a support vessel collision (MEE-05), the recommended response techniques are;

- monitor and evaluate (all scenarios)
- source control via debris clearance and capping stack if plume radius is ~25 m (MEE-01-01)
- source control via relief well drilling (MEE-01-01 and MEE-01-02)
- source control on the vessel (MEE-05)
- shoreline protection and deflection (MEE-01-02)

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- shoreline clean-up (MEE-01-02)
- oiled wildlife response (all scenarios).

Support functions include:

- waste management (all scenarios)
- scientific monitoring programs (all scenarios).

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5 HYDROCARBON SPILL ALARP PROCESS

Woodside's hydrocarbon spill ALARP process is aligned with guidance provided by NOPSEMA in *Oil Spill Risk Management Guidance Note N-04750-GN1488* (2021) and is set out in the 'Woodside Hydrocarbon Spill Oil Spill Preparedness and Response Mitigation Assessment (OSPRMA) Development 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.

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- 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.

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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 20 km of the platform well (MEE-01-02) and 48 km of the spill site (MEE-05). Surface hydrocarbons at >50 g/m^2 are predicted to be present in open water within 1 km of the platform well (MEE-01-02).
- No shoreline contact is predicted at threshold concentrations for MEE-05.
- The shortest time to contact for oil at concentrations of entrained hydrocarbons greater than 100 ppb at shoreline receptors is 1.9 days at Montebello Marine Park (MEE-01-02) and up to 354 km from the spill site, with a maximum at Montebello Marine Park (MEE-05 – 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 68 days (MEE-01-02) with response operations completing in month 4 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).

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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 5.10)**
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

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			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.

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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. Dynamically positioned and most jack-up rigs are not suitable for the GWA and GWF-3 wells water depths, therefore a moored MODU would be required.

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 (MEE-01-01) and 68 days (MEE-01-02)
  - a capping stack is in place (only feasible for MEE-01-01 and 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 (MEE-01-01) with response operations completing in month 4 (MEE-01-02) 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 GDA05 well (WWCI, 2020). WWCI analysed the plume and reported that with the WCCSs (MEE-01-01) 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.

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	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 relief well drilling for the GWA Facility and its wells. Capping stack may be viable for GDA05 well 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 – source and contract a MODU outside Australia with an approved Australian Safety Case

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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 5.10)**
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	Hot Stab and/or well intervention attempt made using ROV and SFRT within 11 days.	1, 3B, 3C
		9.5	Capping stack on suitable vessel mobilised to site within 16 days. Deployment and well intervention attempt will be made if plume size is acceptable (~25 m radius) and safety and metocean conditions are suitable.	1, 3C
		9.6	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
		9.7	MODU mobilised to site for relief well drilling within 21 days.	1, 3C
		9.8	First well kill attempt completed within 71 days (MEE-01-01) and 68 days (MEE-01-02).	1, 3B, 3C
		9.9	Open communication line(s) to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
		9.10	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
		9.11	At least two communication methods, one of which will include the capability to communicate with aviation.	1, 3A
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

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		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.

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5.3 Source Control via Vessel SOPEP

Vessel source control will be conducted, where feasible and in accordance with MARPOL 73/78 Annex I, by the Vessel Master under the Shipboard Oil Pollution Emergency Plan (SOPEP) triggered by any loss of containment from the PAP vessels.

The SOPEP provides guidance to the Master and Officers on board the vessel with respect to the extra steps to be taken when an unexpected pollution incident has occurred or is likely to occur. The SOPEP contains all information and operational instructions required by IMO Resolution MEPC.54 (32) adopted on 6 March 1992, as amended by resolution MEPC.86 (44) adopted on 13 March 2000.

Its purpose is to set in motion the necessary actions to stop or minimise oil discharge and mitigate its effects and outlines responsibilities, pollution reporting requirements, procedures and resources needed in the event of a hydrocarbon spill from vessel activities.

In the event of a potential vessel collision, the vessel master may engage precautionary marine manoeuvres to avoid collision or commence pumping operations to transfer marine diesel and thus minimise the release.

5.3.1 Environmental performance based on need

Woodside has established control measures, environmental performance outcomes, performance standards and measurement criteria to be used for vessel-source oil spill response during the PAP which are detailed in **Section 6.7** of the EP. The vessel master's roles and responsibilities are described in EP **Section 7.3.**

Performance standards for each contracted PAP vessel are detailed in the vessel's specific SOPEP.

These standards ensure that sufficient resources are available and are adequately tested to ensure implementation of the SOPEP in the event of a hydrocarbon spill.

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5.4 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.

5.4.1 Response need based on predicted consequence parameters

GWA03 loss of well containment (Platform surface release) (MEE-01-02)

The following statements identify the key parameters upon which a response need can be based:

- There is no contact to shoreline from floating oil at any threshold (>1 g/m^2).
- Pre-emptive assessment and shoreline assessments (OM04 and OM05) will be mobilised prior to shoreline contact if operational monitoring predicts any contact.

Marine diesel spill caused by vessel collision (MEE-05)

- 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.

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Table 5-5: 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).

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5.4.2 Environmental performance based on need

Table 5-6: Environmental Performance – Shoreline Protection and Deflection

Environmental Performance Outcome		To stop hydrocarbons encountering particularly sensitive areas		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.10)**
12	Response teams	12.1	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
		12.2	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
		12.3	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 71 days (operation as detailed above)	1, 3A, 3B, 4
		12.4	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
		12.5	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
		12.6	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
13	Response equipment	13.1	Equipment mobilised from closest stockpile 5 days prior to predicted impact.	1, 3A, 3C, 4
		13.2	Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles 5 days prior to predicted impact.	1, 3C, 3D, 4
		13.3	Supplementary equipment mobilised from OSRL 5 days prior to predicted impact.	
		13.4	Contract in place with 3rd party providers to access equipment.	1, 3A, 3C, 4
14	Management of Environmental Impact of the response risks	14.1	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
		14.2	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

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day 71.4, 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 6.3.

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5.5 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).

5.5.1 Response need based on predicted consequence parameters

GWA03 loss of well containment (surface platform wellhead release) (MEE-01-02)

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 71.4 days at Murion Islands and Murion Islands MMA (5.7 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 71.4 at Murion Islands (5.7 m^3).
- The duration of the spill may be up to 68 days with response operations extending up to month 4 based on the predicted time to complete shoreline clean-up operations.

Marine diesel spill caused by vessel collision (MEE-05)

- 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.

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- 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 5-7: 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.

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Table 5-8: 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.

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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.

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5.5.2 Environmental performance based on need

Table 5-9: 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 5.10)**
15	Shoreline responders	15.1	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
		15.2	Relevant TRPs will be identified in the first strike plan for activation 5 days prior to operational monitoring predicting impacts.	1, 3A, 3C, 4
		15.3	Relevant TRPs available for shoreline contacted 5 days prior to operational monitoring predicting impacts.	1, 3A, 3C, 4
		15.4	Clean-up operations for shorelines in line with results and recommendations from SCAT outputs.	1, 3A, 3B
		15.5	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.	
		15.6	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
		15.7	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
		15.8	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
16	Shoreline clean-up equipment	16.1	Contract in place with 3rd party providers to access equipment.	1, 3A, 3C, 4
		16.2	Equipment mobilised from closest stockpile 5 days prior to predicted impact.	
		16.3	Supplementary equipment mobilised from State, AMOSC, AMSA stockpiles 5 days prior to predicted impact.	1, 3C, 3D, 4
		16.4	Supplementary equipment mobilised from OSRL 5 days prior to predicted impact.	
17	Management of Environmental Impact of the response risks	17.1	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
		17.2	Shallow draft vessels will be used to access remote shorelines to minimise the impacts associated with seabed disturbance on approach to the shorelines.	

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		17.3	Vehicular access will be restricted on dunes, turtle nesting beaches an in mangroves.	
		17.4	Shoreline access route (foot, car, vessel and helicopter) with the least environmental impact identified will be selected by a specialist in SCAT operations.	
		17.5	Removal of vegetation will be limited to moderately or heavily oiled vegetation.	
		17.6	Oversight by trained personnel who are aware of the risks.	
		17.7	Trained unit leaders brief personnel prior to operations of the environmental risks of presence of personnel on the shoreline.	
		17.8	Limiting vegetation removal to only that vegetation that has been moderately or heavily oiled	

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 71.4 (MEE-01-02), 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 4.
- 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 6.5.

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5.6 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.

5.6.1 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 71.4 days at Muiron Islands and Muiron Islands MMA (5.7 m^3) for MEE-01-02. There is no shoreline impact predicted at response threshold of >100 g/m^2 for MEE-05.
- 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 5-12).

Table 5-10: Key at-risk species potentially in Response Protection Areas and open ocean

Species	Muiron Islands MMA & WHA	Open ocean
Marine turtles	✓	✓
Whale sharks	✓	✓
Seabirds and/or migratory shorebirds	✓	✓
Cetaceans – migratory whales	✓	✓
Cetaceans – dolphins and porpoises	✓	✓
Dugongs	✓	✓
Sharks and rays	✓	✓

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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 5-11 below.

Table 5-11: 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

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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 5-12) and the resources likely to be needed at each increasing level of response.

Table 5-12: 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

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5.6.2 Environmental performance based on need

Table 5-13: 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 5.10)**
18	Wildlife response equipment	18.1	Contracted capability to treat 100 individual wildlife for immediate mobilisation to Response Protection Areas (RPAs).	1, 3A, 3B, 3C, 4
		18.2	Contracted capability to treat up to an additional 250 individual wildlife within a 5-day period.	
		18.3	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
		18.4	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
		18.5	Facilities for the rehabilitation of oiled wildlife are operational 24/7 as per WAOWRP.	1, 3A, 4
19	Wildlife responders	19.1	2 wildlife divisional commanders to lead the oiled wildlife operations who have completed an Oiled Wildlife Response Management course.	1, 2, 3B
		19.2	Wildlife responders to be accessed through resource pool and additional agreements with specialist providers.	1, 2, 3A, 3B, 3C, 4
		19.3	Open communication line to be maintained between IMT and infield operations to ensure awareness of progress against plan(s).	1, 3A, 3B
20	Management of Environmental Impact of the response risks	20.1	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

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.

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5.7 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 to manage waste volumes generated from response activities.

5.7.1 Response need based on predicted consequence parameters

Table 5-14: Response Planning Assumptions – Waste Management

	Response planning assumptions: Waste management
Waste loading per m^3 oil recovered (multiplier)	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.

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5.7.2 Environmental performance based on need

Table 5-15: 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 5.10)**
21	Waste Management	21.1	Contract with waste management services for transport, removal, treatment and disposal of waste.	1, 3A, 3B, 3C, 4
		21.2	Access to 89 m^3 waste storage capacity by month 3.	
		21.3	Recovered hydrocarbons and wastes will be transferred to licensed treatment facility for reprocessing or disposal.	
		21.4	Teams will segregate liquid and solid wastes at the earliest opportunity.	
		21.5	Waste management provider support staff available year-round to assist in the event of an incident with waste management as detailed in contract.	
		21.6	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
		21.7	Waste management to be conducted in accordance with Australian laws and regulations.	1, 3A, 3B, 3C, 4
		21.8	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 MEE-01-02 are 60 m^3 during month 3 and up to 24 m^3 during month 4 with a maximum of 89 m^3 of waste expected across all shoreline clean-up and protection operations during the response. The capability available exceeds the need identified.
- Waste contractor 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 6.7.

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5.8 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 6 of the EP for further information on applicable thresholds and the EMBAs). The Petroleum Activities Program worst-case credible spill MEE-01-01 and MEE-01-02 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) 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 Monitor and Evaluate) for the 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:

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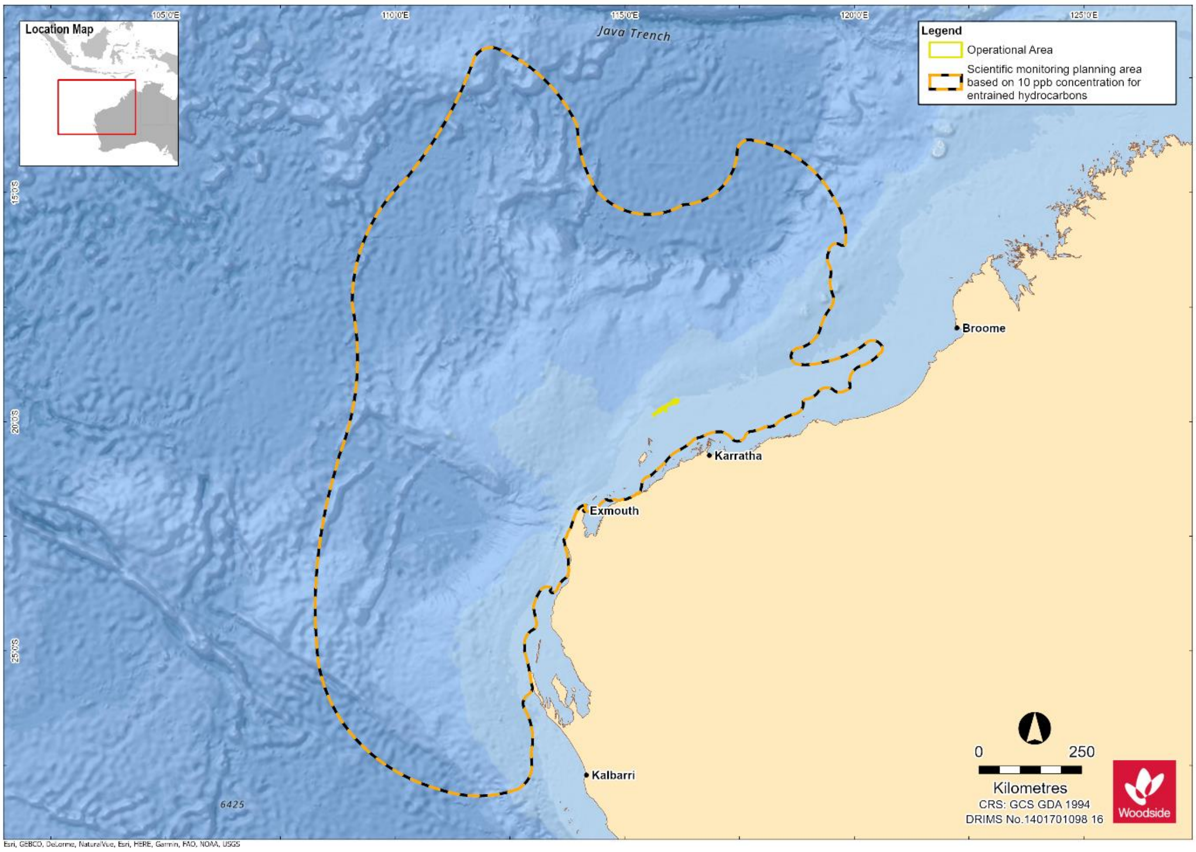

Figure 5-1:The planning area for scientific monitoring based on the area potentially contacted by the low (below ecological impact) entrained hydrocarbon threshold of 10 ppb in the event of the worst-case credible spill scenario (MEE-01-01 and MEE-01-02).

NOTE: 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 MEE-01-01 and MEE-01-02 and therefore represents the largest spatial boundaries of 100 MEE-01-01 and MEE-01-02 hydrocarbon spill combinations, not the spatial extent of a single MEE-01-01 and MEE-01-02 hydrocarbon spill.

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5.8.1 Scientific Monitoring Deployment Considerations

Table 5-16: 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: As part of this assessment, the approach was to conduct a desktop review of available and appropriate baseline data for key receptors for locations (if any) that are potentially impacted within ten days of a spill (based on the EMBA). Then investigate the need to conduct baseline data collection to address data gaps and demonstrate spill response preparedness (refer to Annex D). In the scenario, that baseline data needs are identified, 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). As part of this assessment, a desktop review is conducted of available and appropriate baseline data for key receptors for locations (if any) that are potentially impacted >10 days' time of a hydrocarbon spill event and documented (refer to Section 5.7.2). SMP activation (as per the GWA Facility Operations 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.

5.8.2 Response Planning Assumptions

Table 5-17: 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

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	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 the GWA Facility Operations. PBAs for GWA Facility Operations 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 [11] • Glomar Shoal • Montebello Islands • Barrow Island • Lowendal Islands • 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 upper layers of 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 spills MEE-01-01 and MEE-01-02 (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[12] • Muiron Islands[13] • 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 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

[11] 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 and Glomar Shoal ≤10 days.
[12] Ningaloo Coast includes the WHA and State Marine Park
[13] Muiron islands includes the WHA and Marine Management Area

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	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 GWA Facility Operations 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 spills MEE-01-01 and MEE-01-02, is presented in the GWA Facility Operations 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)[14] (refer to ANNEX C: Oil Spill Scientific Monitoring Program).

5.8.3 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.

5.8.4 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,
- Muiron Islands
- Ningaloo AMP
- 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

[14] https://biocollect.ala.org.au/imsa#max%3D20%26sort%3DdateCreatedSort

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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 6.8 considers ways to reduce the gap by considering alternate, additional, and/or improved control measures on each selected response strategy.

5.8.5 Environmental performance based on need

Table 5-18: 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**
22	• Woodside has an established and dedicated SMP team comprising the Environmental Science Team and additional Environment Advisers within the Health Safety Environment (HSE) Function.	22.1	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.
23	• 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). • 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.	23.1	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 Implementation Plan. • Scientific Monitoring Program Implementation Plan describes the process for standing up and implementing the scientific monitoring programs.	• Hydrocarbon Spill Preparedness Team Internal Control Environment tracks the quarterly review of the Oil Spill Contracts Master. • SMP resource report of personnel availability provided by SMP contractor on monthly basis (SMP resourcing report register.

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			• SMP team stand up personnel receive training regarding the stand up, activation and implementation of the SMP on an annual basis.	• Training materials. • Training attendance registers. • Competency criteria for SMP roles. • SMP annual arrangement testing and reporting.
24	• 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 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	24.1	• 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.

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	Monitoring Program (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 standby contractor and the SMP arrangements (people and equipment availability) tested annually since 2016.			
25	• 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 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	25.1	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.

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	practicable, the environmental baseline data prior to hydrocarbon contact required to support the post-response SMP.			
26	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)[15] (refer to ANNEX C: Oil Spill Scientific Monitoring Program).	26.1	• 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**
27	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.	27.1	**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 (IAPs).

15 https://biocollect.ala.org.au/imsa#max%3D20%26sort%3DdateCreatedSort

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		27.2	**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**
28	• 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 Incident Action Plan (IAP) to trigger operational logistic support services. Methodology documents for each of the ten SMPs are accessible detailing 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.	28.1	**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.
		28.2	**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.
		28.3	**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,	Evidence of Termination Criteria triggered: • Documentation and approval by relevant stakeholders to end SMPs for

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			and the Termination Criteria Decision-tree for Oil Spill Environmental Monitoring (Figure C-3 of ANNEX C):	specific receptor types.

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5.9 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.

5.9.1 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.

5.9.2 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.

5.9.3 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.

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5.9.4 Environmental performance based on need

Table 5-19: Environmental Performance – Incident Management System

Environmental Performance Outcome		To support the effectiveness of all other control measures and monitor/record the performance levels achieved.		
Control measure		**Performance Standard**		**Measurement Criteria (Section 5.10)**
29	Operational SIMA	29.1	Confirm that the response strategies adopted at the time of acceptance remain appropriate to reduce the consequences of the spill within 24 hours.	1, 3A
		29.2	Record the evidence and justification for any deviation from the planned response activities.	
		29.3	Record the information and data from operational and scientific monitoring activities used to inform the SIMA.	
30	Stakeholder engagement	30.1	Prompt and record all notifications (including government notifications) for stakeholders in the region are made.	
		30.2	In the event of a response, identification of relevant stakeholders will be re-assessed throughout the response period.	
		30.3	Undertake communications in accordance with: • Woodside Crisis Management Functional Support Team Guideline – Reputation • External Communication and Continuous Disclosure Procedure • External Stakeholder Engagement Procedure	
31	Personnel required to support any response	31.1 31.2	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.	1, 3B
		31.3	A duty roster of trained and competent people will be maintained to ensure that minimum manning requirements are met all year round.	3C
		31.4	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.	1, 2, 3B, 3C, 4
		31.5	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.	
		31.6	S&EM advisors will be integrated into ICC to monitor performance of all functional roles.	
		31.7	Continually communicate the status of the spill and support Woodside to determine the most appropriate response by delivering on the responsibilities of their role.	
		31.8	Follow the OPEA, Operational Plans, FSPs, support plans and the IAPs developed.	1, 2, 3A, 4
		31.9	Contribute to Woodside's response in accordance with the aims and objectives set by the Duty Manager.	1, 2, 3B, 3C, 4

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5.10 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:

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- Woodside internal
- AMOSC core group
- AMOSC
- OSRL
- Marine Spill Response Corporation (MSRC)
- AMSA
- Woodside contracted workforce

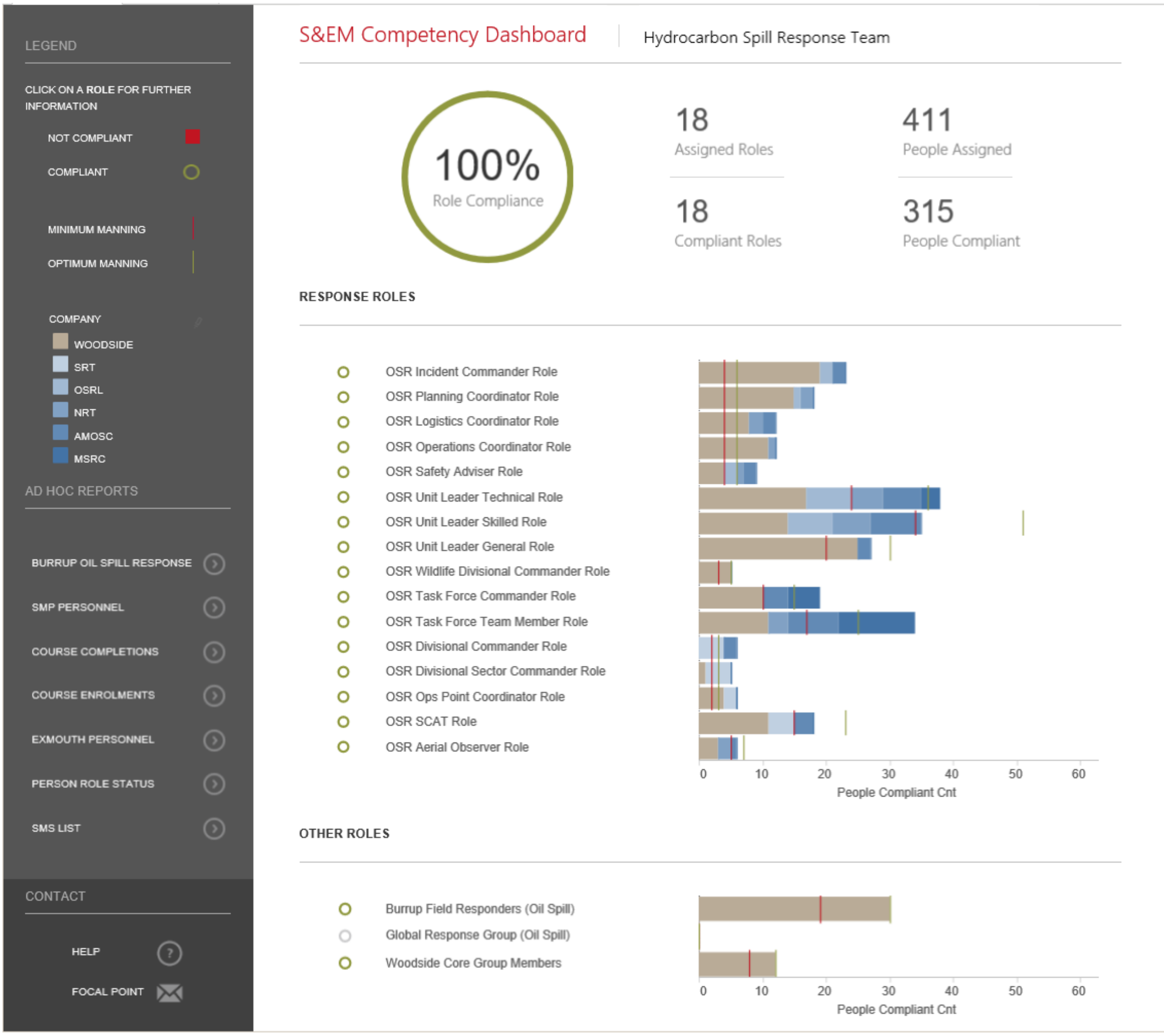

Figure 5-2: Example screen shot of the Hydrocarbon Spill Preparedness competency dashboard

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.

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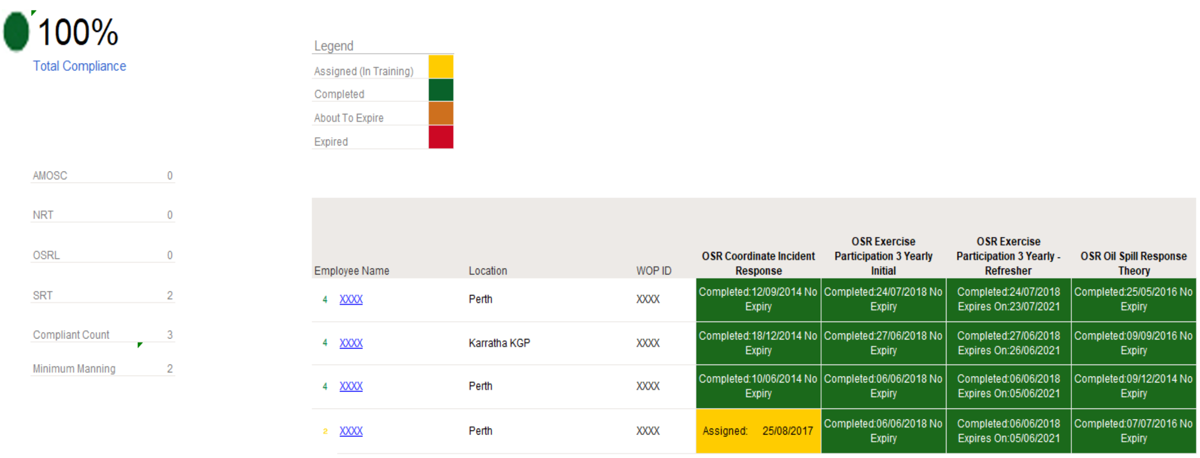

Figure 5-3: Example screen shot for the Operations Point Coordinator role

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[16] 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.

[16] 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

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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.

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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

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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

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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:

- Capping stack (only viable for MEE-01-01: loss of well containment where the plume radius is ~25 m)
- Relief well drilling.

6.2.1 ROV Intervention

Following confirmation of an emergency event involving a subsurface release, Woodside would mobilise inspection class ROVs via existing frame agreements to undertake inspection activities. ROV would be 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 GWA and 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 (days)
Source and mobilise vessel with work class ROV	2 days
Liaise with Regulator regarding risks and impacts*	4 days
Undertake ROV Inspection	1 day
TOTAL	**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 6-3 for implementing this response would be “no safety case revision required”. Timeframes for well intervention are detailed in Figure 6-2 and would be implemented concurrently to the actions required by the “no Safety Case” revision scenario detailed in Figure 6-3, therefore, the Safety Case scenario will have no impact on the delivery of the strategy.

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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 6-3 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 would be implemented concurrently to the actions required by the “No Safety Case” revision scenario detailed in Figure 6-3, 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. This response applies to MEE-01-01 (GDA05 subsea release) only.

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 GDA05 well (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.

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.

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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 would be implemented concurrently with the actions required for the Safety Case revision development scenarios detailed in Figure 6-3 and 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 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.

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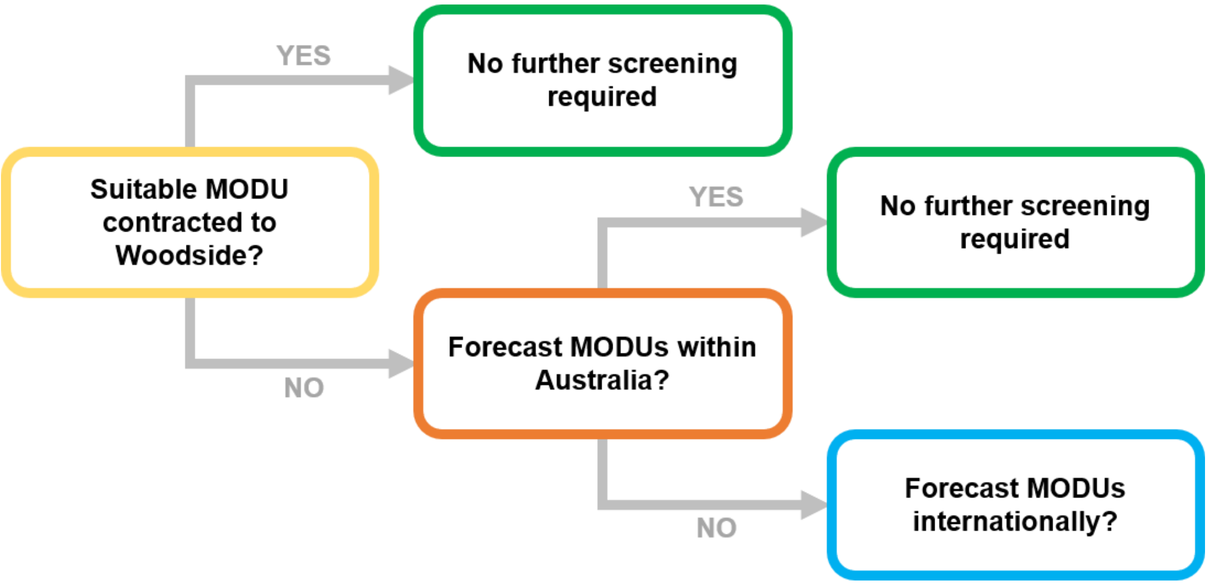

Figure 6-1: GWA process for sourcing relief well MODU

The internal and external availability of 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 Australia safety case is not identified, an internal review will be undertaken, NOPSEMA notified and the issue tables 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 environmental management of change requirements and relevant regulatory triggers. The lookahead timeframe would allow two years' warning of any potential gap. Woodside will execute relief well drilling in the fastest possible timeframe.

Based on the detail provided, the Primary and Alternate approaches are expected to be achieved within the relief well duration period.

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 68 days for GWA08. 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 GDA wells drilled in the GWF-3 campaign. This well was also analysed for the well-kill modelling work due to it being the worst-case blowout rates for the GDA wells.
- GWA08 is the highest producing platform well at time of modelling and represents the worst-case platform well blowout scenario

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 GWA and GWF PAPs and have been used as the basis for the analysis within this document.

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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 contains the breakdown for relief well drilling for GDA05 as the longest relief well timeframe. Timing variations between relief well durations are due to the wells' casing program differences, however intersection point is assumed to be into the production liner of the blowing out well for both wells analysed.

Table 6-2: Relief well drilling timings

	Estimate Relief Well duration for GDA05 Well (days) – moored
Source and contract MODU comprising the following stages:	**21 days total:**
Activate MOU. Secure and suspend well. Complete relief well design. Secure relief well materials.	*8 days*
Transit to location based on mobilisation from Northwest shelf region.	*2 days*
Backload and loadout bulks and equipment, complete internal assurance of relief well design.	*2 days*
Contingency for unforeseen event (e.g. longer transit from another area, problems in securing well, cyclone event)	*9 days*
Pre-spud survey	**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**
Drilling, casing and look ahead estimate	**20.0 days**
Intersection & well kill comprising the following stages:	**14.0 days total:**
Drill out shoe, conduct formation integrity test and drill towards intersection point	*1.5 days*
Execute well-specific ranging plan to intersect blowout wellbore in minimum timeframe, with highest possible accuracy.	*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*
Contingency for unforeseen technical issues (e.g.: more ranging runs required to make intersect, additional mud circulations required to execute kill	*2.5 days*
	71.0 days

The following conditions and assumptions are applicable:

- A dynamically positioned MODU is not feasible for the water depths at GDA05 and GWA08.

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- 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	2
Total	**37**

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.

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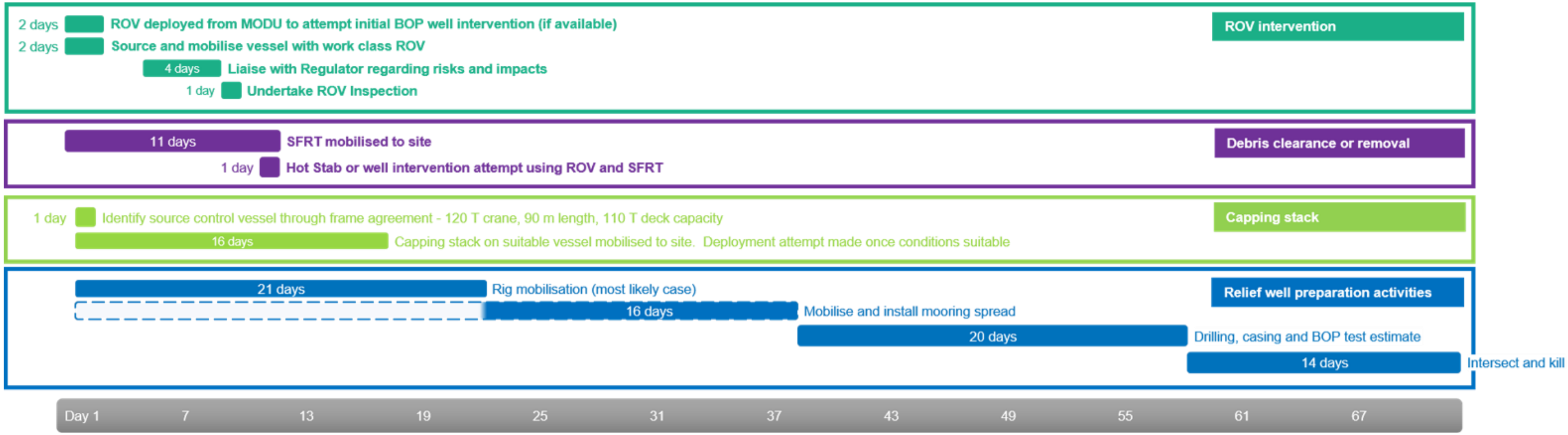

Figure 6-2: Source control and well intervention response strategy deployment timeframes

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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 6-3. 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.

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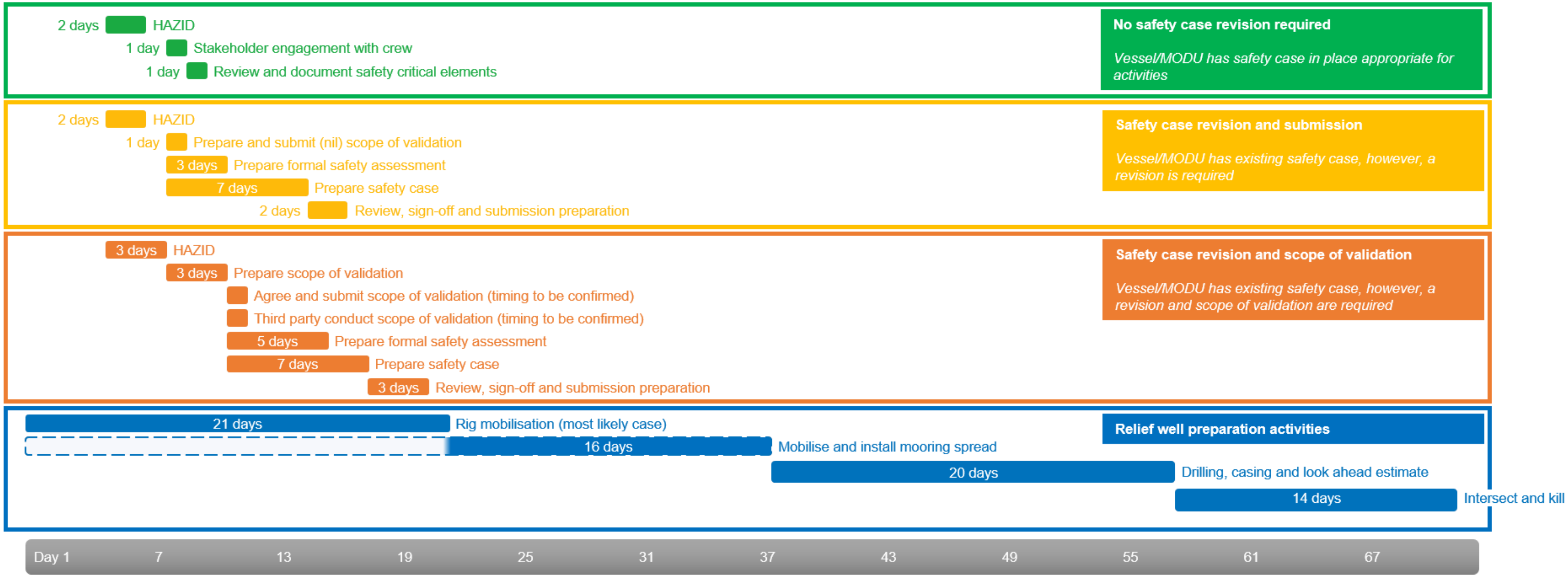

Figure 6-3: Timeline showing safety case revision timings alongside other relief well preparation activity timings

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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.

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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).

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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

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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

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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), 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 GDA05 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), 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 (GDA05) 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 (GDA05) 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

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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

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6.3 Source Control via Vessel SOPEP – ALARP Assessment

Alternative, Additional and Improved options have been 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 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 Source Control via Vessel SOPEP – Control Measure Options Analysis

6.3.1.1 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**	**Approx. Cost**	**Implemented**
No reasonably practical alternative control measures identified.				N/A

6.3.1.2 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**	**Approx. Cost**	**Implemented**
No reasonably practical alternative control measures identified.				N/A

6.3.1.3 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**	**Approx. Cost**	**Implemented**
No reasonably practical alternative control measures identified.				N/A

6.3.1.4 Selected control measures

Following review of alternative, additional and improved control measures, the following controls were selected for implementation for the activity.

- Alternative
  - None selected
- Additional
  - None selected
- Improved
  - None selected

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6.4 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.

6.4.1 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.

6.4.2 Response Planning: GWA (MEE-01-02) 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 1 (if required). Deterministic modelling scenarios indicate that first shoreline impact at Muiron Islands/ Muiron Islands MMA within 71.4 days for MEE-01-02. There is no shoreline impact predicted at threshold for MEE-05. 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 6-5 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 6-5: 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) m³ – GWA (MEE-01-02)	0	0	0	0	0	0	0		0	0	0		0	6	0
A	Capability Required															
A1	RPAs impacted by maximum accumulated volume – GWA (MEE-01-02)	0	0	0	0	0	0	0		0	0	0		0	1	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	330
B2	SPD operations available – per day (upper)	1	2	3	4	6	8	10		84	84	84		336	336	336
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 5.3).

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.

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Table 6-6: RPAs for GWA (MEE-01-02)

Areas of coastline contacted	Conservation status	IUCN protection category	Minimum time to shoreline contact (above 100g/m²) in days [17]	Maximum shoreline accumulation (above 100g/m²) in m³ [18]
			MEE-01-02	
Muiron Islands/ Muiron Islands MMA	Marine Management Area	IUCN VI – Protected area with sustainable use of natural resources IUCN IA – Strict Nature Reserve	71.4 days (5.7 m^3)	5.7 m^3 (71.4 days)

[17] This volume and time represent the first time to contact on defined shoreline polygon and the maximum volume ashore for that 24 hour period.
[18] This volume and time represent the maximum volume ashore on defined shoreline polygon for any 24 hour time period

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6.4.3 Shoreline Protection and Deflection – 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**
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

6.4.3.2 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**
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

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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**	**Approximate cost**	**Assessment conclusions**	**Implemented**
Faster response/ mobilisation time	Given modelling does not predict shoreline impacts at threshold until day 71.4 (MEE-01-02) 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 71 at Muiron Islands/ Muiron Islands MMA for MEE-01-02 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

6.4.4 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

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6.5 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.

6.5.1 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.

6.5.2 Response planning: GWA– 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 only shoreline impact is at Muiron Islands/ Muiron Islands MMA within 71.4 days for MEE-01-02 (5.7 m^3). There is no shoreline impact predicted at threshold for MEE-05. 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 6.5.3

Table 6-7: 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	0	0	0	6	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	0	0	0	1	0
A2	**Shoreline clean-up operations required (upper)**	0	0	0	0	0	0	0	0	0	0	0	1	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 5.5).

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.

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Table 6-8: RPAs for GWA (MEE-01-02)

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]
			MEE-01-02	
Muiron Islands/ Muiron Islands MMA	Marine Management Area	IUCN VI – Protected area with sustainable use of natural resources IUCN IA – Strict Nature Reserve	71.4 days (5.7 m^3)	5.7 m^3 (71.4 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

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6.5.3 Shoreline Clean-up – 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**
No reasonably practical alternative control measures identified.					

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**
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

6.5.3.3 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**
Faster response/ mobilisation time	Given modelling does not predict shoreline impacts at threshold until day 71.4 (MEE-01-02) 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 71.4 at Muiron Islands/ Muiron Islands MMA for MEE-01-02 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

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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
  - None selected

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6.6 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.

6.6.1 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.

6.6.2 Oiled Wildlife Response – Control Measure Options Analysis

6.6.2.1 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

6.6.2.2 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 71.4 (MEE-01-02), 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 71.4, 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

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6.6.2.3 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

6.6.3 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

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6.7 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.

6.7.1 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.

6.7.2 Waste Management – Control Measure Options Analysis

6.7.2.1 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.					

6.7.2.2 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 waste contractor'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

6.7.2.3 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 waste contractor 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 waste contractor'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

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6.7.3 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

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6.8 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.

6.8.1 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.

6.8.2 Scientific Monitoring – Control Measure Options Analysis

Table 6-9: 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 6-10: 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 activities.

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6.8.3 Improved Control Measures

Improved Control Measures considered – No reasonably practicable improved Control Measures identified.

6.8.4 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

6.8.5 Operational Plan

Key actions from the Scientific Monitoring Program Operational Plan for implementing the response are outlined in Table 6-11.

Table 6-11: 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 Lead/Manager, SMP Coordinator, SMP	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.

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Responsibility	Action
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).

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6.8.6 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>Additional Measures: Determine baseline data needs and activate SMPs for any identified PBAs in the event of an unplanned hydrocarbon release</td></tr>
<tr><td></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 ALARP 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>

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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
- 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.

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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		✓	✓	✓	✓	✓	✓
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

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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.

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)

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- 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

- 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 14.1, PS 17.1).
- Shallow draft vessels will be used to access remote shorelines to minimise the impacts associated with seabed disturbance on approach to the shorelines (PS 14.2, PS 17.2).

Presence of personnel on the shoreline

- Vehicular access will be restricted on dunes, turtle nesting beaches and in mangroves (PS 17.3).
- Shoreline access route (foot, car, vessel and helicopter) with the least environmental impact identified will be selected by a specialist in SCAT operations (PS 7.3, PS 17.4).
- Removal of vegetation will be limited to moderately or heavily oiled vegetation (PS 17.5).
- Oversight by trained personnel who are aware of the risks (PS 17.6).
- Trained unit leaders brief personnel prior to operations of the environmental risks of presence of personnel on the shoreline (PS 17.7).

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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 20.1).

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 15.5).
- Limiting vegetation removal to only that vegetation that has been moderately or heavily oiled (PS 17.8).

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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.

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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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10 REFERENCES

Allen, A. and D. Dale. 1996. Computerized Mission Planners: Useful tools for the planning and implementation of oil spill response operations. Proceedings, “Prevention is the Key: A Symposium on Oil Spill Prevention and Readiness,” Valdez, AK, Oct. 8–11, 1996, 24 pp.

ANZECC / ARMCANZ 2018. Australian & New Zealand Guidelines for Fresh & Marine Water Quality Management Framework. https://www.waterquality.gov.au/anz-guidelines

APASA 2013. Xena Vessel Collision – Spill Modelling Results. Memorandum to Woodside Energy Ltd.

Australian Maritime Safety Authority. The National Plan Oil Spill Control Agents List. Available from: https://www.amsa.gov.au/environment/maritime-environmental-emergencies/national-plan/General-Information/control-agents/list/index.asp [Accessed 23 June 2014]

Australian Maritime Safety Authority (AMSA). 2015a. Automated Identification System Point Density Data. Australian Government, Canberra, Australian Capital Territory. Available at: https://www.operations.amsa.gov.au/Spatial/DataServices/MapProduct (accessed 08/10/2015).

Australasian Fire and Emergency Service Authorities Council, 2011, Fundamentals of Doctrine: A best practice guide, East Melbourne, VIC, AFAC Limited.

AMOSC/DPAW (2014). Inter-Company Oil Spill Wildlife Response Plan – Pilbara region. pp. 272 http://www.dpaw.wa.gov.au/images/documents/conservation-management/marine/wildlife/PROWRP_20141103.pdf

Brandvik, PJ, Johansen, Ø, Farooq, O, Angell, G. and Leirvik, F. (2014). Subsurface oil releases – Experimental study of droplet distributions and different dispersant injection techniques. A scaled experimental approach using the SINTEF Tower basin. SINTEF report no. A26122. Norway.

Brown M, 2012, Implementing an Operational Capability System within Fire & Rescue NSW, Australasian Fire and Emergency Service Authorities Council Conference Paper, September 2012.

BSEE. 2016. https://www.bsee.gov/site-page/worst-case-discharge-scenarios-for-oil-and-gas-offshore-facilities-and-oil-spill-response

BSEE. 2016. https://www.bsee.gov/what-we-do/oil-spill-preparedness/response-system-planning-calculators

Department of Parks and Wildlife and Australian Marine Oil Spill Centre, 2014. Western Australian Oiled Wildlife Response Plan.

Edwards v National Coal Board, 1949. 1 All ER 743 CA

EMSA, Manual on the applicability of oil spill dispersants, 2010, Vers 2, p 57.

European Maritime Safety Agency, 2012. Manual on the Applicability of Oil Spill Dispersants, Version 2, p.57.

Fingas, M. 2001. The Basics of Oil Spill Cleanup. Second Edition. Lewis Publishers, CRC Press LLC, Boca Raton, Florida. 233 p.

Fingas, M. 2011a. Physical Spill Countermeasures. *Oil Spill Science and Technology: Prevention, Response, and Cleanup*, edited by M. Fingas. Elsevier, Inc.

Fingas, M. 2011b. Weather Effects on Oil Spill Countermeasures. *Oil Spill Science and Technology: Prevention, Response, and Cleanup*, edited by M. Fingas. Elsevier, Inc.

French-McCay, D.P. 2003. Development and application of damage assessment modeling: Example assessment for the North Cape oil spill. Mar. Pollut. Bull. 47(9-12), 341-359.

French-McCay, D.P. 2004. Oil spill impact modeling: development and validation. Environ. Toxicol. Chem. 23(10), 2441-2456.

French, D., Reed, M., Jayko, K., Feng, S., Rines, H., Pavignano, S.1996. The CERCLA Type A Natural Resource Damage Assessment Model for Coastal and Marine Environments (NRDAM/CME), Technical Documentation, Vol. I - Model Description, Final Report. Office of Environmental

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Policy and Compliance, U.S. Department of the Interior. Washington, D.C.: Contract No. 14-0001-91-C-11

French, D.P., H. Rines and P. Masciangioli. 1997. Validation of an Orimulsion spill fates model using observations from field test spills. In: Proceedings of the 20th AMOP Technical Seminar, Environment and Climate Change Canada, Ottawa, ON, Canada, 20, 933-961.

French, D.P. and H. Rines. 1997. Validation and use of spill impact modeling for impact assessment. International Oil Spill Conference Proceedings, Vol. 1997, No. 1, pp. 829-834. [https://doi.org/10.7901/2169-3358-1997-1-829]

French-McCay, D.P. and J.J. Rowe. 2004. Evaluation of bird impacts in historical oil spill cases using the SIMAP oil spill model. In Proceedings of the 27th AMOP Technical Seminar, Environment and Climate Change Canada, Ottawa, ON, Canada, 27, 421-452.

French-McCay, D.P, C. Mueller, K. Jayko, B. Longval, M. Schroeder, J.R. Payne, E. Terrill, M. Carter, M. Otero, S. Y. Kim, W. Nordhausen, M. Lampinen, and C. Ohlmann, 2007. Evaluation of Field-Collected Data Measuring Fluorescein Dye Movements and Dispersion for Dispersed Oil Transport Modeling. In: Proceedings of the 30th Arctic and Marine Oil Spill Program (AMOP) Technical Seminar, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada, pp.713-754.

French McCay, D.P, K. Jayko, Z. Li, M. Horn, Y. Kim, T. Isaji, D. Crowley, M. Spaulding, L. Decker, C. Turner, S. Zamorski, J. Fontenault, R. Shmookler, and J.J. Rowe. 2015. Technical Reports for Deepwater Horizon Water Column Injury Assessment – WC_TR14: Modeling Oil Fate and Exposure Concentrations in the Deepwater Plume and Cone of Rising Oil Resulting from the Deepwater Horizon Oil Spill. DWH NRDA Water Column Technical Working Group Report. Prepared for National Oceanic and Atmospheric Administration by RPS ASA, South Kingstown, RI, USA. September 29, 2015. Administrative Record no. DWH-AR0285776.pdf [https://www.doi.gov/deepwaterhorizon/adminrecord]

French-McCay, D.P, Z. Li, M. Horn, D. Crowley, M. Spaulding, D. Mendelsohn, and C. Turner. 2016. Modeling oil fate and subsurface exposure concentrations from the Deepwater Horizon oil spill. In: Proceedings of the 39th AMOP Technical Seminar, Environment and Climate Change Canada, Ottawa, ON, Canada, 39, 115-150.

IPIECA, 2015, Dispersants: surface application, IOGP Report 532, p.43.

ITOPF, 2011. Fate of Marine Oil Spills, Technical Information Paper #2.

ITOPF, 2014, Use of Dispersants to Treat Oil Spills, Technical Information Paper #4, p. 7.

ITOPF, 2014, Aerial Observation of marine oil spills, Technical Information Paper #1, p. 5

ITOPF, 2014, Use of skimmers in oil pollution response, Technical Information Paper #5, p. 9

National Oceanic and Atmospheric Administration (NOAA) Characteristics of Response Strategies: A Guide for Spill Response Planning in Marine Environments, 2013, p.19 and p24.

National Offshore Petroleum Safety and Environmental Management Authority. 2012. Environment Plan Assessment Policy, N-04700-PL0930, Perth, WA.

National Offshore Petroleum Safety and Environmental Management Authority. 2012. Environment Plan Preparation Guidance Note, N-04700-GL0931, Perth, WA

National Offshore Petroleum Safety and Environmental Management Authority. 2012. Control Measures and Performance Standards, Guidance Note N04300-N0271, Perth, WA.

National Offshore Petroleum Safety and Environmental Management Authority. 2012. Oil Spill Contingency Planning, Guidance Note N-04700-GN0940, Perth, WA.

National Offshore Petroleum Safety and Environmental Management Authority. 2015. ALARP, Guidance Note N-04300-GN0166, Perth, WA.

National Offshore Petroleum Safety and Environmental Management Authority. 2021. Oil Pollution Risk Management, Guidance Note N-04750-GN1488, Perth, WA.

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National Offshore Petroleum Safety and Environmental Management Authority. 2016. Vessels Subject to the Australian Offshore Petroleum Safety Legislation, Guidance Note N-09000-GN1661, Perth WA

Payne, J.R., E. Terrill, M. Carter, M. Otero, W. Middleton, A. Chen, D. French-McCay, C. Mueller, K. Jayko, W. Nordhausen, R. Lewis, M. Lampinen, T. Evans, C. Ohlmann, G.L. Via, H. Ruiz-Santana, M. Maly, B. Willoughby, C. Varela, P. Lynch and P. Sanchez, 2007a. Evaluation of Field-Collected Drifter and Subsurface Fluorescein Dye Concentration Data and Comparisons to High Frequency Radar Surface Current Mapping Data for Dispersed Oil Transport Modeling. In: Proceedings of the Thirtieth Arctic and Marine Oil Spill Program (AMOP) Technical Seminar, Emergencies Science Division, Environment Canada, Ottawa, ON, pp. 681-711.

Payne, J.R., D. French-McCay, C. Mueller, K. Jayko, B. Longval, M. Schroeder, E. Terrill, M. Carter, M. Otero, S.Y. Kim, W. Middleton, A. Chen, W. Nordhausen, R. Lewis, M. Lampinen, T. Evans, and C. Ohlmann, 2007b. Evaluation of Field-Collected Drifter and In Situ Fluorescence Data Measuring Subsurface Dye Plume Advection/Dispersion and Comparisons to HighFrequency Radar-Observation System Data for Dispersed Oil Transport Modeling, Draft Final Report 06-084, Coastal Response Research Center, NOAA/University of New Hampshire, Durham, NH, 98 p. plus 8 appendices. Available at http://www.crrc.unh.edu/

Spaulding, M.S., D. Mendelsohn, D. Crowley, Z. Li, and A. Bird, 2015. Draft Technical Reports for Deepwater Horizon Water Column Injury Assessment: WC_TR.13: Application of OILMAP DEEP to the Deepwater Horizon Blowout. DWH NRDA Water Column Technical Working Group Report. Prepared for National Oceanic and Atmospheric Administration by RPS ASA, South Kingstown, RI 02879. Administrative Record no. DWH-AR0285366.pdf [https://www.doi.gov/deepwaterhorizon/adminrecord]

Spence, A, McTaggart, A (2018) Defining response capability: effectiveness, limitations and determining ALARP. Interspill Conference, London 2018.

Wadsworth, T, 1995, *Containment & Recovery of Oil Spills at Sea. Methods and limitations*, ITOPF, London, United Kingdom.

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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.

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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.

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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

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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

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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

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ANNEX A: NET ENVIRONMENTAL BENEFIT ANALYSIS DETAILED OUTCOMES

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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 GWA Condensate (GWA03) from the platform well (MEE-01-02) and a spill of marine diesel from a vessel collision (MEE-05). 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 GWA Facility Operations project preoperational NEBAs contains the full assessments.

Table A-1: NEBA assessment technique recommendations for GWA (MEE-01-02)

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
Muiron Islands & Marine Management Area	Yes	Yes	N/A	No	No	No	No	No	Potentially	Yes	No	No	Yes
Open water	Yes	Yes	N/A	No	No	No	No	No	Potentially	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	No	No	No	No	No	Potentially	Yes	No	No	Yes
NEBA identifies response potentially of net environmental benefit?	Yes	Yes	N/A	No	No	No	No	No	Potentially	Yes	No	No	Yes

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Table A-2: NEBA assessment technique recommendations for marine diesel (MEE-05)

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

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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. **[See NOTE]**	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.

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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

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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.

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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).

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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.

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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.

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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).

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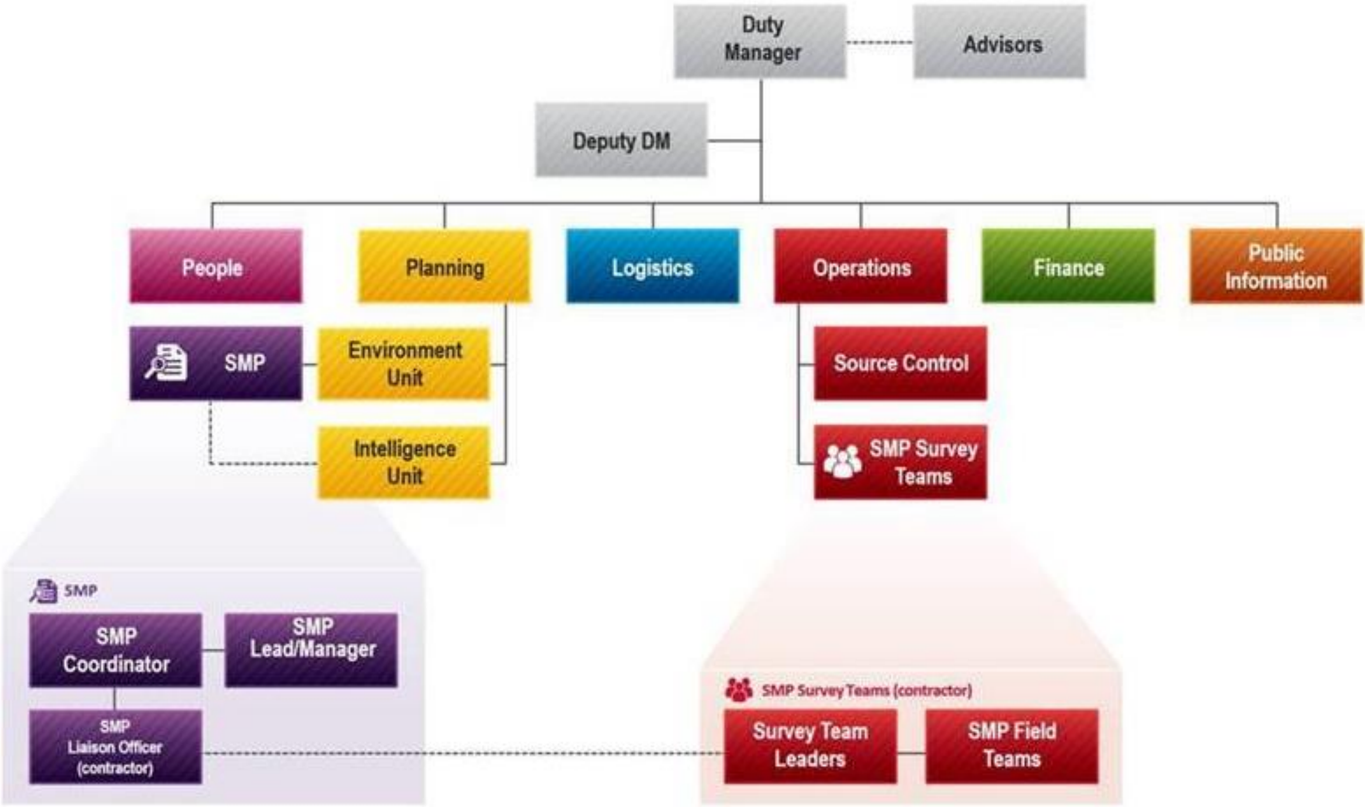

Figure C-1: Woodside Oil Spill Scientific Monitoring Program Delivery Team and Linkage to Incident Control Centre (ICC) organisational structure.

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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[21]) 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[22]) 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.

[21] NOPSEMA (2019) Bulletin #1 – Oil spill modelling – April 2019, https://www.nopsema.gov.au/assets/Bulletins/A652993.pdf
[22] 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.

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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.

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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.

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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

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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).

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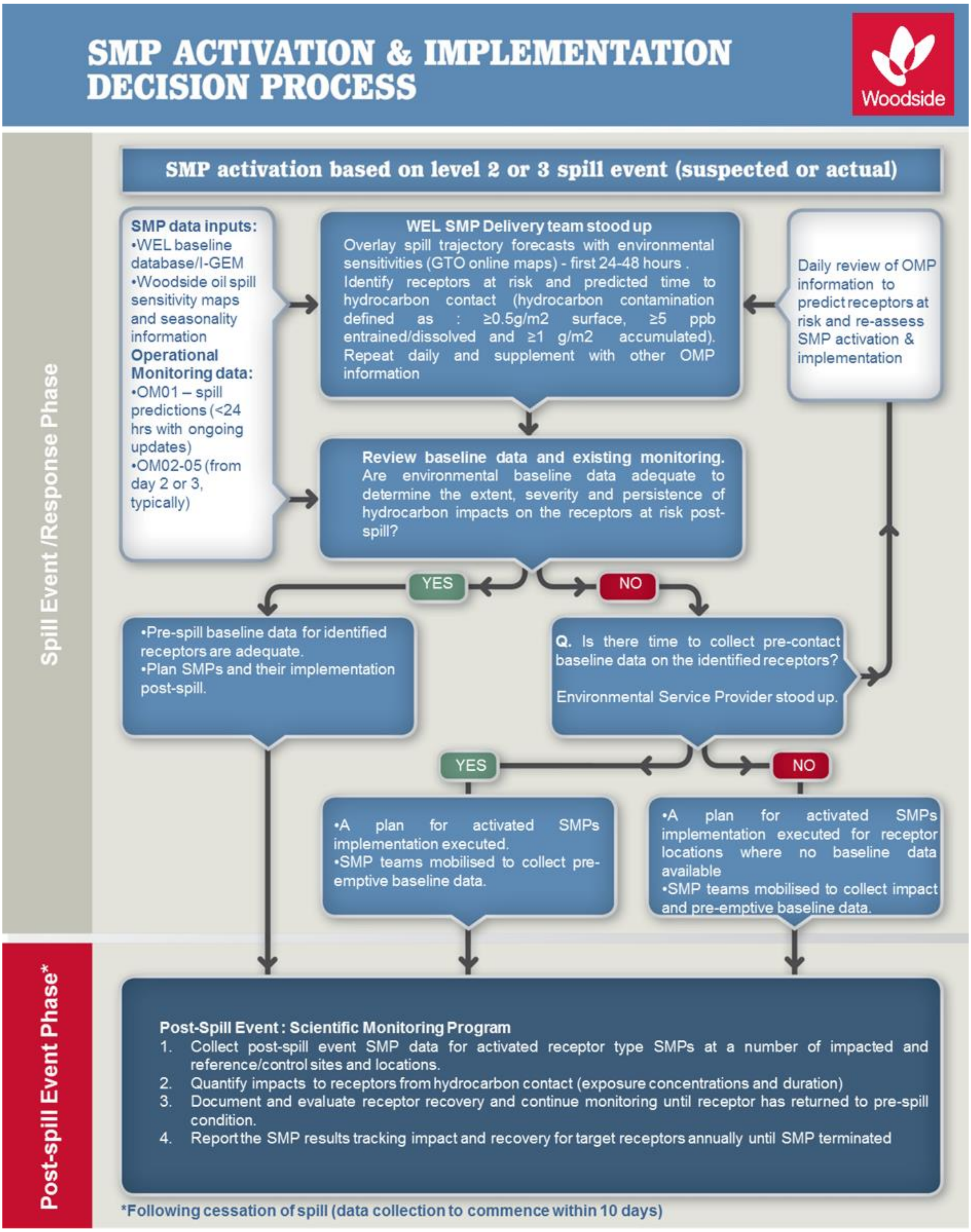

Figure C-2: Activation and Implementation Decision-tree for Oil Spill Environmental Monitoring

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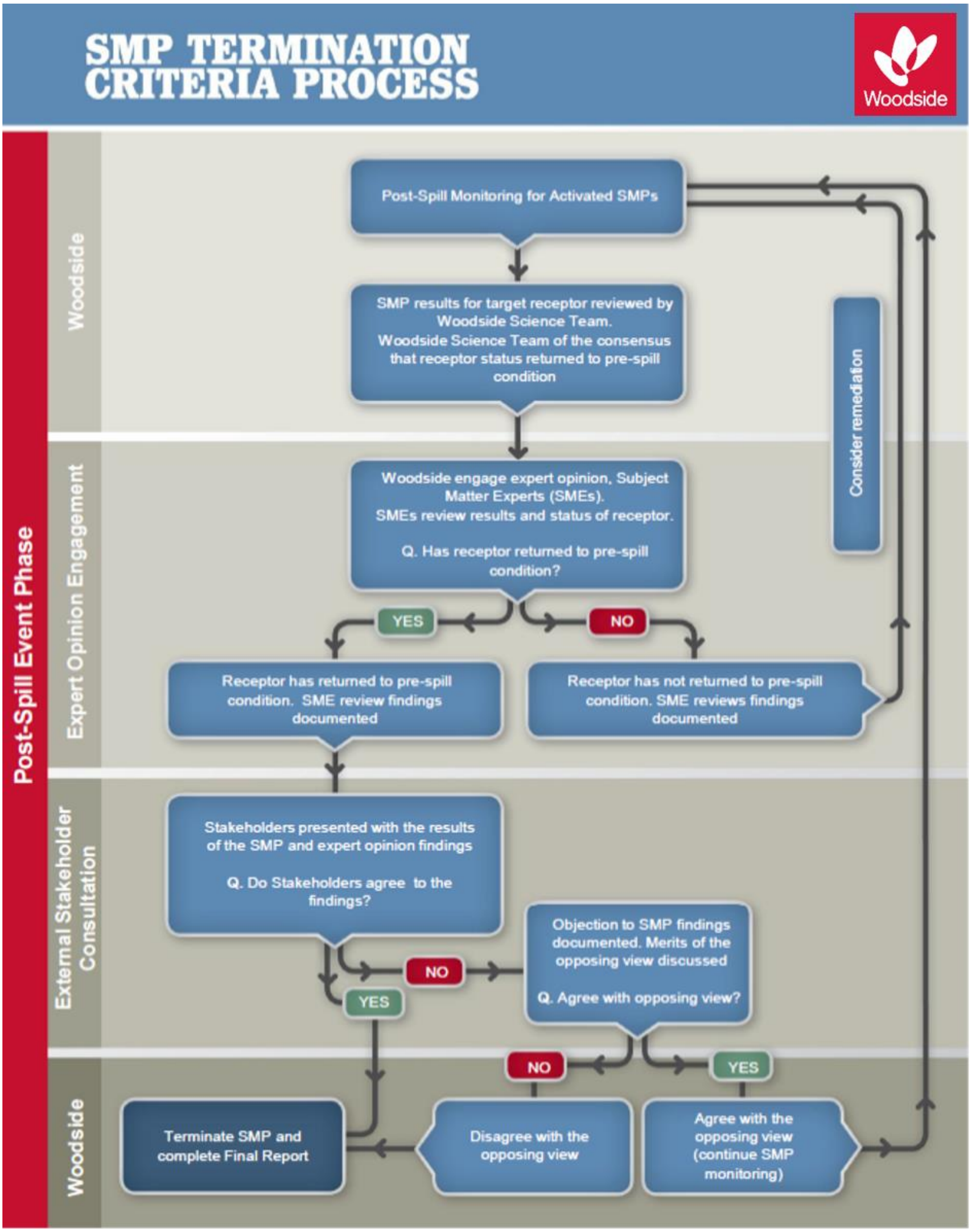

Figure C-3: Termination Criteria Decision-tree for Oil Spill Environmental Monitoring

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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)[23] 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.

[23] https://biocollect.ala.org.au/imsa#max%3D20%26sort%3DdateCreatedSort

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ANNEX D: SCIENTIFIC MONITORING PROGRAM AND BASELINE STUDIES FOR THE PETROLEUM ACTIVITIES PROGRAM

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Table D-1: Oil Spill Environmental Monitoring – scientific monitoring program scope for the Petroleum Activities Program based on Spill EMBA for MEE-01-01 and MEE-01-02

Receptor Areas - Potential Impact and Reference Scientific Monitoring Sites (marked X)

Receptors to be Monitored	Applicable SMP	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

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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

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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

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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

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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: [redacted] 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

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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

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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

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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 ([redacted]) 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 ([redacted]) 3. DBCA.	1. UWA. The UWA Oceans Institute & School of Biological Sciences. 2. DATAHOLDER: Woodside and WAM.	1. CSIRO. DATAHOLDER: CSIRO ([redacted])	1. Keesing 2019. 2. McLean et al. 2019.

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References

Advisian (2019) Montebello Marine Park Benthic Habitat Survey ROV Analysis of the Scarborough Pipeline Route. Report Prepared for Woodside Energy Ltd. 183 pp.

Abdul Wahab, M, A., Radford, B., Cappo, C., Colquhoun, J., Stowar, M., Depczynski, M., Miller, K and Heyward, A. (2018). Biodiversity and spatial patterns of benthic habitat and associated demersal fish communities at two tropical submerged reef ecosystems. *Coral Reefs*. Vol. 37, Issue 2, pp. 327-343. https://doi.org/10.1007/s00338-017-1655-9

AIMS (2014a). AIMS 2013 Biodiversity Survey of Glomar Shoal and Rankin Bank. Report prepared by the Australian Institute of Marine Science for Woodside Energy Ltd. Australian Institute of Marine Science, Townsville. October 2014 Rev 1,153pp.

AIMS (2014b). AIMS 2014 Extended Benthic Models and Habitat Maps of Rankin Bank. Report prepared by the Australian Institute of Marine Science for Woodside Energy Ltd. Australian Institute of Marine Science, Townsville. December 2014 Rev 0 (43pp.).

Bancroft, K.P. (2009). Establishing long-term coral community monitoring sites in the Montebello/ Barrow Islands marine protected areas: data collected in December 2006. Marine Science Program Data Report Series MSPDR4. January 2009. Marine Science Program, Science Division, Department of Environment and Conservation, Perth, Western Australia. 68p.

Bamford M.J. (2004). Gorgon Development on Barrow Island. Technical Report: Avifauna

Bamford and Moro (2011). Barrow Island as an important bird area for migratory waders in the East Asian – Australasian Flyway. Stilt 60: 46–55

Chevron Australia (2010). Gorgon Gas Development and Jansz Feed Gas Pipeline: Coastal and Marine Baseline State and Environmental Impact Report: Domestic Gas Pipeline. Document Number: G1-NT-REPX0002750 http://www.chevronaustralia.com/Libraries/Chevron_Documents/Gorgon_Project_Coastal_and_Marine_Baseline_State_and_Environmental_Impact_Report_Domestic_Gas_Pipeline.pdf.sflb.ashx

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

Chevron Australia (2013). Wheatstone Project, Oil Spill Operational Scientific Monitoring Program-OPS 5 Shorebird and Seabird Rapid Assessment. Document Number: WS0-0000-HESRPT-CVX-000-00144-000. https://www.chevronaustralia.com/docs/default source/defaultdocument-library/wheatstone-ops5-shorebird-and-seabird-rapid-assessment.pdf?sfvrsn=2

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

Currey-Randall L, Wakeford M, Colquhoun J, Cappo M, Stowar M, Birt M, Cure K, Vaughan B, Case M, Fisher R and Miller KJ (2019) Temporal trends in benthic communities and demersal fishes at Rankin Bank and Glomar Shoal. Report prepared for Woodside Energy Ltd. Australian Institute of Marine Science, Perth. 59 pp.

Department of Environment and Conservation (DEC), 2007, Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007-2017, Marine Management Plan No. 55, DEC, Perth, WA.

EOMAP. (2017). Atmospheric correction and land cover classification, NW Cape. Report prepared for Woodside Energy Ltd.

Hutchins, J.B. (2004). Fishes of the Dampier Archipelago, Western Australia. *Records of the Western Australian Museum* Supplement No. 66: 343-398.

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Johnstone R.E, Burbidge A. H, Darnell J.C. (2013). Birds of the Pilbara Region, including seas and offshore islands, Western Australia: distribution, status and historical changes. Records of the Western Australian Museum, Supplement 78: 343-441. http://museum.wa.gov.au/sites/default/files/WAM_Supp78(B)_JOHNSTONEetal%20pp343-441_0.pdf

Joint Carnarvon Basin Operators (2012). Draft Joint Carnarvon Basin Operators North West Cape Sensitivity Mapping. Part A. (Apache Energy Ltd, Woodside Energy Ltd, BHP Billiton and the Australian Marine Oil Spill Centre Pty Ltd (AMOSC).

Keesing, J., K. (2019). Benthic habitats and biodiversity of the Dampier Archipelago and Montebello Australian Marine Parks. Report of the Director of Nationals Parks. CSIRO, Australia

Le Noahic, M., Cornwall, M. E., Comeau, S., McCulloch, M. T. and Schoepf, V. (2017). Marine heatwave causes unprecedented regional mass bleaching of thermally resistant corals in northwestern Australia. *Scientific Reports,* vol. 7, doi: 10.1038/s41598-017-14794-y

McLean, D., Taylor M., Vaughan B. (2019) Marine Communities of the Pluto Trunkline within the Montebello Marine Park. Report prepared for Woodside Energy Ltd. Australian Institute of Marine Science, Perth. 45 pp.

Pendoley Environment (2005). Proposed Gorgon Development: Sea turtle Monitoring program results November 2004 to February 2005. Report for Chevron Australia.

Pendoley, K. (2009). Marine Turtle Beach Survey. Onslow Mainland Area and Nearby Islands. Report to URS for the Chevron Wheatstone Project Team, 91 pp. https://www.chevronaustralia.com/Files/PDF/Wheatstone%20Draft%20EIS_ERMP%20Technical%20Appendices%20O8%20to%20O12%20and.pdf

Pitcher, C.R., Miller, M., Morello, E., Fry, G., Strzelecki, J., McLeod, I., Slawinski, D., Ellis, N., Thomson, D., Bearham, D., Keesing, J., Donovan, A., Mortimer, N. Babcock, R., Fromont, J, Gomez, O., Hosie, A., Hara, A., Moore, G., Morrison, S., Kirkendale, L., Whisson, C., Richards, Z., Bryce, M., Marsh, L., Naughton, K., O'Loughlin, M., O'Hara, T., Boddington, D., Huisman, J. (2016) Environmental Pressures: Regional Biodiversity — Pilbara Seabed Biodiversity Mapping & Characterisation. Final report, CSIRO Oceans & Atmosphere, Published Brisbane, March 2016, 62 pages

Quadrant Energy - Seabird Monitoring - Lowendal, Airlie, Serrurier islands - 1994 to present. Industry-Government Environmental Meta-database (IGEM). UUID: bdd428fe-cf24-4596-a822-cd578695ee16. Accessed June 2017

RPS-Bowman Bishaw Gorham (2005). Gorgon Development on Barrow Island, Technical Report, Marine Benthic Habitats. Prepared for Chevron Australia. https://www.chevronaustralia.com/docs/default-source/default-document-library/c8_marine_benthic_habitats.pdf?sfvrsn=0

RPS (2012). Pipeline Corridor Biological Seabed Survey: Apache Julimar Development Project – Field Report. Prepared for Apache Energy Limited, October 2011.

Surman CA and Nicholson LW (2012) Monitoring of annual variation in seabird breeding colonies throughout the Lowendal Group of islands: 2012 Annual Report. Unpublished report prepared for Apache Energy Ltd. by Halfmoon Biosciences.

URS Australia Pty Ltd (2010). Biota of Subtidal Habitats in Pilbara Mangroves with Particular Reference to the Ashburton Delta and Hooley Creek, Technical Appendix N13. In: Technical Appendices N11 to N15 and O1 to O7. Draft Environmental Impact Statement/Environmental Review and Management Programme for the Proposed Wheatstone Project. July 2010, pp 124-245
https://www.chevronaustralia.com/Files/PDF/Wheatstone%20Draft%20EIS_ERMP%20Tech
Watson, D.L., Harvey, E.S., Fitzpatrick, B.M. et al. Mar Biology (2010) Assessing reef fish assemblage structure: how do different stereo-video techniques compare? Vol 157 (6): pp 1237-1250. https://doi.org/10.1007/s00227-010-1404-x
nical%20Appendices%20N11%20to%20N15%20an.pdf Unpublished Report for ChevronAustralia Pty Ltd.

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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

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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

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APPENDIX E EPBC ACT PROTECTED MATTERS SEARCH TOOL REPORTS

Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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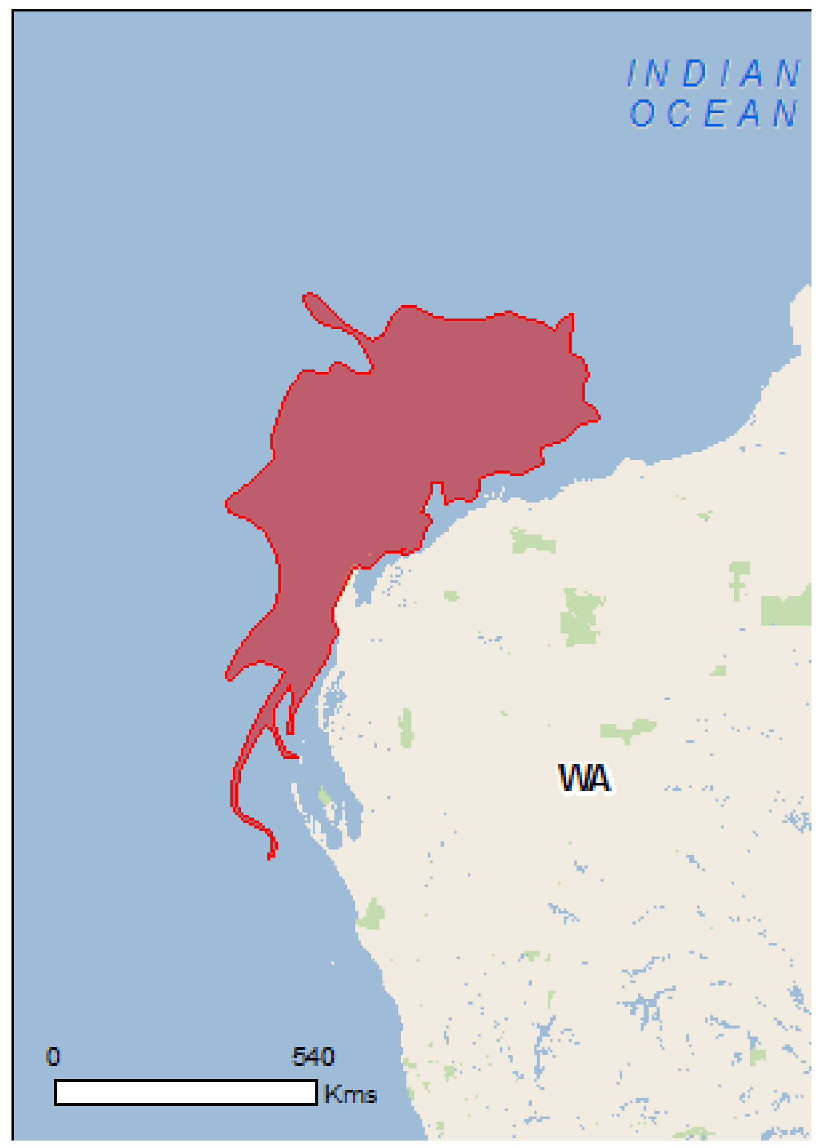

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates
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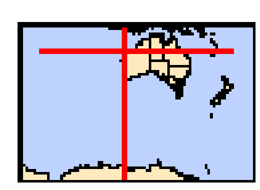

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	50
Listed Migratory Species:	65

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	3
Commonwealth Heritage Places:	2
Listed Marine Species:	115
Whales and Other Cetaceans:	30
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	7

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	11
Regional Forest Agreements:	None
Invasive Species:	11
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	7

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

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		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Malurus leucopterus edouardi White-winged Fairy-wren (Barrow Island), Barrow Island Black-and-white Fairy-wren [26194]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Status	Type of Presence
		to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia lesueur Barrow and Boodie Islands subspecies Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Species or species habitat known to occur within area
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
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
Other		
Kumonga exleyi Cape Range Remipede [86875]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Ctenotus zastictus Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel	Endangered	Species or species

Name	Threatened	Type of Presence
[1060]		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]		Foraging, feeding or related behaviour likely to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat 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 leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Species or species habitat 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 Greater Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Defence - EXMOUTH VLF TRANSMITTER STATION
Defence - LEARMONTH - AIR WEAPONS RANGE

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Learmonth Air Weapons Range Facility	WA	Listed place
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
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 likely to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
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
Limnodromus semipalmatus Asian Dowitcher [843]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
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

Name	Threatened	Type of Presence
		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]		Foraging, feeding or related behaviour likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat 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 anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys 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
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus 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

Name	Threatened	Type of Presence
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species

Name	Status	Type of Presence
		habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	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 grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
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

Name	Status	Type of Presence
Tursiops aduncus (Arafura/Timor Sea populations)		
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str.		
Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris		
Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Name	Label
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
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
Montebello Islands	WA
Muiron Islands	WA
Unnamed WA40322	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
Capra hircus		
Goat [2]		Species or species habitat likely to occur within area
Equus caballus		
Horse [5]		Species or species habitat likely to occur

Name	Status	Type of Presence
		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

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
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

-18.62683 118.3172,-18.93074 118.3104,-19.10761 118.558,-19.23673 118.6103,-19.29229 118.5695,-19.32341 118.255,-19.60737 117.9711,-19.7775 117.5176,-20.04543 117.5578,-20.08196 117.4173,-20.14802 117.3726,-20.21168 117.1899,-20.15655 116.759,-20.21791 116.5187,-20.33806 116.3839,-20.49719 116.3856,-20.52631 116.3229,-20.617 116.3206,-20.69128 116.2343,-20.63568 115.9856,-20.73499 115.7673,-20.35738 115.683,-20.38105 115.5195,-20.48761 115.4838,-20.53455 115.5106,-20.86132 115.3072,-20.92826 115.4509,-21.05442 115.5154,-21.24588 115.3358,-21.48298 115.283,-21.62267 115.072,-21.60749 114.9632,-21.49831 114.9794,-21.56077 114.8781,-21.55767 114.6797,-21.84175 114.3422,-21.85365 114.2389,-21.78157 114.1471,-21.89316 113.9951,-22.30565 113.8242,-22.56569 113.6634,-22.73267 113.6647,-22.90323 113.7657,-22.99386 113.7622,-23.06332 113.6798,-23.393 113.5623,-24.14699 113.0499,-24.40462 112.9434,-24.64347 112.9087,-24.6502 112.8369,-24.58348 112.8174,-24.08693 112.9251,-23.84547 112.9012,-24.10976 112.6758,-24.2963 112.5732,-24.47081 112.5784,-24.84876 112.7307,-24.94495 112.8433,-24.99077 112.9929,-25.05581 113.0058,-25.06602 112.7821,-25.01848 112.7072,-24.5625 112.5211,-24.52592 112.4374,-24.67967 112.3064,-25.31703 111.9623,-25.65665 111.9011,-25.8558 111.9116,-25.97441 112.0022,-26.15054 112.3408,-26.31873 112.5516,-26.54323 112.6143,-26.70799 112.5716,-26.74093 112.4983,-26.54768 112.5544,-26.38612 112.5091,-26.27268 112.3839,-26.16678 112.1186,-26.0425 111.9366,-25.84233 111.8041,-25.64876 111.7868,-25.29363 111.8634,-24.44831 112.214,-23.613 112.7587,-23.48212 112.5545,-23.44682 112.3144,-23.54259 112.0235,-23.75152 111.7781,-23.74027 111.7168,-23.68383 111.6904,-23.36353 111.8372,-23.05254 112.0407,-22.77793 112.2834,-22.5406 112.5632,-22.20445 112.6823,-21.84768 112.6916,-21.53017 112.6016,-21.2515 112.4243,-21.01395 112.1397,-20.86055 111.7604,-20.70167 111.7028,-20.62014 111.7507,-20.30253 112.184,-19.93204 112.5599,-19.57598 112.554,-19.14194 112.6575,-18.76155 112.8415,-18.42835 113.1007,-18.44296 113.5543,-18.32293 113.6467,-18.27176 113.7893,-18.2915 113.9076,-18.38479 114.0249,-18.444 114.2085,-18.4348 114.3724,-18.35027 114.4102,-18.0488 114.2723,-17.80154 114.0457,-17.65166 113.7996,-17.58891 113.4981,-17.47682 113.3197,-17.17607 113.143,-17.08347 113.1491,-17.04723 113.2505,-17.07096 113.3619,-17.5626 113.8539,-17.86957 114.4322,-17.79516 114.6313,-17.41651 114.7852,-17.31769 114.8889,-17.2734 115.0164,-17.28324 115.1908,-17.45587 115.5362,-17.52467 115.8838,-17.50932 116.4126,-17.38128 116.9137,-17.48991 117.1579,-17.56707 117.576,-17.69501 117.7551,-17.53074 117.9325,-17.43887 118.1354,-18.06474 118.0621,-18.21993 118.3047,-18.32028 118.3834,-18.5026 118.3987,-18.62683 118.3172

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-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

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Please feel free to provide feedback via the Contact Us page.

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Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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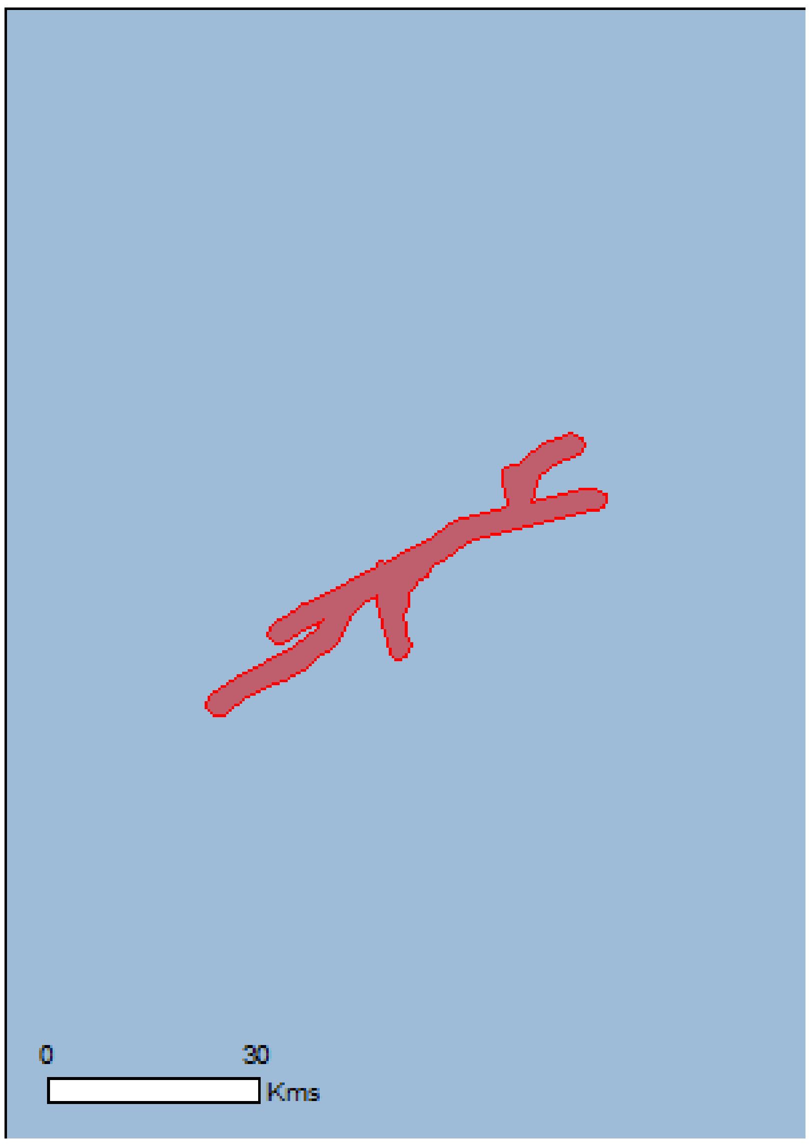

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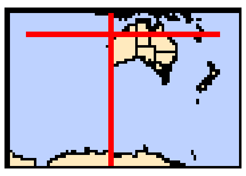
Coordinates

Buffer: 0.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	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:	54
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	Breeding known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species

Name	Status	Type of Presence
		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		
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
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat 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	Breeding 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

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

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		
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
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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 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 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 Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area

Name	Status	Type of Presence
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
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

-19.54366 116.0872,-19.55767 116.0682,-19.58766 116.0585,-19.57293 116.1216,-19.57114 116.1394,-19.57424 116.1475,-19.57963 116.1523,-19.58712 116.1535,-19.5936 116.1507,-19.59793 116.1447,-19.59923 116.131,-19.60214 116.1277,-19.60053 116.1228,-19.63327 115.9823,-19.65504 115.948,-19.66251 115.94,-19.66576 115.9341,-19.6765 115.9246,-19.68187 115.9149,-19.68932 115.9078,-19.69721 115.9029,-19.71425 115.9009,-19.72178 115.8942,-19.73819 115.8998,-19.74472 115.9002,-19.7611 115.905,-19.76808 115.9036,-19.77348 115.8986,-19.77573 115.8929,-19.77552 115.8868,-19.77257 115.8806,-19.76791 115.8767,-19.70976 115.8613,-19.70151 115.8619,-19.70951 115.8431,-19.71785 115.8324,-19.72294 115.8301,-19.72751 115.8256,-19.74835 115.8169,-19.75775 115.8093,-19.76756 115.7985,-19.77399 115.7862,-19.78629 115.7713,-19.79799 115.749,-19.80182 115.7469,-19.8014 115.741,-19.80643 115.7329,-19.8233 115.6958,-19.84272 115.666,-19.84278 115.6543,-19.83697 115.646,-19.83252 115.6439,-19.82669 115.6438,-19.81763 115.6498,-19.79826 115.6815,-19.76243 115.7549,-19.75047 115.769,-19.74184 115.7835,-19.73294 115.7915,-19.74555 115.7629,-19.75767 115.7433,-19.75918 115.7361,-19.75564 115.7271,-19.74693 115.7222,-19.73839 115.724,-19.73097 115.7316,-19.72173 115.7487,-19.71505 115.7578,-19.71095 115.7677,-19.71048 115.7739,-19.7047 115.787,-19.66605 115.8619,-19.66228 115.861,-19.65925 115.8634,-19.65903 115.8673,-19.66176 115.8701,-19.63963 115.9131,-19.63728 115.9218,-19.60928 115.9604,-19.59336 116.026,-19.59149 116.0267,-19.56157 116.0204,-19.55218 116.0214,-19.54604 116.0256,-19.54234 116.0342,-19.54387 116.043,-19.53656 116.0495,-19.51935 116.0729,-19.51084 116.0932,-19.50633 116.1108,-19.50762 116.1169,-19.51114 116.1218,-19.51629 116.1247,-19.52114 116.1252,-19.53002 116.1208,-19.54366 116.0872

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX F DEPARTMENT OF PLANNING LAND, HERITAGE AND ABORIGINAL ENQUIRY SYSTEM RESULTS

Department of Planning, Lands and Heritage

GOVERNMENT OF WESTERN AUSTRALIA

Aboriginal Heritage Inquiry System

List 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

Search Criteria

41 Registered Aboriginal Sites in Shapefile - Ecological_EMBA. Warning: Search area complex so results may be inaccurate. Contact DPLH for assistance.

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 AboriginalHeritage@dplh.wa.gov.au and we will make every effort to rectify it as soon as possible.

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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 AboriginalHeritage@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.

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ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
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
6754	OSPREY BAY 6	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792942mE 7538749mN Zone 49 [Reliable]	P06165
6755	OSPREY BAY INTERDUNAL 1	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792342mE 7537149mN Zone 49 [Unreliable]	P06166
6756	OSPREY BAY INTERDUNAL 2	No	No	No Gender Restrictions	Registered Site	Midden / Scatter	*Registered Knowledge Holder names available from DAA	792642mE 7537149mN Zone 49 [Reliable]	P06167
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
6759	BLOODWOOD CREEK MIDDEN 3	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	795142mE 7544949mN Zone 49 [Reliable]	P06170
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

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ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
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
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
6798	YARDIE INTERDUNAL SWALE	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	789942mE 7528849mN Zone 49 [Reliable]	P06156
6799	YARDIE BEACH MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	789842mE 7529049mN Zone 49 [Reliable]	P06157
6800	OYSTER STACKS MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	797042mE 7549849mN Zone 49 [Reliable]	P06158
6801	NORTH T-BONE BAY	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	801666mE 7562059mN Zone 49 [Reliable]	P06159
6802	OSPREY BAY 1	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792742mE 7538149mN Zone 49 [Reliable]	P06160
6803	OSPREY BAY 2	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792742mE 7538049mN Zone 49 [Reliable]	P06161
6804	OSPREY BAY 3	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792542mE 7537849mN Zone 49 [Reliable]	P06162
6805	OSPREY BAY 4	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792342mE 7537049mN Zone 49 [Reliable]	P06163

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

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ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
6806	OSPREY BAY 5	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	792742mE 7538149mN Zone 49 [Reliable]	P06164
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
7254	SANDY BAY NORTH	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	793442mE 7539949mN Zone 49 [Reliable]	P05652
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
7298	YARDIE CREEK ROCKSHELTERS	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter	*Registered Knowledge Holder names available from DAA	790635mE 7529704mN Zone 49 [Reliable]	P05644
7299	YARDIE CREEK	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	789642mE 7528649mN Zone 49 [Unreliable]	P05645
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
7304	PILGRAMUNNA BAY MIDDEN	No	No	No Gender Restrictions	Registered Site	Artefacts / Scatter, Midden / Scatter	*Registered Knowledge Holder names available from DAA	794642mE 7543349mN Zone 49 [Reliable]	P05650
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

Aboriginal Heritage Inquiry System

List of Registered Aboriginal Sites

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ID	Name	File Restricted	Boundary Restricted	Restrictions	Status	Type	Knowledge Holders	Coordinate	Legacy ID
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
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
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
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]	

Department of Planning, Lands and Heritage

Aboriginal Heritage Inquiry System

Map of Registered Aboriginal Sites

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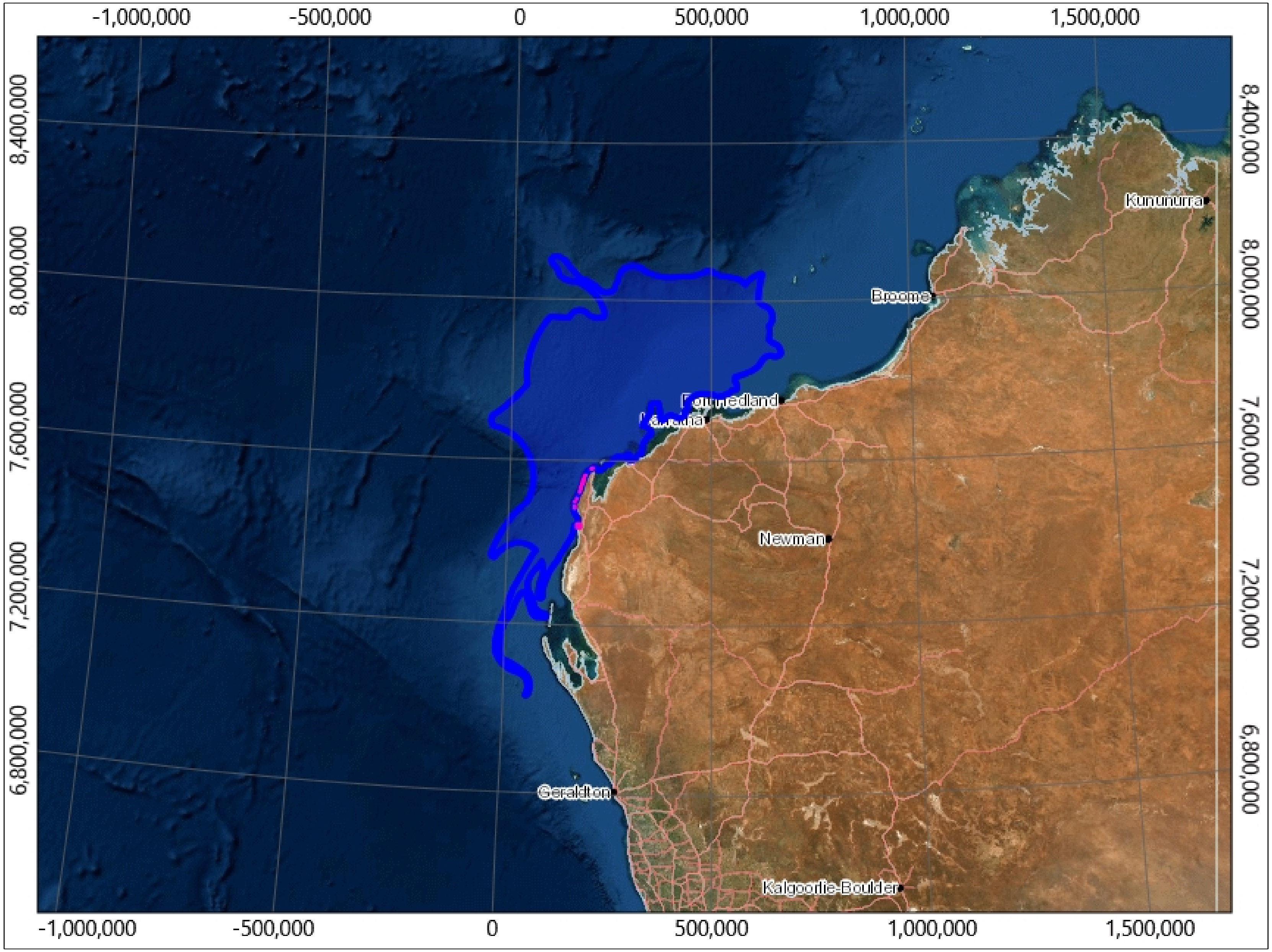

Legend

- Registered Aboriginal Site
- Search Area
- Town
- Road
- River
- Local Government Authority

507.27 kilometres

Map Scale 1 : 15,370,000

MGA Zone 50 (GDA94)

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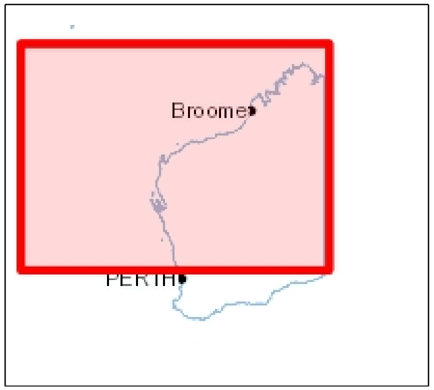

Aboriginal Heritage Inquiry System

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Search Criteria

No Heritage Surveys in Shapefile - Operational_Area. Warning: Search area complex so results may be inaccurate. Contact DPLH for assistance.

Disclaimer

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Department of Planning, Lands and Heritage
GOVERNMENT OF WESTERN AUSTRALIA

Aboriginal Heritage Inquiry System

Map of Heritage Survey Areas

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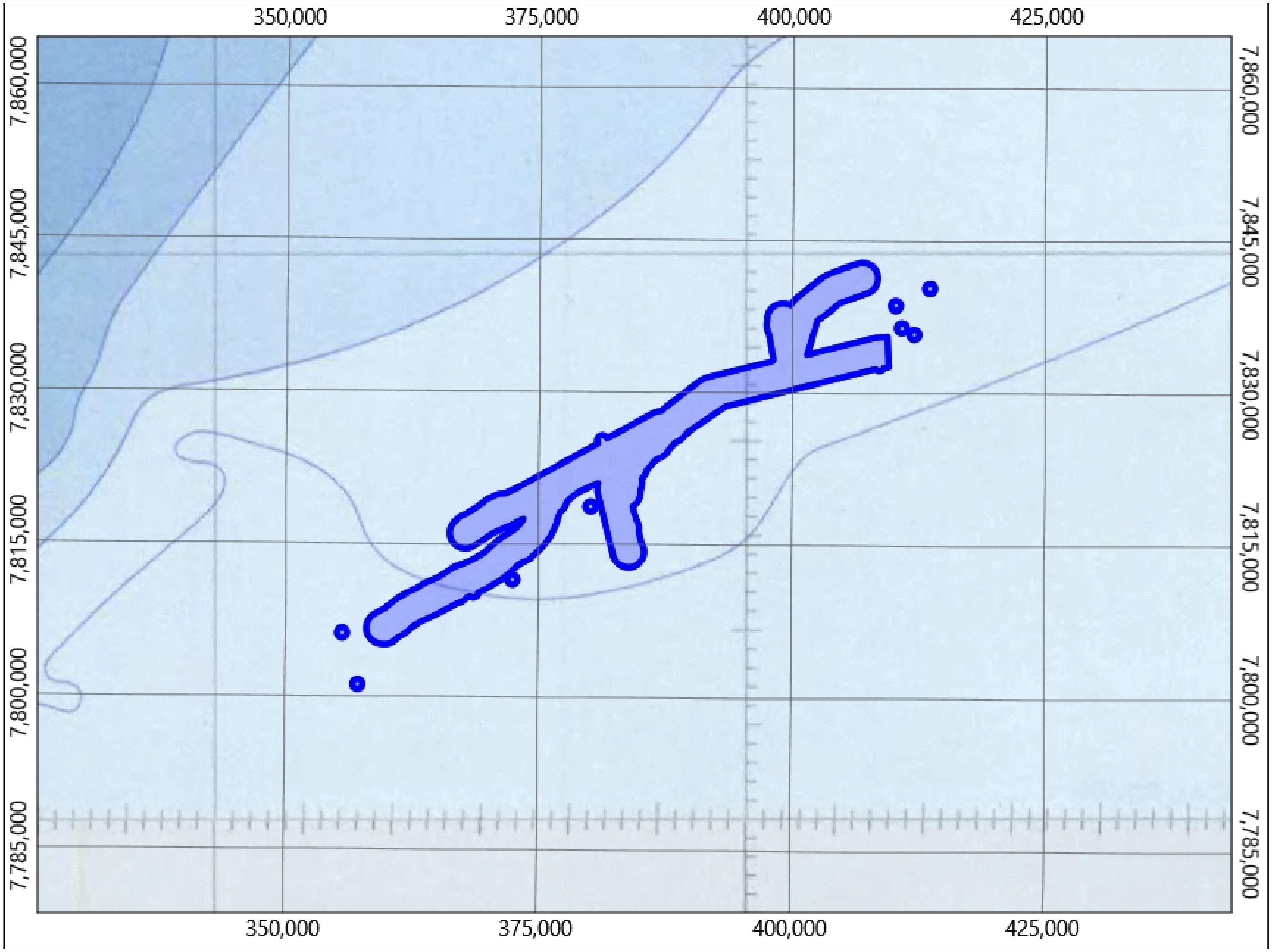

Legend

- Heritage Survey Area
- Search Area
- Town
- Road
- River
- Local Government Authority

20.01 kilometres

Map Scale 1 : 606,000

MGA Zone 50 (GDA94)

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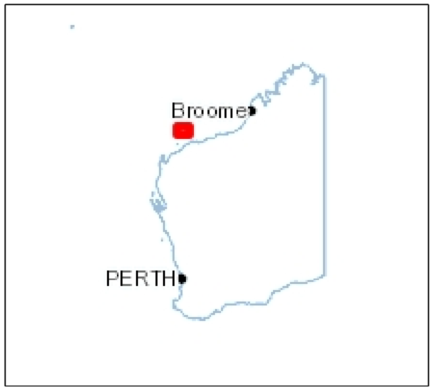

APPENDIX G STAKEHOLDER CONSULTATION

Goodwyn Alpha (GWA) Facility Operations Environment Plan

Date: August 2021

Revision: 0

TABLE OF CONTENTS

Consultation

1.1 Email sent to Australian Border Force (4 May 2021)

Dear Stakeholder

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set. A Consultation Information Sheet is attached, which provides background on proposed activities, including a summary of potential key risks and associated management measures. The Information Sheet is also available on our website.

Activity:

	GWA	Angel
Facility location	19° 39' 12" S 115° 55' 42" E	19° 29' 55.144" S 116° 35' 53.066" E
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Facility type	Fixed platform, processing equipment, pipelines	Fixed platform, processing equipment, pipelines
Subsea infrastructure	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads
Vessels	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities
Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
Distance from the platform to nearest marine park	~ 46.5 km from Montebello Islands Marine Park (Multiple Use Zone)	~ 90 km Montebello Islands Marine Park (Multiple Use Zone)

Water depth at Field Production System	131 m	80 m
Field Production System commissioned	1995	2008

Feedback:
If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted].

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.2 Email sent to Australian Maritime Safety Authority (Marine Safety) and Australian Hydrographic Office (4 May 2021)

Dear Stakeholder

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set. A Consultation Information Sheet is attached, which provides background on proposed activities, including a summary of potential key risks and associated management measures. The Information Sheet is also available on our website. A map showing vessel density is also attached for reference.

Activity:

	GWA	Angel
Facility location	19° 39’ 12” S 115° 55’ 42” E	19° 29' 55.144" S 116° 35' 53.066" E

Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Facility type	Fixed platform, processing equipment, pipelines	Fixed platform, processing equipment, pipelines
Subsea infrastructure	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads
Vessels	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities
Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
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Field Production System commissioned	1995	2008

Feedback:
If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted].

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.3 Email sent to Australian Maritime Safety Authority (Marine Pollution) (4 May 2021)

Dear [redacted]

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set. A Consultation Information Sheet is attached, which provides background on proposed activities, including a summary of potential key risks 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:

	GWA	Angel
Facility location	19° 39’ 12” S 115° 55’ 42” E	19° 29' 55.144" S 116° 35' 53.066" E
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
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Feedback:
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Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.4 Email to Department of Agriculture, Water and the Environment (13 May 2021)

Dear DAWE

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set. A Consultation Information Sheet is attached, which provides background on proposed activities, including a summary of potential key risks and associated management measures. The Information Sheet is also available on our website.

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Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Facility type	Fixed platform, processing equipment, pipelines	Fixed platform, processing equipment, pipelines
Subsea infrastructure	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads
Vessels	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities
Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
Distance from the platform to nearest marine park	~ 46.5 km from Montebello Islands Marine Park (Multiple Use Zone)	~ 90 km Montebello Islands Marine Park (Multiple Use Zone)
Water depth at Field Production System	131 m	80 m
Field Production System commissioned	1995	2008

Implications for DAWE's interests
We have identified and assessed potential risks and impacts to active Commonwealth commercial fishers, biosecurity matters and the marine environment that overlap the proposed Operational Areas in the development of the proposed Environment Plan for this activity. Woodside has endeavoured to reduce these risks to an as low as reasonably practicable (ALARP) level.

Commercial fishing implications:
No Commonwealth-managed fisheries were identified as being relevant to the proposed activities, based on fishing licence overlap with the Operational Areas and consideration of government fishing effort data from recent years, fishing methods and water depth.

Biosecurity implications:
With respect to the biosecurity matters, please note the following information below.

Environment description:

The Operational Areas lies on the outer continental shelf and the seabed is relatively flat with a gentle slope seaward. The seabed is comprised of soft sediment and is relatively featureless. Relatively complex bathymetric features in close proximity to the Operational Area include Rankin Bank (about 1.1 km North of the GWA Operational Area) and Glomar Shoals (about 13.3 km south-east of the Angel Operational Area).

Potential IMS risk	*IMS mitigation management*
Introduction and establishment of IMS.	Vessels are required to comply with the Australian Biosecurity Act 2015, specifically the Australian Ballast Water Management Requirements (as defined under the Biosecurity Act 2015) (aligned with the International Convention for the Control and Management of Ships' Ballast Water and Sediments) to prevent introducing IMS. 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.

Feedback:
If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted].

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.5 Email to Department of Industry, Science, Energy and Resources (4 May 2021)

Dear Stakeholder

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set. A Consultation Information Sheet is attached, which provides background on proposed activities, including a summary of potential key risks and associated management measures. The Information Sheet is also available on our website.

Activity:

	GWA	Angel
Facility location	19° 39' 12" S 115° 55' 42" E	19° 29' 55.144" S 116° 35' 53.066" E
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Facility type	Fixed platform, processing equipment, pipelines	Fixed platform, processing equipment, pipelines
Subsea infrastructure	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads
Vessels	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities
Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
Distance from the platform to nearest marine park	~ 46.5 km from Montebello Islands Marine Park (Multiple Use Zone)	~ 90 km Montebello Islands Marine Park (Multiple Use Zone)
Water depth at Field Production System	131 m	80 m
Field Production System commissioned	1995	2008

Feedback:

If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted].

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.6 Email to Director of National Parks (4 May 2021)

Dear Director of National Parks

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set. A Consultation Information Sheet is attached, which provides background on proposed activities, including a summary of potential key risks and associated management measures. The Information Sheet is also available on our website.

Activity:

	GWA	Angel
Facility location	19° 39’ 12” S 115° 55’ 42” E	19° 29' 55.144" S 116° 35' 53.066" E
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Facility type	Fixed platform, processing equipment, pipelines	Fixed platform, processing equipment, pipelines
Subsea infrastructure	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads
Vessels	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities

Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
Distance from the platform to nearest marine park	~ 46.5 km from Montebello Islands Marine Park (Multiple Use Zone)	~ 90 km Montebello Islands Marine Park (Multiple Use Zone)
Water depth at Field Production System	131 m	80 m
Field Production System commissioned	1995	2008

Implications for Parks Australia interests

We note Australian Government Guidance on consultation activities with respect to the proposed activities and confirm that:

- We have assessed potential impacts and risks to AMPs in the development of the proposed Environment Plan for this activity and believe that there are no credible impacts associated with 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 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, considering both the Angel and GWA wells, there is a risk of condensate entering the:
    - Abrolhos Marine Park
    - Argo-Rowley Terrace Marine Park
    - Carnarvon Canyon Marine Park
    - Dampier Marine Park
    - Eighty Mile Beach Marine Park
    - Gascoyne Marine Park
    - Montebello Marine Park
    - Ningaloo Marine Park
    - Shark Bay Marine Park
- 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 park.

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

Corporate Affairs Adviser | Corporate Affairs

1.7 Email to Department of Biodiversity, Conservation and Attractions (6 May 2021)

Dear DBCA

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set. A Consultation Information Sheet is attached, which provides background on proposed activities, including a summary of potential key risks and associated management measures. The Information Sheet is also available on our website.

Activity:

	GWA	Angel
Facility location	19° 39' 12" S 115° 55' 42" E	19° 29' 55.144" S 116° 35' 53.066" E
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Facility type	Fixed platform, processing equipment, pipelines	Fixed platform, processing equipment, pipelines
Subsea infrastructure	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads
Vessels	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities
Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier

Distance from the platform to nearest marine park	~ 46.5 km from Montebello Islands Marine Park (Multiple Use Zone)	~ 90 km Montebello Islands Marine Park (Multiple Use Zone)
Water depth at Field Production System	131 m	80 m
Field Production System commissioned	1995	2008

Implications for DBCA interests

- We have assessed potential impacts and risks to WA Marine Parks in the development of the proposed Environment Plan for this activity and believe that there are no credible impacts associated with 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 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 tha 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, considering both the Angel and GWA wells, there is a risk of condensate entering the:

  - Barrow Island MP
  - Barrow Island MMA
  - Rowley Shoals MP
  - Montebello MP
  - Muiron MMA
  - Ningaloo MP

- 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.

Feedback:

If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted]

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.8 Email to Department of Mines, Industry Regulation and Safety (4 May 2021)

Dear Stakeholder

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set. A Consultation Information Sheet is attached, which provides background on proposed activities, including a summary of potential key risks and associated management measures. The Information Sheet is also available on our website.

Activity:

	GWA	Angel
Facility location	19° 39’ 12” S 115° 55’ 42” E	19° 29' 55.144" S 116° 35' 53.066" E
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Facility type	Fixed platform, processing equipment, pipelines	Fixed platform, processing equipment, pipelines
Subsea infrastructure	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads
Vessels	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities
Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
Distance from the platform to nearest marine park	~ 46.5 km from Montebello Islands Marine Park (Multiple Use Zone)	~ 90 km Montebello Islands Marine Park (Multiple Use Zone)
Water depth at Field Production System	131 m	80 m
Field Production System commissioned	1995	2008

Feedback:
If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted].

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.9 Email to Department of Primary Industries and Regional Development (4 May 2021)

Dear Stakeholder

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set.

An Information Sheet (available on our website) and a map of relevant fisheries are attached. Fisheries have been identified as being relevant based on fishing licence overlap, assessment of government fishing effort data (including Fishcube), fishing methods and water depth.

We have identified potential impacts to active commercial fishers and the environment and have endeavoured to reduce these risks to an as low as reasonably practicable level.

Activity:

	GWA	Angel
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL

Platform location	19° 39' 12" S 115° 55' 42" E	19° 29' 55.144" S 116° 35' 53.066" E
Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
Water depth at Field Production System	131 m	80 m
Schedule	Ongoing operations for the duration of the five-year Environment Plan.	
Duration	Activities occur 24 hours per day, 365 days per year.	
Relevant State Fisheries	• Mackerel Managed Fishery (Area 2) • Pilbara Fish Trawl Interim Managed Fishery • Pilbara Trap Managed Fishery • Pilbara Line Fishery	
Exclusionary/Cautionary Zone:	• A 500 m radius Petroleum Safety Zone (exclusion zone) will be implemented around the GWA and Angel facilities. • A 1500 m Operational Area will be implemented around the GWA and Angel Field Production System subsea infrastructure, including wells and flowlines/pipelines. • A 500 m Operational Area will be implemented around exploration wells with wellheads that do not fall within the above Operational Area for the production system. • Commercial fishers and other marine users will be permitted to use but should take care when entering the Operational Area.	
Vessels	Operations support vessel(s) will be used, with the number, size and type of vessel(s) dependent on the work scope and water depth.	

Feedback:
If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted]

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.10 Email to Department of Transport (4 May 2021)

Dear DOT

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set. A Consultation Information Sheet is attached, which provides background on proposed activities, including a summary of potential key risks 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:

	GWA	Angel
Facility location	19° 39' 12" S 115° 55' 42" E	19° 29' 55.144" S 116° 35' 53.066" E
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Facility type	Fixed platform, processing equipment, pipelines	Fixed platform, processing equipment, pipelines
Subsea infrastructure	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads
Vessels	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities
Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
Distance from the platform to nearest marine park	~ 46.5 km from Montebello Islands Marine Park (Multiple Use Zone)	~ 90 km Montebello Islands Marine Park (Multiple Use Zone)

Water depth at Field Production System	131 m	80 m
Field Production System commissioned	1995	2008

Feedback:

If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted]

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.11 Email to licence holders in the Mackerel Managed Fishery (Area 2), Pilbara Fish Trawl Interim Managed Fishery, Pilbara Trap Managed Fishery and Pilbara Line Fishery (4 May 2021)

Dear Licence Holder

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set.

An Information Sheet (available on our website) and a map of relevant fisheries are attached. Fisheries have been identified as being relevant based on fishing licence overlap, assessment of government fishing effort data (including Fishcube), fishing methods and water depth.

We have identified potential impacts to active commercial fishers and the environment and have endeavoured to reduce these risks to an as low as reasonably practicable level.

Activity:

	GWA	Angel
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Platform location	19° 39' 12" S 115° 55' 42" E	19° 29' 55.144" S 116° 35' 53.066" E
Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
Water depth at Field Production System	131 m	80 m
Schedule	Ongoing operations for the duration of the five-year Environment Plan.	
Duration	Activities occur 24 hours per day, 365 days per year.	
Relevant State Fisheries	• Mackerel Managed Fishery (Area 2) • Pilbara Fish Trawl Interim Managed Fishery • Pilbara Trap Managed Fishery • Pilbara Line Fishery	
Exclusionary/Cautionary Zone:	• A 500 m radius Petroleum Safety Zone (exclusion zone) will be implemented around the GWA and Angel facilities. • A 1500 m Operational Area will be implemented around the GWA and Angel Field Production System subsea infrastructure, including wells and flowlines/pipelines. • A 500 m Operational Area will be implemented around exploration wells with wellheads that do not fall within the above Operational Area for the production system. • Commercial fishers and other marine users will be permitted to use but should take care when entering the Operational Area.	
Vessels	Operations support vessel(s) will be used, with the number, size and type of vessel(s) dependent on the work scope and water depth.	

Feedback:
If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted].

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Corporate Affairs Adviser | Corporate Affairs

1.12 Email to BP Developments Australia, Lightmark Enterprises (FAR Limited), Mobil, Santos and Sapura (4-5 May 2021)

Dear Stakeholder

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set. A Consultation Information Sheet is attached, which provides background on proposed activities, including a summary of potential key risks and associated management measures. The Information Sheet is also available on our website.

A map showing the proposed activity relative to adjacent titles is attached for reference.

Activity:

	GWA	Angel
Facility location	19° 39' 12" S 115° 55' 42" E	19° 29' 55.144" S 116° 35' 53.066" E
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Facility type	Fixed platform, processing equipment, pipelines	Fixed platform, processing equipment, pipelines
Subsea infrastructure	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads
Vessels	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities

Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
Distance from the platform to nearest marine park	~ 46.5 km from Montebello Islands Marine Park (Multiple Use Zone)	~ 90 km Montebello Islands Marine Park (Multiple Use Zone)
Water depth at Field Production System	131 m	80 m
Field Production System commissioned	1995	2008

Feedback:
If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted].

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.13 Email to Australian Petroleum Production and Exploration Association (APPEA) (4 May 2021)

Dear Stakeholder

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set. A Consultation Information Sheet is attached, which provides background on proposed activities, including a summary of potential key risks and associated management measures. The Information Sheet is also available on our website.

Activity:

	GWA	Angel
Facility location	19° 39' 12" S 115° 55' 42" E	19° 29' 55.144" S 116° 35' 53.066" E
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Facility type	Fixed platform, processing equipment, pipelines	Fixed platform, processing equipment, pipelines
Subsea infrastructure	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads
Vessels	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities
Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
Distance from the platform to nearest marine park	~ 46.5 km from Montebello Islands Marine Park (Multiple Use Zone)	~ 90 km Montebello Islands Marine Park (Multiple Use Zone)
Water depth at Field Production System	131 m	80 m
Field Production System commissioned	1995	2008

Feedback:

If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted].

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.14 Email to Pearl Producers Association (4 May 2021)

Hi [redacted]

Dear Stakeholder

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set.

An Information Sheet (available on our website) and a map of relevant fisheries are attached. Fisheries have been identified as being relevant based on fishing licence overlap, assessment of government fishing effort data (including Fishcube), fishing methods and water depth.

We have identified potential impacts to active commercial fishers and the environment and have endeavoured to reduce these risks to an as low as reasonably practicable level.

Activity:

	GWA	Angel
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Platform location	19° 39’ 12” S 115° 55’ 42” E	19° 29' 55.144" S 116° 35' 53.066" E
Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
Water depth at Field Production System	131 m	80 m
Schedule	Ongoing operations for the duration of the five-year Environment Plan.	
Duration	Activities occur 24 hours per day, 365 days per year.	
Relevant State Fisheries	• Mackerel Managed Fishery (Area 2) • Pilbara Fish Trawl Interim Managed Fishery	

	• Pilbara Trap Managed Fishery • Pilbara Line Fishery
Exclusionary/Cautionary Zone:	• A 500 m radius Petroleum Safety Zone (exclusion zone) will be implemented around the GWA and Angel facilities. • A 1500 m Operational Area will be implemented around the GWA and Angel Field Production System subsea infrastructure, including wells and flowlines/pipelines. • A 500 m Operational Area will be implemented around exploration wells with wellheads that do not fall within the above Operational Area for the production system. • Commercial fishers and other marine users will be permitted to use but should take care when entering the Operational Area.
Vessels	Operations support vessel(s) will be used, with the number, size and type of vessel(s) dependent on the work scope and water depth.

Feedback:
If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted]

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.15 Email to Western Australian Fishing industry Council (4 May 2021)

Dear WAFIC

Woodside is submitting revisions of the Environment Plans for Goodwyn Alpha (GWA) operations and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

We are undertaking a joint consultation process for the two Environment Plans, given the relative proximity of respective operations and the common stakeholder set.

An Information Sheet (available on our website) and a map of relevant fisheries are attached. Fisheries have been identified as being relevant based on fishing licence overlap, assessment of government fishing effort data (including Fishcube), fishing methods and water depth.

We have identified potential impacts to active commercial fishers and the environment and have endeavoured to reduce these risks to an as low as reasonably practicable level.

Activity:

	GWA	Angel
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PL
Platform location	19° 39’ 12” S 115° 55’ 42” E	19° 29' 55.144" S 116° 35' 53.066" E
Distance from the platform to the nearest port	~ 138 km from Dampier	~ 128.5 km from Dampier
Water depth at Field Production System	131 m	80 m
Schedule	Ongoing operations for the duration of the five-year Environment Plan.	
Duration	Activities occur 24 hours per day, 365 days per year.	
Relevant State Fisheries	• Mackerel Managed Fishery (Area 2) • Pilbara Fish Trawl Interim Managed Fishery • Pilbara Trap Managed Fishery • Pilbara Line Fishery	
Exclusionary/Cautionary Zone:	• A 500 m radius Petroleum Safety Zone (exclusion zone) will be implemented around the GWA and Angel facilities. • A 1500 m Operational Area will be implemented around the GWA and Angel Field Production System subsea infrastructure, including wells and flowlines/pipelines. • A 500 m Operational Area will be implemented around exploration wells with wellheads that do not fall within the above Operational Area for the production system. • Commercial fishers and other marine users will be permitted to use but should take care when entering the Operational Area.	
Vessels	Operations support vessel(s) will be used, with the number, size and type of vessel(s) dependent on the work scope and water depth.	

Feedback:
If you have any issues or concerns with these activities, or any other issues relevant to this location then please respond to Woodside at Feedback@woodside.com.au or [redacted]

Your feedback and our response will be included in our Environment Plans which will be submitted to 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).

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 **3 June 2021**.

Regards

Corporate Affairs Adviser | Corporate Affairs

1.16 AMSA (Marine Pollution) (6 July 2021)

Dear [redacted]

As part of Woodside's ongoing consultation for its current and planned activities, I would like to advise Australian Maritime Safety Authority (AMSA) that Woodside are preparing the Goodwyn-Alpha (GWA) Facility Operations Environment Plan (five year update) and would like to offer AMSA 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. Please note that this is a joint Information Sheet with Angel Operations.

- The Goodwyn-Alpha Facility Operations 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).

Woodside propose to submit an EP on 24th August 2021 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 19th August 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.

Many thanks,

Hydrocarbon Spill Coordinator | Security & Emergency Management

1.17 Email to Department of Transport (6 July 2021)

Dear [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 Goodwyn-Alpha (GWA) Facility Operations Environment Plan (five year update) 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. Please note that this is a joint Information Sheet with Angel Operations.
- The Goodwyn-Alpha Facility Operations 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 (July 2020) and from recent engagement activities between DoT and Woodside, responses to the information requirements in a succinct summary and source of information.

Woodside propose to submit an EP on 24th August 2021 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 19th August 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.

Many thanks,

Hydrocarbon Spill Coordinator | Security & Emergency Management

Information Requested in the Offshore Petroleum Industry Guidance Note (July 2020)	Information Provided & Reference
Description of activity, including the intended	Included in the consultation information sheet

schedule, location (including coordinates), distance to nearest landfall and map.	
Worst case spill volumes.	Included in Appendix A of the First Strike Plan
Known or indicative oil type/properties.	Included in Appendix A of the First Strike Plan
Amenability of oil to dispersants and window of opportunity for dispersant efficacy.	Dispersant is not deemed to be suitable for GWA Condensate/ GWA03 Condensate (MEE-01 (Credible Scenario-01) and (Credible scenario-02)) for the following reasons: • GWA Condensate and GWA03 Condensate have very low residues of 0.8% and 1.6% respectively • Floating hydrocarbons at feasible thresholds (>50 g/m^2) for dispersant application are predicted within 1 km of the spill location for both scenarios but do not contact any response protection areas (RPAs). Hydrocarbons at response thresholds in open ocean are no longer present by Day 4. • Only one shoreline RPA is predicted to be contacted by hydrocarbon at response thresholds (>100 g/m^2) for MEE-01C but not until day 71.4 (5.7 m^3). Application of dispersant would therefore not provide an net environmental benefit and would result in the addition of chemicals and additional entrained oil to the marine environment. Dispersant use is also not deemed appropriate for marine diesel spills (MEE-05)
Description of existing environment and protection priorities.	Included in section 4 of the First Strike Plan
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. Eleven 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 worst-case credible scenarios (MEE-01 (Credible Scenario 2) and MEE-05) have been used for response planning purposes for the activity as all other scenarios are of a lesser scale and extent, however, a third scenario (MEE-01 (Credible Scenario-01)) has been addressed due to differing source control options. By demonstrating capability to meet and manage an event of this size and timescale, 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.			
Outcomes of oil spill trajectory modelling, including predicted times to enter State waters and contact shorelines.		MEE-01, Credible Scenario-01 – LOWC from subsurface production well (GDA-05): 108,843 m^3 GWA Condensate over 71 days – residue of 870.7 m^3 or 12.3 m^3 per day (0.8%) Minimum time to shoreline contact (above 100g/m^2) in days	MEE-01, Credible Scenario 2 – LOWC from GWA-08 platform: 171,033 m^3 GWA03 Condensate over 68 days – residue of 2,832.5 m^3 or 41.7 m^3 per day (1.6%) Minimum time to shoreline contact (above 100g/m^2) in days	MEE-05 – loss of containment due to loss of marine vessel separation: 1,000 m^3 instantaneous release of marine diesel – residue of 50 m^3 (5%) Minimum time to shoreline contact (above 100g/m^2) in days
	Muiron Islands/ Muiron Islands MMA	No contact	71.4 days (5.7 m^3)	No contact
Details on initial response actions and key activation timeframes.	Included in Section 2 and 3 of the First Strike Plan			
Potential Incident Control Centre arrangements.	Included in Appendix E and F of the First Strike Plan			
Potential staging areas / Forward Operating Base.	A Forward Operating Base can be established at Exmouth and/ or Dampier.			
Details on response strategies.	Included in Section 2 and 3 of the First Strike Plan			
Use of DoT equipment resources	Woodside has access to its own and contracted stockpiles of response equipment and acknowledges that potential use of DoT resources cannot be assumed and is at the discretion of DoT.			
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			
Details on testing of arrangements of OPEP/OSCP.	• Level 1 Response – two Level 1 ‘First Strike’ drills conducted per year.			

	• Level 2 Response – a minimum of one Emergency Management exercise will be conducted every two years. • Level 3 Response – 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. **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. 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.
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.

1.18 Woodside Consultation Information Sheet (sent to all relevant stakeholders)

Woodside

STAKEHOLDER CONSULTATION

INFORMATION SHEET

May 2021

GWA AND ANGEL OPERATIONS ENVIRONMENT PLANS

CARNARVON BASIN, NORTH WEST AUSTRALIA

Woodside is submitting a revision of the Operational Environment Plans for the Goodwyn Alpha (GWA) and Angel operations in Commonwealth waters, in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) (the regulations).

The Environment Plans are being resubmitted to account for the integration of planned production from the Greater Western Flank Phase 3 and Lambert Deep gas projects respectively into the GWA and Angel production systems. The Environment Plans will also include a number of exploration wells not linked to the production systems.

The Environment Plans will cover the existing GWA and Angel Field Production Systems, both of which are operated by Woodside on behalf of the North West Shelf (NWS) Project, as well as a number of exploration wells not linked to the production systems. The Project participants are Woodside Energy Ltd (Operator), BHP Petroleum (NWS) Pty Ltd, BP Developments Australia Pty Ltd, Chevron Australia Pty Ltd, Japan Australia LNG (MIMI) Pty Ltd and Shell Australia Pty Ltd.

Woodside is undertaking consultation activities for these Environment Plans as a combined consultation process, given the relative proximity of these operations and the common stakeholder set.

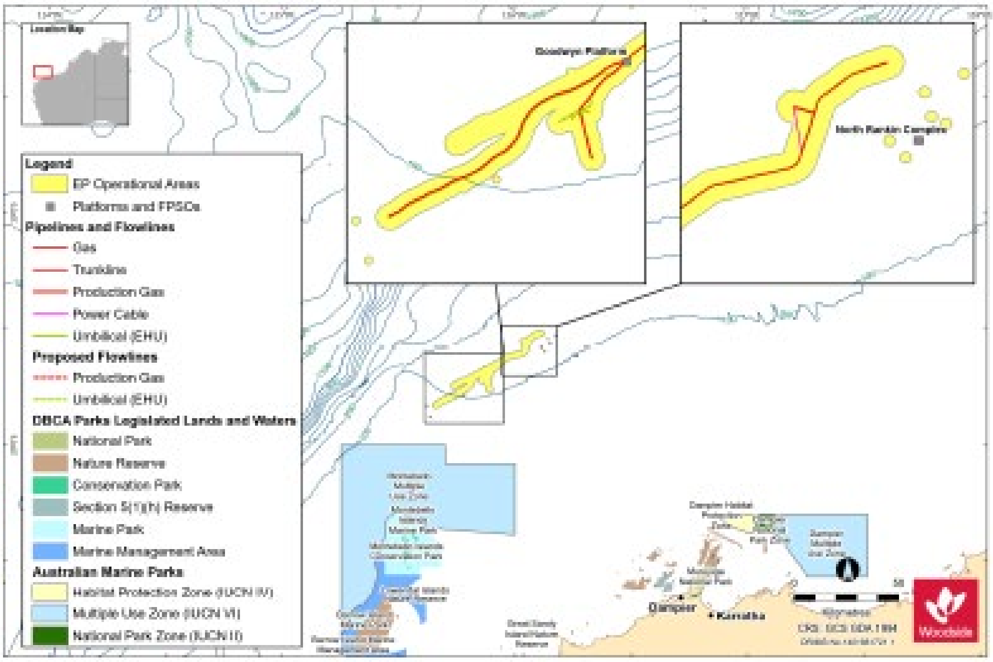


Figure 1. GWA Field Production Systems

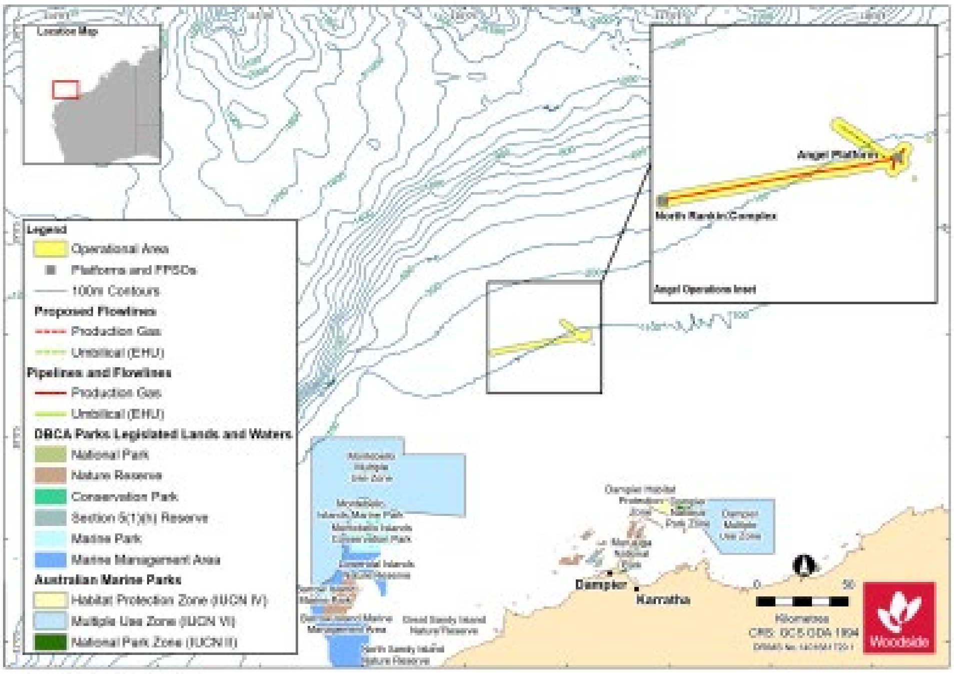


Figure 2. Angel Field Production Systems

Proposed Activity

Table 1. Activity Summary

Activity	GWA	Angel
Facility location	19° 39' 12" S 115° 55' 42" E	19° 29' 55.144" S 116° 35' 53.066" E
Production Licence Areas	WA-1-L, WA-5-L, WA-6-L, WA-23-L, WA-24-L, WA-57-L	WA-3-L, WA-16-L
Pipeline Licences	WA-2-PL, WA-9-PL, WA-13-PL, WA-24-PL, WA-27-PL	WA-14-PLw
Facility type	Fixed platform, processing equipment, pipelines	Fixed platform, processing equipment, pipelines
Subsea infrastructure	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads	Wells, Xmas trees, manifolds, flowlines/pipelines and umbilicals, and explorations wells with wellheads
Vessels	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities.	Platform support vessels, subsea support vessels, heavy lift vessels and others appropriate to nature of petroleum activities.
Distance from platform to the nearest port	~138 km	~128.5 km
Distance from platform to nearest marine park	~46.5 km	~90 km
Water depth at Field Production System	131 m	80 m
Field Production System commissioned	1995	2008

GWA Location and Operations

GWA produces dry gas and condensate from a series of reservoirs and associated subsea infrastructure.

Two processing trains on the facility process the production fluids via a series of cooling, separation, compression and dehydration processes before being exported via a 23 km inter-field line to the North Rankin Complex (NRC) facility and then to the Karratha Gas Plant (KGP) for processing via one of the NWS Project's trunklines.

The facility was commissioned as an integrated drilling, production, utilities and accommodation platform. However, the GWA facility no longer has drilling capability and drilling does not form part of the scope of the revised Environment Plan.

Angel Location and Operations

Until late 2020 gas and condensate were produced from the Angel field via three wells tied back to the Angel facility by rigid flowlines. The wells were shut in following high water cut and are currently being monitored while assessment of long-term management plans for the wells is undertaken.

Angel topsides processing equipment and subsea infrastructure were subsequently placed in preservation mode, with topsides processing equipment scheduled to be recommissioned at the start-up of the Lambert Deep well tie-back in 2022.

Dry gas and condensate production from the Lambert Deep reservoir will be processed via the single train on the Angel facility. Condensate and gas will be comingled for export and transport along a 49 km export pipeline to the NRC and then to KGP for processing via one of the NWS Project's trunklines.

The Angel platform is a not normally manned facility, with the subsea system and processing equipment typically controlled from the NRC via an integrated power and control cable.

Proposed Activities GWA and Angel

Production – GWA

Production will continue from the GWA facility. Production will commence from new wells once construction and commissioning of the Greater Western Flank 3 (GWF-3) wells and associated subsea infrastructure have been completed under the accepted GWF-3 and Lambert Deep Environment Plan in Q2 2021 to Q2 2022.

Production – Angel

Production will commence from the Lambert Deep reservoir in approximately Q2 2022 following construction and commissioning of the LDA-01 well and associated subsea infrastructure have been completed under the accepted GWF-3 and Lambert Deep Environment Plan in Q2 2021 to Q2 2022.

Subsea Inspection

Inspection of subsea infrastructure is the process of physical verification and assessment of subsea components in order to detect changes compared to its installed state. Typical site inspection activities include visual surveys via a remotely operated vehicle, side scan sonar surveillance, cathodic protection measurements and ultrasonic pipe condition checks.

Monitoring

Monitoring is the surveillance of the physical and chemical environment around subsea infrastructure. Monitoring activities may include process composition, corrosion probes, corrosion mitigation checks, and metocean and geological monitoring.

Repair

Repair activities are those required when a subsea system or component is degraded or damaged as defined by design codes.

Maintenance

Maintenance of subsea infrastructure is required at regular and/or planned intervals to maintain performance reliability and prevent deterioration or failure of equipment. Maintenance activities may include cycling of valves and leak pressure testing.

Decommissioning – GWA

The Yodel-3 and Yodel-4 wells have been plugged and production is now suspended. All activities associated with final plugging and abandonment are provided for under the approval of the Echo Yodel and Capella Plugging for Abandonment Environment Plan (NOPSEMA ID 5488). The Echo Yodel pipeline is suspended and isolated. All activities associated with decommissioning are to be provided for under the Echo Yodel Decommissioning Environment Plan. Maintenance of the subsea infrastructure will be continued under the GWA Operations Environment Plan until decommissioning activity commences.

Decommissioning – Angel

The subsea infrastructure tying the three Angel wells back to the Angel facility are to be flushed of hydrocarbons. This will be completed in preparation for the permanent plugging for abandonment of the three wells, which will be the subject of a separate Environment Plan. Following plugging and abandonment the associated subsea infrastructure is planned to be decommissioned, with these activities also subject to a separate Environment Plan.

Activity Vessels

Operations support vessels will be used to undertake inspection, maintenance and repair of subsea infrastructure. The vessel size and type will be dependent on the work scope.

Implications for Stakeholders

Woodside is consulting relevant shareholders whose functions, interests or activities may be affected by the proposed activities. We will also keep other stakeholders who have identified an interest in the activities informed about our 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 petroleum activities.

A number of mitigation and management measures will be implemented and are summarised in Table 3. Further details will be provided in the Environment Plan.

Table 2. 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 chemical selection and approval procedures.
Interests of relevant stakeholders including: • Defence activities • Petroleum activities • Commercial and recreational fishing activities • Shipping activities	• Consultation with relevant petroleum titleholders, commercial fishers and their representative organisations, and government departments and agencies will be conducted to inform decision making for the proposed activity and revision of the Environment Plan. • All vessels within the Operational Area will be required to adhere to the navigation safety requirements including the *Navigation Act 2012* (Cth) and any subsequent Marine Orders.
Marine discharges	• All routine marine discharges will be managed according to legislative and regulatory requirements and Woodside's Environmental Performance Standards where applicable.
Physical presence of infrastructure on seafloor causing interference/ displacement	• Flowline and well locations will be marked on nautical charts, which state that vessels should avoid anchoring, trawling or conducting other underwater operations in the vicinity of the infrastructure.
Vessel interaction	• Navigational aids and practices will be used as required by Maritime Regulations to minimise potential impact on other marine users. • A 500 m radius Petroleum Safety Zone (exclusion zone) will be implemented around the GWA and Angel facilities. • A 1500 m Operational Area will be implemented around the GWA and Angel Field Production System subsea infrastructure, including wells and flowlines/pipelines. • A 500 m Operational Area will be implemented around exploration wells with wellheads that do not fall within the above Operational Area for the production system. • Commercial fishers and other marine users will be permitted to use but should take care when entering the Operational Area. • Stakeholder engagement activities will be conducted as part of the Environment Plan.
Waste generation	• Waste generated on the vessels will be managed in accordance with applicable legislative requirements and a Waste Management Plan. • Waste will be managed and disposed of in a safe and environmentally responsible manner that aims to prevent accidental loss to the environment. • Waste transported onshore will be sent to appropriate recycling or disposal facilities by a licensed waste contractor.
Underwater Noise	• Noise will be generated by support vessels. Due to the low acoustic source levels associated with vessel operations there is not likely to be any interaction or potential impact to fish hearing, feeding or spawning.
Unplanned	
Hydrocarbon release	• Appropriate spill response plans, equipment and materials will be in place and maintained. • Appropriate 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. • Australian biosecurity requirements and guidance will be complied with.
Marine fauna interactions	• Vessel masters will implement interaction management actions in accordance with the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth).

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. If you would like to comment on the proposed activities outlined in this information sheet, or would like additional information, please contact Woodside before **3 June 2021**.

Please note that your feedback and our response will be included in our Environment Plan for the proposed activity, which 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).

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.

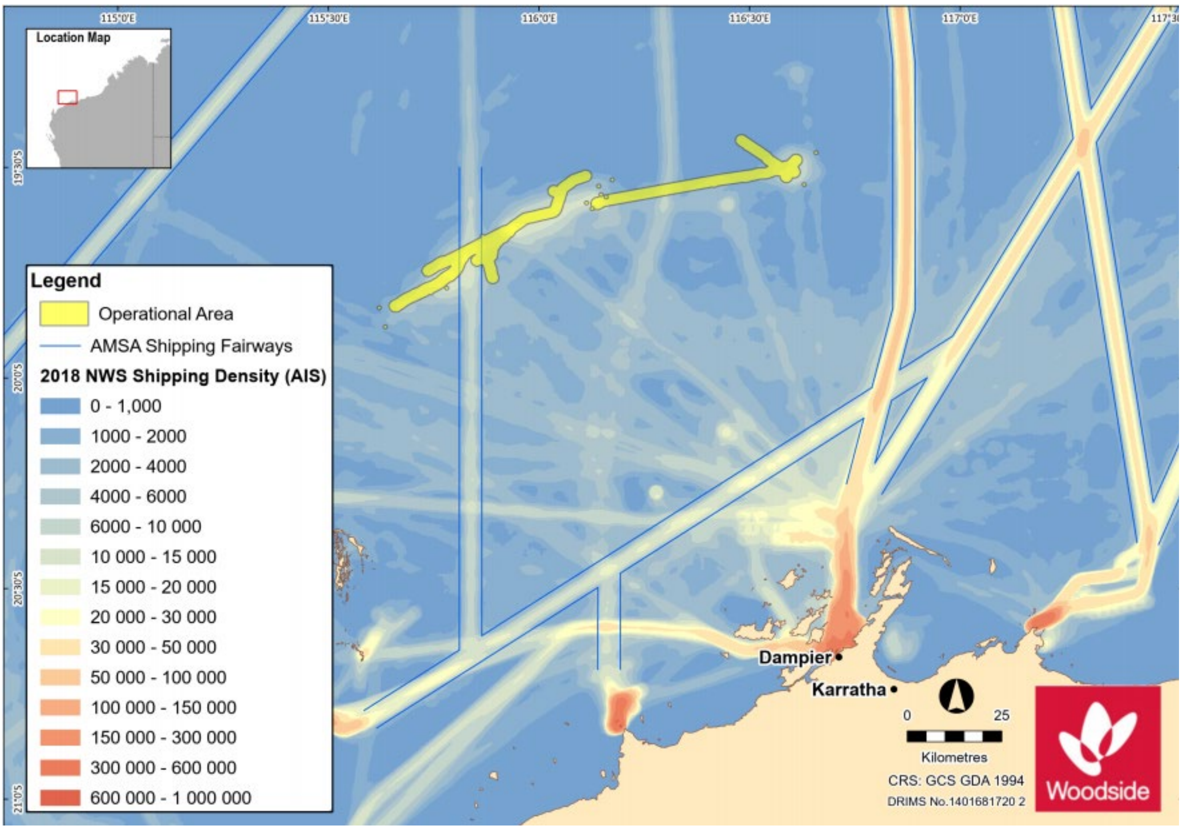
Tony Johnson, Corporate Affairs Adviser Woodside Energy Ltd
E: Feedback@woodside.com.au | Toll free: 1800 442 977

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.

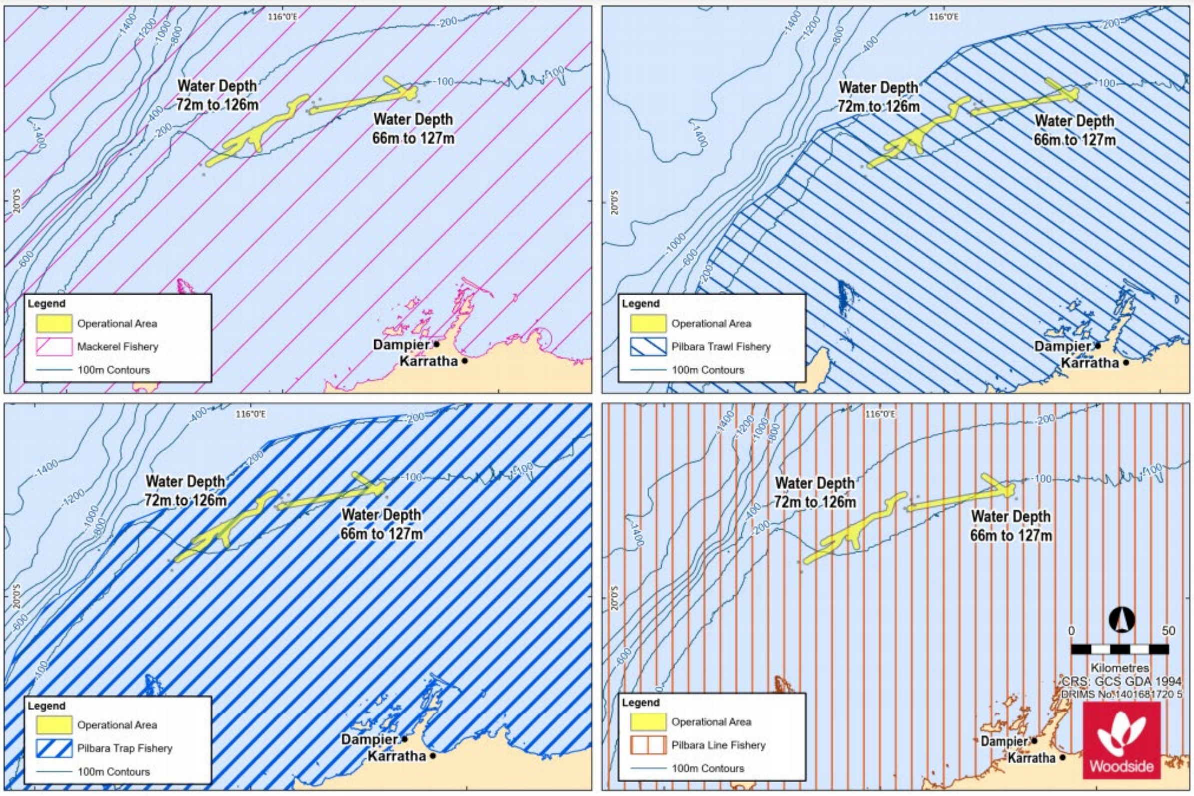
www.woodside.com.au

Woodside

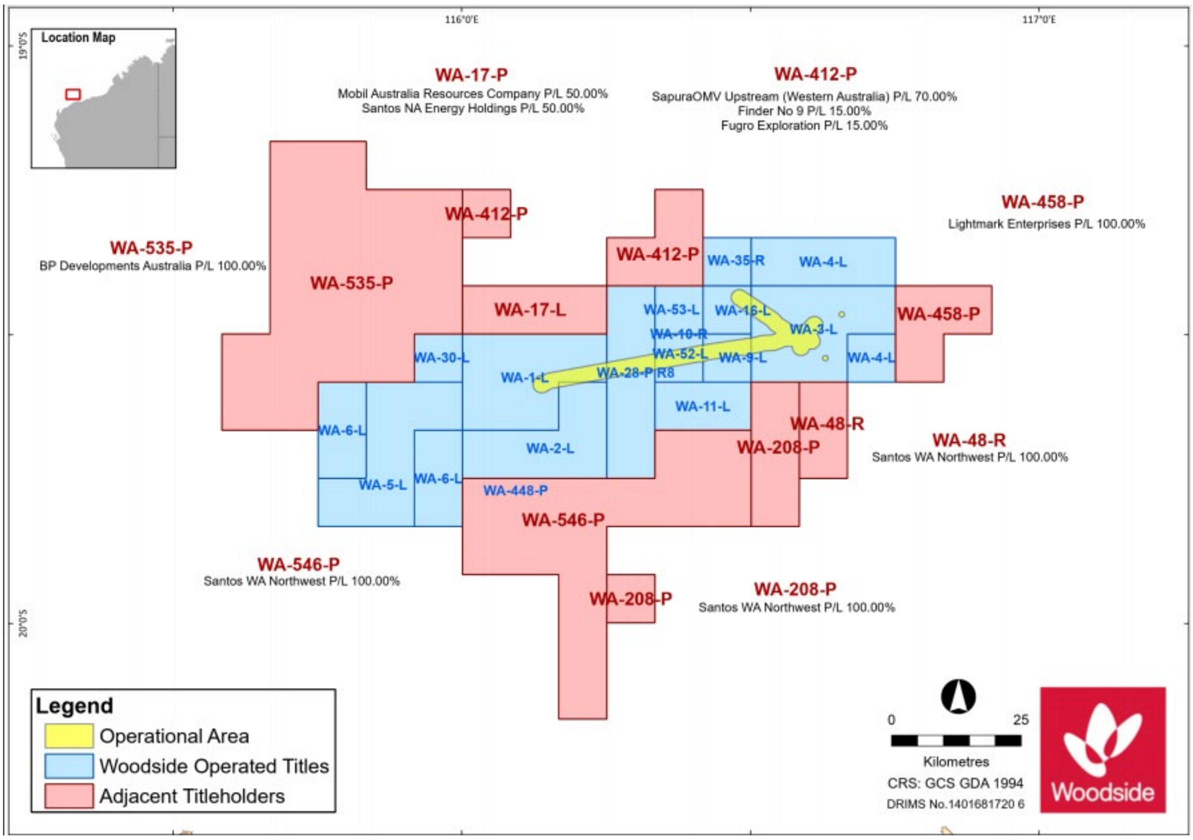
1.19 Shipping lane map sent to AMSA and AHO (4 May 2021)



1.20 Fisheries map sent licence holders in the Mackerel Managed Fishery (Area 2), Pilbara Fish Trawl Interim Managed Fishery, Pilbara Trap Managed Fishery and Pilbara Line Fishery; Pearl Producers Association; WAFIC (4 May 2021)



1.21 Titleholder map sent to BP Developments Australia, Lightmark Enterprises (FAR Limited), Mobil, Santos and Sapura (4-5 May 2021)



APPENDIX H NOPSEMA REPORT FORM

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 I FIRST STRIKE PLAN

Goodwyn Alpha (GWA) Facility Operations – Oil Pollution First Strike Plan

Security and Emergency Management
Hydrocarbon Spill Preparedness Unit

August 2021

Revision: 10

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GOODWYN ALPHA (GWA) FACILITY OPERATIONS 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:	**Offshore Installation Manager (OIM) (initially), then CICC DUTY MANAGER (DM)**

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)**

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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 (DoT). The Director General of DoT is the Hazard Management Agency (HMA) for Western Australian waters.

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 or 3 then DoT will become the Control Agency/ HMA 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/ HMA 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.

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Uncontrolled when printed. Refer to electronic version for most up to date information.

Response Process Overview

<table>
<tr><th colspan="3">Use the below to determine actions required and which parts of this plan are relevant to the incident.</th></tr>
<tr><th colspan="3">For guidance on credible scenarios and hydrocarbon characteristics, refer to APPENDIX A – Credible spill scenarios and hydrocarbon information</th></tr>
<tr><td rowspan="2">ALL INCIDENTS</td><td colspan="2">Notify the Woodside Communication Centre (WCC) on:
[redacted]</td></tr>
<tr><td colspan="2">Incident Controller or delegate to make relevant notifications in Table 1-1 of this document.</td></tr>
<tr><td rowspan="3">LEVEL 1</td><td>FACILITY INCIDENT</td><td>VESSEL INCIDENT</td></tr>
<tr><td>Coordinate pre-identified tactics in Table 2-1 of this document.
Remember to download each Operational Plan.</td><td>Upon agreement with AMSA: Coordinate pre-identified tactics in Table 2-1 of this document.
Remember to download each Operational Plan.</td></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td rowspan="4">LEVEL 2/3</td><td>FACILITY INCIDENT</td><td>VESSEL INCIDENT</td></tr>
<tr><td>Hand over control to CICC for facility spill including from subsea infrastructure.
OR
Handover control to DoT for facility spill which has entered State waters.</td><td>Stand up CICC to assist AMSA.</td></tr>
<tr><td>Undertake quick revalidation of the recommended strategies in Table 3-1 taking into consideration seasonal sensitivities and current situational awareness.

Undertake validated strategies.</td><td>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.</td></tr>
<tr><td>Create an Incident Action Plan (IAP) for all ongoing operational periods.

<u>The content of the IAP should reflect the selected response strategies based on current situational awareness.</u>

For the full detailed pre-operational Net Environmental Benefit Analysis (NEBA) see Appendix D of the Goodwyn Alpha (GWA) Facility Operations Environment Plan.</td><td>If requested by AMSA:
Create an IAP for all ongoing operational periods.

<u>The content of the IAP should reflect the selected response strategies based on current situational awareness.</u>

For the full detailed pre-operational Net Environmental Benefit Analysis (NEBA) see Appendix D of the Goodwyn Alpha (GWA) Facility Operations Environment Plan.</td></tr>
</table>

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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 *Goodwyn Alpha (GWA) Facility Operations 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	Offshore Installation Manager (OIM) 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	OIM or Woodside Site Rep (WSR)	National Offshore Petroleum Safety Environmental Management Authority (NOPSEMA[1])	Incident notification office	[redacted]	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	OIM or Woodside Site Rep (WSR)				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.

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Notification timing	Responsibility	Authority /Company	Name	Contact Number	Instruction	Form/ Template	Mark Complete (✓)
					NOPSEMA: [redacted] NOPTA: [redacted] DMIRS: [redacted]		
As soon as practicable	CICC DM or Delegate	Woodside	Environment Duty Manager	[redacted]	Verbally notify Environment Duty Manager of event and seek advice on relevant performance standards 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	

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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 Karratha supply shed. Follow up with a written POLREP as soon as practicable following verbal notification.	APPENDIX B – Form 5	

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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 (DBCA)	CICC DM or Delegate	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	

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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 Goodwyn Alpha (GWA) Facility Operations Environment Plan Appendix D: Oil Spill Preparedness and Response Mitigation Assessment.

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Table 2-1: Level 1 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	GWA Condensate	GWA03 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.
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 – Credible spill scenarios and hydrocarbon information).	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 [redacted]) and call [redacted]	Intelligence	**DAY 1:** Detailed modelling within four hours of APASA receiving information from Woodside.		
Monitor and evaluate – aerial	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:**		Surveillance and Reconnaissance to Detect Hydrocarbons

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Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWA Condensate	GWA03 Condensate					
surveillance (OM02)						Two trained aerial observers. One aircraft available. Report made available to the IMT within two hours of landing after each sortie.		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 [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	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		Pre-emptive Assessment of Sensitive Receptors at Risk (OM04 of The Operational Monitoring Operational Plan).

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Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWA Condensate	GWA03 Condensate					
at risk (OM04)						Protection Areas (RPA) within 10 days of predicted impacts.		
Monitor and evaluate – shoreline assessment (OM05)	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 10 days of predicted impacts.		Monitoring of contaminated resources (OM05 of The Operational Monitoring Operational Plan).

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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 Goodwyn Alpha (GWA) Facility Operations Environment Plan Appendix D: Oil Spill Preparedness and Response Mitigation Assessment.

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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	GWA Condensate	GWA03 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 and weathering fate analysis using ADIOS (or refer to the hydrocarbon information in APPENDIX A – Credible spill scenarios and hydrocarbon information).	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 [redacted]	Intelligence	**DAY 1:** Detailed modelling within 4 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 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).

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Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWA Condensate	GWA03 Condensate					
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 [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.		*Planning to download immediately and follow steps*
Monitor and evaluate – monitoring hydrocarbon s 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 assessment surveys (OM05).	Planning or Environment	**DAY 2:** In agreement with WA DoT, deployment of one specialist in SCAT for each of the RPAs with predicted impacts.		Shoreline Assessment (OM05) of The Operational Monitoring Operational Plan.
Surface Dispersant	No	No	No	This technique is not recommended for marine diesel. This response strategy is not recommended given the limited surface oil, low residue and highly volatile nature of GWA Condensate. Dispersant is				

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Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWA Condensate	GWA03 Condensate					
				therefore not considered to have a net environmental benefit.				
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	No	No	This technique is not recommended for marine diesel. Containment and recovery of GWA Condensates poses a significant safety risk and low flash points. Corralling low flash point substances should be avoided, therefore this response technique is not feasible.				
In Situ Burning	No	No	No	This technique is not recommended. Requires calm sea state conditions which limits its feasibility in the region.				

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Response Techniques	Hydrocarbon Type: Marine Diesel	Hydrocarbon Type: GWA Condensate	Hydrocarbon Type: GWA03 Condensate	Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
				Furthermore, modelling predicts that floating oil will not reach response thresholds or slick 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**	**No**	**Potentially**	Shoreline protection and deflection may be deployed if Operational Monitoring activities detect surface hydrocarbons moving towards sensitive 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 sensitive 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 Stockpiles mobilised. Consideration of mobilisation of interstate/international shoreline protection equipment (i.e. OSRL).	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: Muiron Islands TRP

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Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWA Condensate	GWA03 Condensate					
				Mobilise security provider as per security support plan.				Land Based Security Support Plan
Shoreline Clean Up	**No**	**No**	**Yes**	Shoreline clean-up operations may be deployed if Operational Monitoring activities detect surface hydrocarbons moving towards shorelines or accumulation at shorelines for the platform well spill. 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 equipment and relevant personnel (i.e. OSRL). Modelling for GWA condensate does not predict any shoreline accumulation at threshold.	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 89 m^3 of solid and liquid waste storage available by month 3, from third party contractors.		Shoreline Clean-up Operational Plan *Logistics to download immediately and follow steps*
				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.	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

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Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWA Condensate	GWA03 Condensate					
				Consider whether additional equipment is required from local suppliers.				
Scientific Monitoring (Type II)	Yes	Yes	Yes	Notify Woodside science team of spill event.	Environment			Oil Spill Scientific Monitoring Programme – Operational Plan
Well Intervention – SFRT	No	Yes	Yes		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	No	No	This technique is not recommended. This response strategy is not recommended given the limited surface oil, low residue and highly volatile nature of GWA Condensate. Subsea dispersant is therefore not considered to have a net environmental benefit.				
Capping Stack	No	Yes	No	Capping stacks are not able to be utilised on the platform wellhead (GWA03). Conventional/vertical capping stack deploymen 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	Operations, Logistics and Drilling and Completions (source control)	**DAY 16:** Capping stack deployed by a chartered construction vessel.		Subsea First Response Toolkit (SFRT) and Capping Stack Operational Plan Source Control Emergency Response Plan

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Response Techniques	Hydrocarbon Type			Pre- Identified Tactics	Responsible	ALARP Commitment Summary	Complete ✓	Link to Operational Plans for notification numbers and actions
	Marine Diesel	GWA Condensate	GWA03 Condensate					
				onditions (e.g. wind speed, wave height, current and plume radius).				
Relief Well	No	Yes	Yes	As per Source Control Emergency Response 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 Plan

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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 up to 1 km from both the GWA03 platform well (Credible Scenario-02 (MEE-01-02)) and the GDA05 subsea well (Credible Scenario-01 (MEE-01-01)) are 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 100 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 containment and recovery and surface dispersant application
100	Predicted minimum shoreline accumulation threshold for shoreline assessment operations
250	Predicted minimum threshold for effective shoreline clean-up operations

Table 4-2: Receptors for Priority Protection

Receptor	Distance from platform/well	Threshold triggered and recommended strategy	Tactical Response Plans (also available within the Data Directory)
Open ocean	1 km	Surface hydrocarbons at >50 g/m^2 • Monitor and evaluate • Source control	N/A – open ocean
Muiron Islands/ Muiron Islands Marine Management Area	227 km SSW	Shoreline accumulation 100 g/m^2 • Monitor and evaluate • Shoreline protection and deflection • Shoreline clean-up	Muiron Islands TRP

Hydrocarbon spill modelling results indicate the no other the sensitive receptors have the potential to be contacted above response thresholds.

[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.

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Tactical Response plans 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 Goodwyn Alpha (GWA) Facility Operations 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 Goodwyn Alpha (GWA) Facility Operations PAP.

Table 4-3: Assets in the vicinity of the Goodwyn Alpha (GWA) Facility operational area

Asset	Distance and direction from operational area	Operator
North Rankin Complex	0 km	Woodside
Wheatstone Platform	30 km west	Chevron
Pluto	34 km west	Woodside
Angel	48 km east	Woodside
Reindeer	50 km south-east	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.

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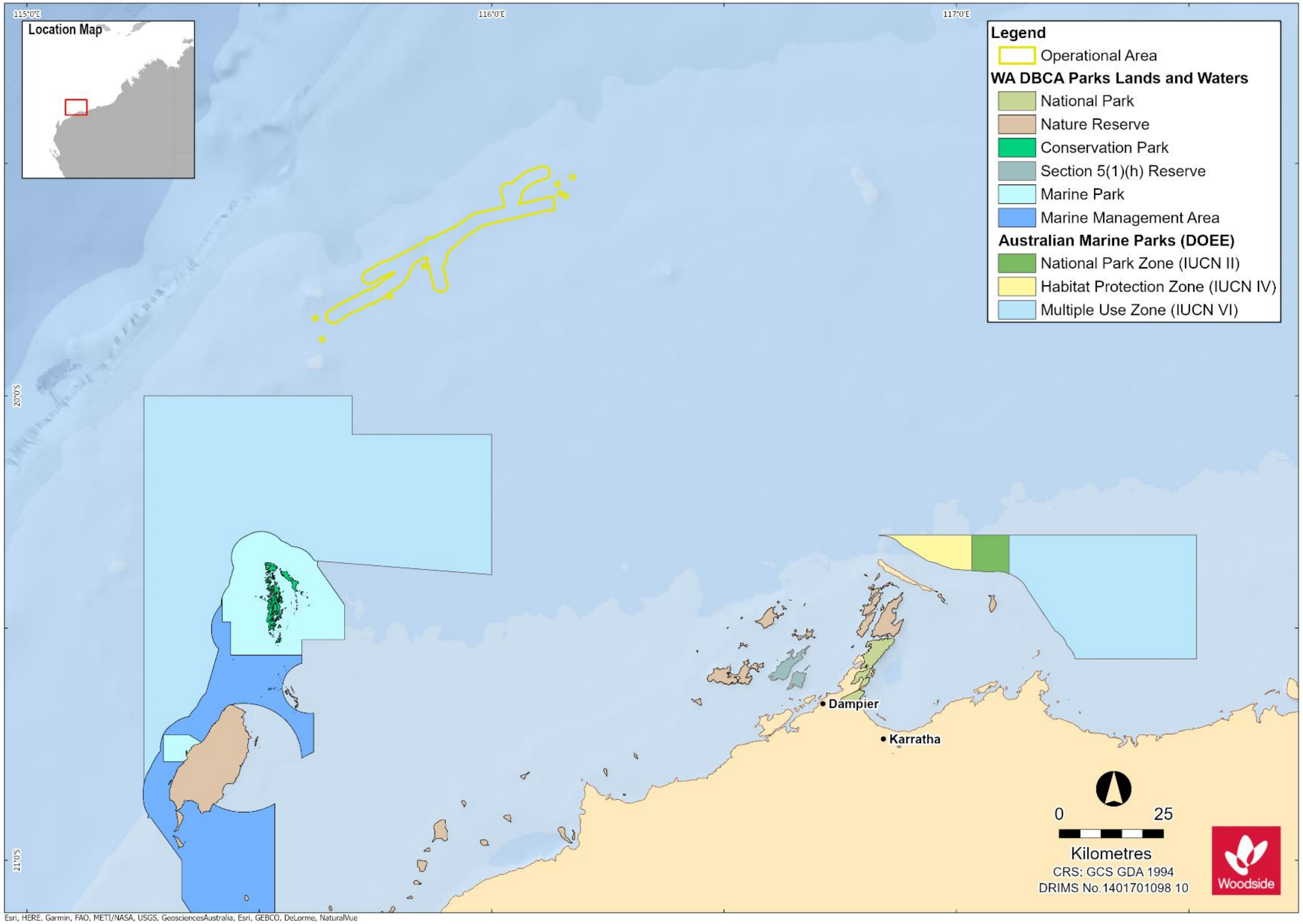

Figure 4-1: Regional sensitive receptors – Goodwyn Alpha (GWA) Facility operational area

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5. DISPERSANT APPLICATION

Dispersant is not considered an appropriate response strategy for this activity as described in Appendix D (Woodside’s Hydrocarbon Spill Response) of the Goodwyn Alpha (GWA) Facility Operations Environment Plan.

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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*
MEE-01-01: Hydrocarbon release caused by loss of well containment	GWA Condensate (API 47.5°)	108,843 m^3 (0.8% residue of 870.7 m^3)	NWS Condensate
MEE-01-02: Hydrocarbon release caused by loss of well containment	GWA03 Condensate (API 57.6°)	171,033 m^3 (1.6% residue of 2736.5 m^3)	NWS Condensate
Credible Scenario-05: 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*

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GWA Condensate

GWA condensate is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi-volatile components. In favourable evaporation conditions, 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 whole oil has a low asphaltene content (< 0.5%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble aromatic hydrocarbons contribute approximately 16.3% by mass of the whole oil. Around 9.1% by mass is highly soluble and highly volatile. A further 7.2% by mass has semi-to-low volatility. These compounds dissolve more slowly but tend to persist in soluble form for longer. Discharge onto the water surface will favour the process of evaporation over dissolution under calm sea conditions, but increased entrainment of oil and dissolution of soluble compounds can be expected under breaking wave conditions.

The mass balance forecast for the constant-wind case (see **Figure A-1**) for GWA Condensate shows that about 88.4% of the oil is predicted to evaporate within 24 hours. Under calm conditions, the majority of the remaining oil on the water surface will weather at a slower rate due to being comprised of the longer-chain compounds with higher boiling points. Evaporation of the residual compounds will slow significantly, and they will then be subject to more gradual decay through biological and photochemical processes (RPS Group, 2021).

GWA Condensate (GWA03)

GWA condensate (GWA03) is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi-volatile components. In favourable evaporation conditions, about 71.6% of the oil mass should evaporate within the first 12 hours (BP < 180 °C); a further 19.8% should evaporate within the first 24 hours (180 °C < BP < 265 °C); and a further 7.0% should evaporate over several days (265 °C < BP < 380 °C). Approximately 1.6% of the oil is shown to be persistent.

The whole oil has a low asphaltene content (< 0.5%), indicating a low propensity for the mixture to take up water to form water-in-oil emulsion over the weathering cycle.

Soluble aromatic hydrocarbons contribute approximately 13.2% by mass of the whole oil. Around 9.6% by mass is highly soluble and highly volatile. A further 3.6% by mass has semi-to-low volatility. These compounds dissolve more slowly but tend to persist in soluble form for longer. Discharge onto the water surface will favour the process of evaporation over dissolution under calm sea conditions, but increased entrainment of oil and dissolution of soluble compounds can be expected under breaking wave conditions.

The mass balance forecast for the constant-wind case (see **Figure A-2**) for GWA-03 Condensate shows that about 91.4% of the oil is predicted to evaporate within 24 hours. Under calm conditions, the majority of the remaining oil on the water surface will weather at a slower rate due to being comprised of the longer-chain compounds with higher boiling points. Evaporation of the residual compounds will slow significantly, and they will then be subject to more gradual decay through biological and photochemical processes.

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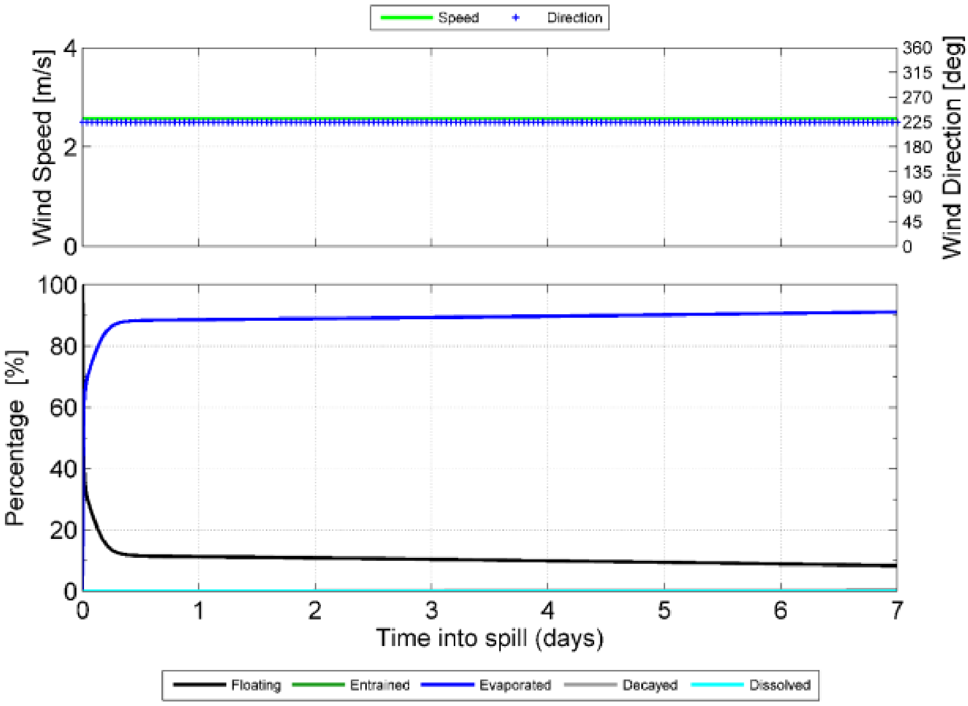

Figure A-1: Proportional mass balance plot representing the weathering of GWA condensate spilled onto the water surface as a one-off instantaneous release and subject to a constant 5 kn (2.6 m/s) wind at 27 °C water temperature and 25 °C air temperature.

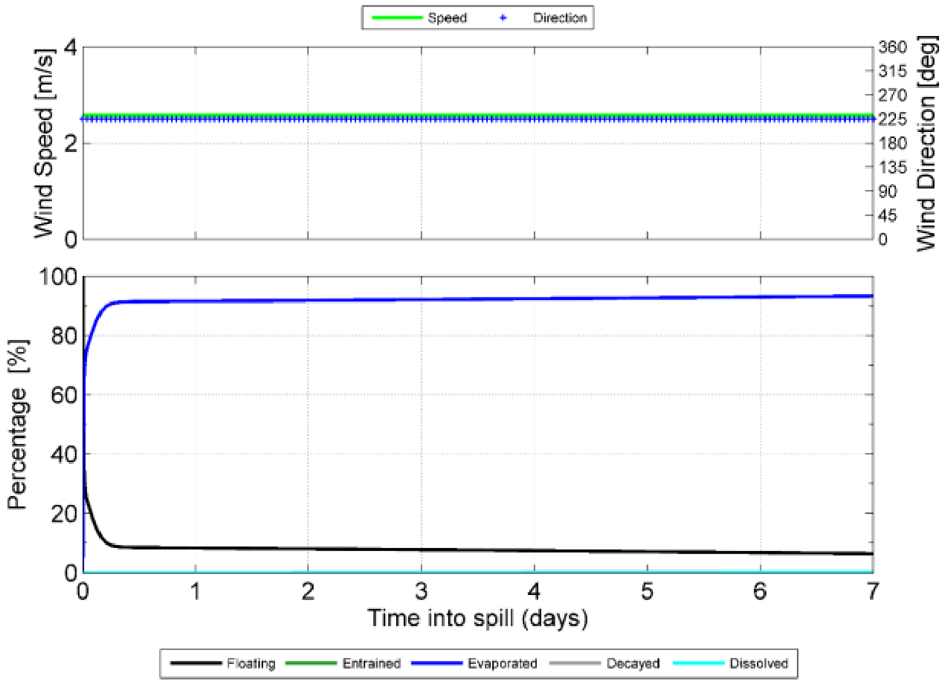

Figure A-2: Proportional mass balance plot representing the weathering of GWA condensate (GWA03) spilled onto the water surface as a one-off instantaneous release and subject to a constant 5 kn (2.6 m/s) wind at 27 °C water temperature and 25 °C air temperature.

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

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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).

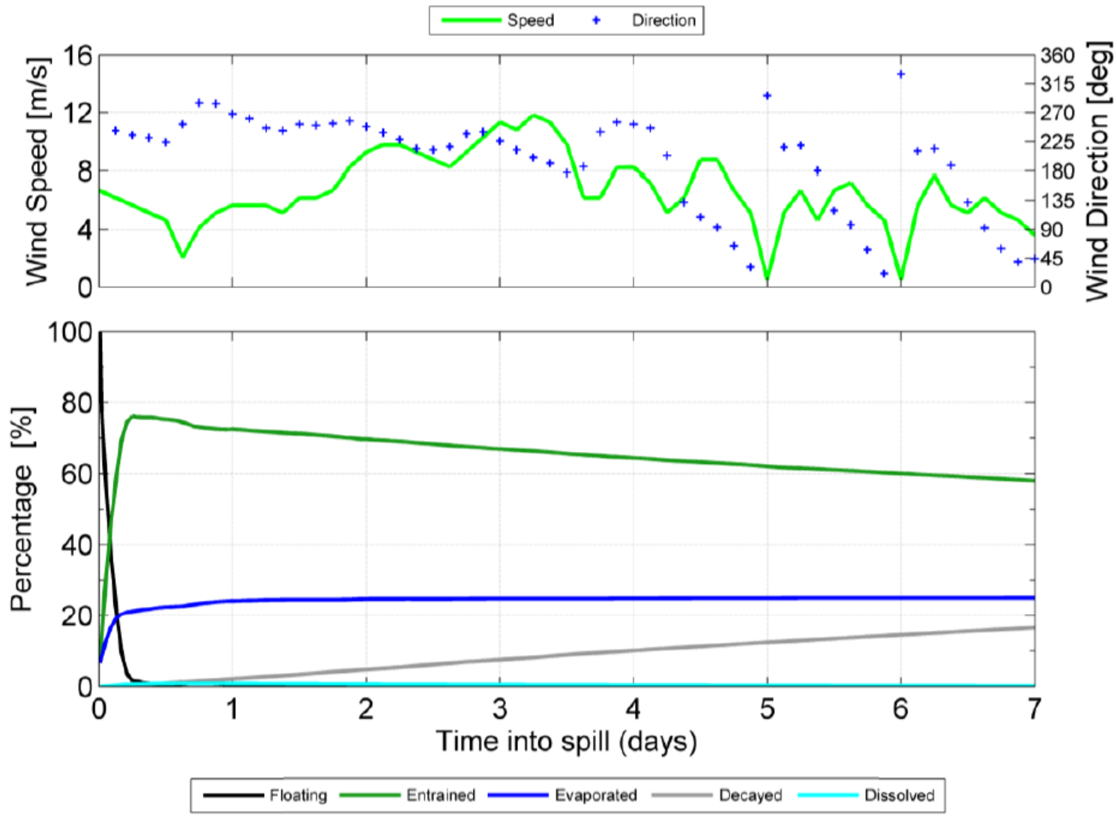

Figure A-3: Proportional mass balance plot representing the weathering of marine diesel spilled onto the water surface as a one-off release (50 m^3 over 1 hour) and subject to variable wind at 27 °C water temperature and 25 °C air temperature.

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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

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FORM 1

Record of initial verbal notification to NOPSEMA

(NOPSEMA ph: [redacted])

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	

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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** [redacted]
2. **NOPTA** [redacted]
3. **DMIRS** [redacted]

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FORM 2

[for exploration/development activities]
[insert NOPSEMA Incident Report Form when printing]
Link

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FORM 3

[insert Marine Pollution Report (POLREP – AMSA) when printing]

Link

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FORM 4

[insert AMOSC Service Contract note when printing]

Link

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FORM 5

[insert Marine Pollution Report (POLREP – DoT) when printing]

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FORM 6a

[insert OSRL Initial Notification Form when printing]
Link

FORM 6b

[insert OSRL Mobilisation Activation Form when printing]
Link

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FORM 7

[insert RPS APASA Oil Spill Trajectory Modelling Request form when printing]

Link

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FORM 8

[insert Aerial Surveillance Observer Log when printing]

Link

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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	

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APPENDIX D – TRACKING BUOY DEPLOYMENT INSTRUCTIONS

(Insert Link when printing)

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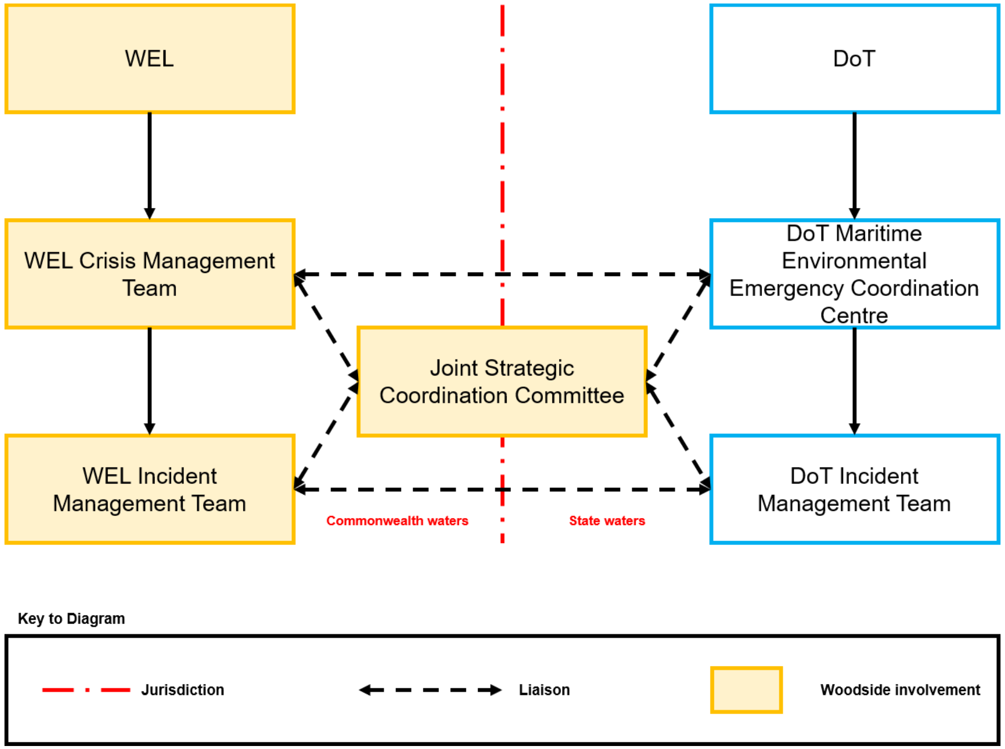
APPENDIX E – COORDINATION STRUCTURE FOR A CONCURRENT HYDROCARBON SPILL IN BOTH COMMONWEALTH AND STATE WATERS/SHORELINES[5]



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.

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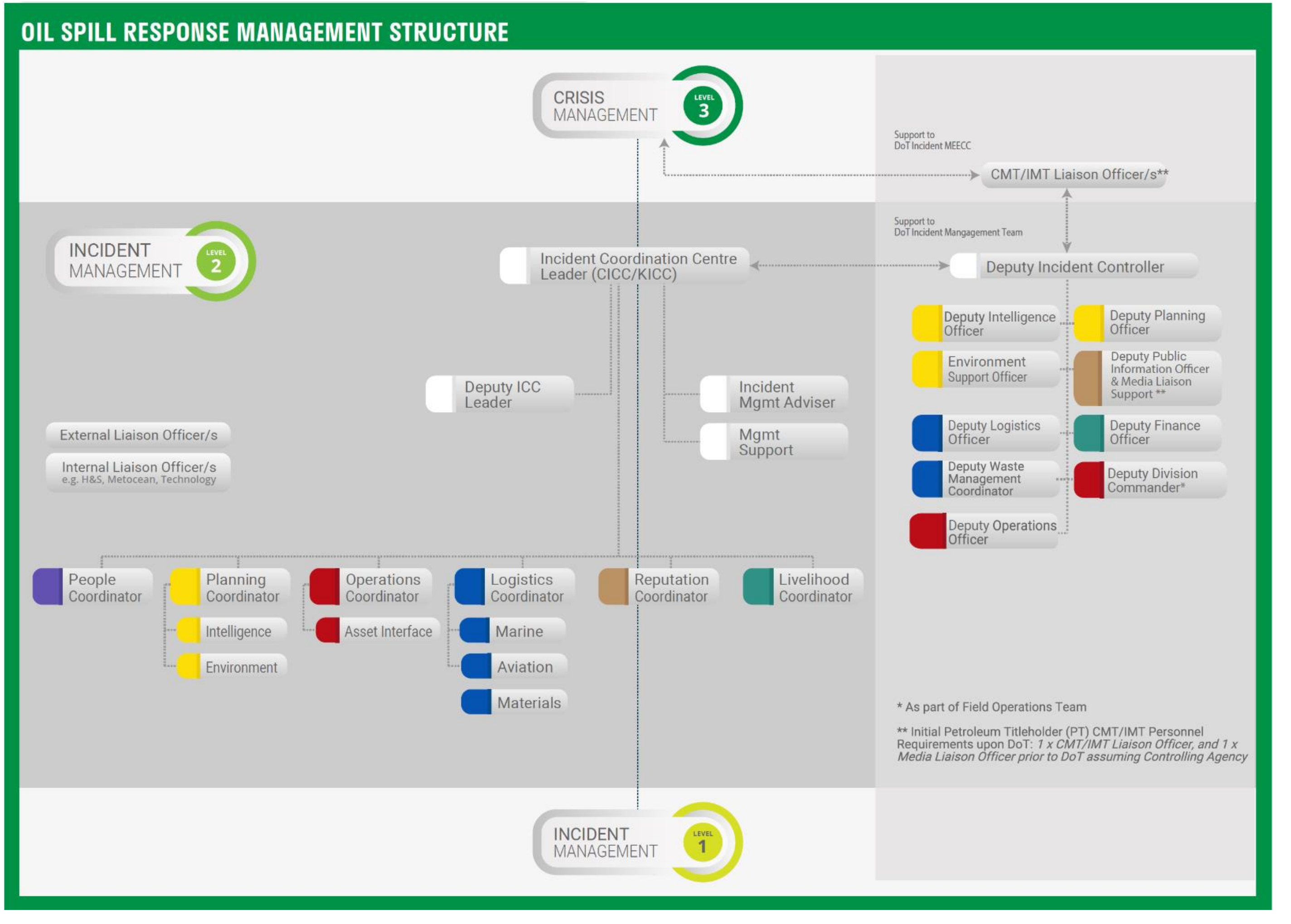
APPENDIX F – WOODSIDE INCIDENT MANAGEMENT STRUCTURE

Woodside Incident Management Structure for Hydrocarbon Spill (including Woodside Liaison Officers Command Structure within DoT IMT if required).



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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 Leader Roster	• Provide a direct liaison between the CMT and the MEECC. • Facilitate effective communications and coordination between the CMT Leader and State Marine Pollution Coordinator (SMPC). • Offer advice to SMPC on matters pertaining to PT crisis management policies and procedures.	1
DoT IMT Incident Control	WEL Deputy Incident Controller	CICC Leader 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

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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	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	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/ Financial Monitoring	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

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Area	WEL Liaison Role	Personnel Sourced from[6]:	Key Duties	#
			• 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	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

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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 SMPC / 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

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